INDIAN INSTITUTE OF TECHNOLOGY MADRAS

FACULTY EXPERTISE

Updated as on 20th August, 2025

DEPARTMENTS

- Aerospace Engineering
- Applied Mechanics & Biomedical Engineering
- Biotechnology
- Chemical Engineering
- Chemistry
- Civil Engineering
- Computer Science & Engineering
- Data Science & Artificial Engineering
- Electrical Engineering
- Engineering Design
- Humanities and Social Sciences
- Management Studies
- Mathematics
- Mechanical Engineering
- Medical Science & Technology
- Metallurgical & Materials Engineering
- Ocean Engineering
- Physics

INDIVIDUAL FACULTY PROFILE

DEPARTMENT OF AEROSPACE ENGINEERING

LIST OF FACULTY

- Amit Kumar
- Aniketh Kalur
- Aswathy Surendran
- Bharath M Govindarajan
- Bhaskar K
- David Kumar
- Devaprakash Muniraj
- Joel George
- Luoyi Tao
- Manikandan S. Mathur
- Murthy N. Haradanahalli
- Muruganandam T M
- Nagabhushana Rao Vadlamani
- Nagendra Gopal K V
- Nandan Kumar Sinha
- Nidish Narayana Balaji
- Nikhil Khobragade
- Prashant Rawat
- Pravendra Kumar
- Rajesh G
- Ramakrishna M
- Ramakrishna P.A.
- Ranjith Mohan
- Sameen A
- Santanu Ghosh
- Satadal Ghosh
- Satya R Chakravarthy
- Senthil Murugan M
- Shankar Ghosh
- Shantanu Shashikant Mulay
- Shyam Mohan Keralavarma
- Sivasambu Mahesh
- Sriram P
- Sriram R
- Sujith R I
- Sunetra Sarkar
- Velmurugan R

Dr. Amit Kumar

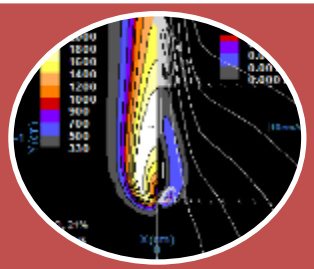
PhD, Case Western Reserve University, USA

Professor, Aerospace Engineering

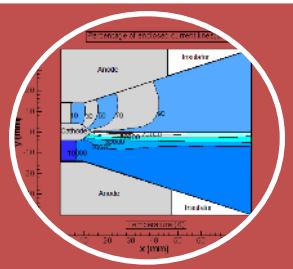
044-2257-4019; amitk@ae.iitm.ac.in

http://www.ae.iitm.ac.in/~amitk

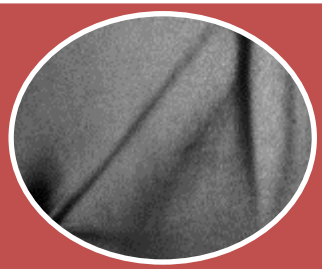
- Combustion: Fire Safety Research on earth and in space (microgravity)
- Propulsion: Rocket and spacecraft propulsion, Electric propulsion



Modeling of spreading flames over solid fuels and their extinction in space and in normal gravity environments



Numerical modeling of a Magneto Plasma Dynamic (MPD) thruster



A study on the shock pattern over an obstruction in a rectangular channel at high subsonic flows to understand Deflagration to Detonation (DDT) phenomena

FIRE SCIENCE AND PROPULSION

Dr. Aniketh Kalur

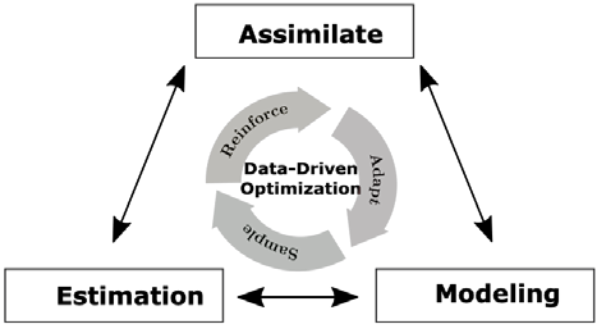
PhD, Keele University, United Kingdom

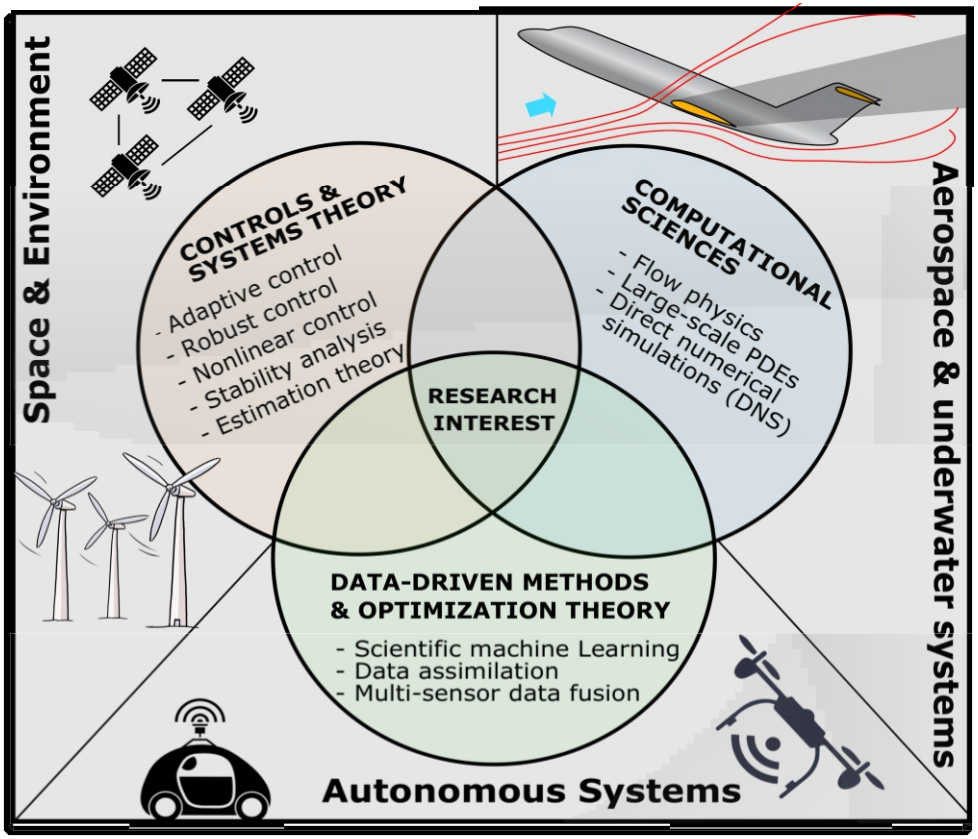
Assistant Professor, Aerospace Engineering

044-2257-4041, aswathys@iitm.ac.in

Major Research Areas

- Dynamical systems and control theory
- Data-driven methods and scientific machine learning
- Reduced-order modeling of large-scale complex dynamical systems





Summary: We work towards bridging the gap between fundamental research and applied research by developing methods that leverage big-data to control, model, and estimate complex aerospace systems.

Dr. Aswathy Surendran

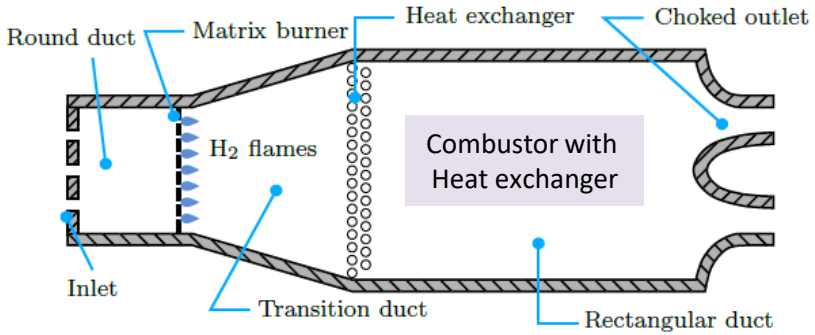
PhD, Keele University, United Kingdom

Assistant Professor, Aerospace Engineering

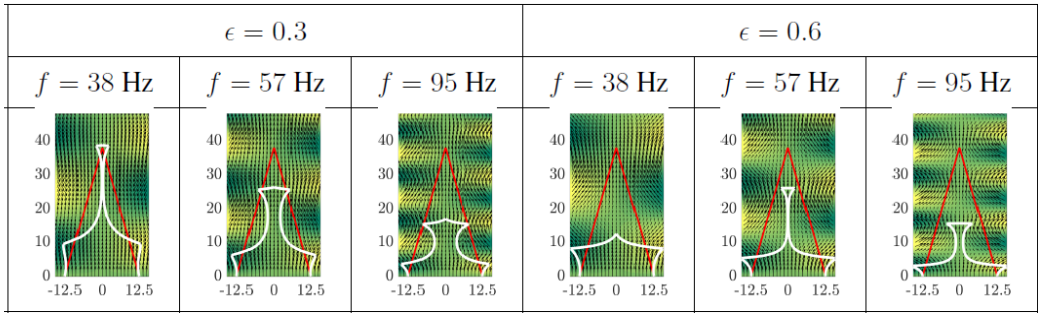
044-2257-4041, aswathys@iitm.ac.in

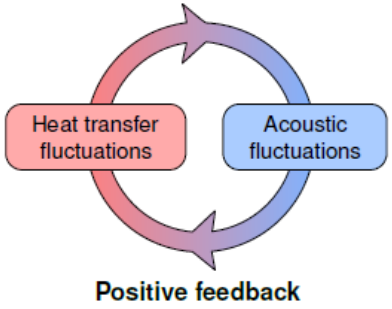
Major Areas of Research

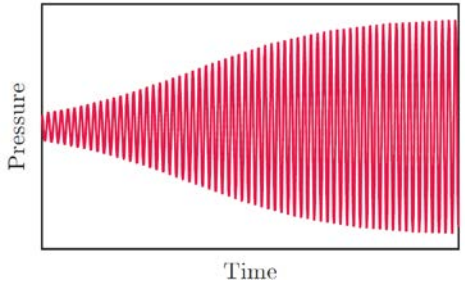
- Passive thermoacoustic instability control through Heat Transfer and Acoustic Metamaterials
- Development of Low Order Models (LOMs) for Thermoacoustics Systems with Heat transfer; Aeroacoustics of Acoustic Dampers
- Green's function based modelling of Aero- and Thermoacoustic Systems
- Flame dynamics and FDF models (Frequency and Time domain)



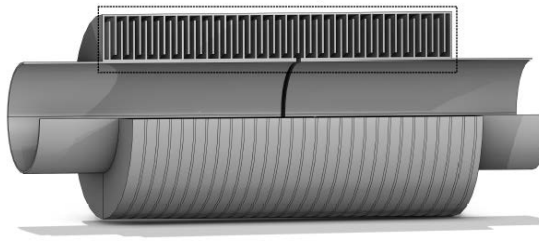
Flame modelling

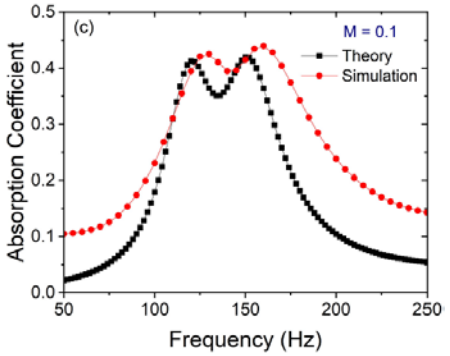






Acoustic metamaterial





Dr. Bharath Govindarajan

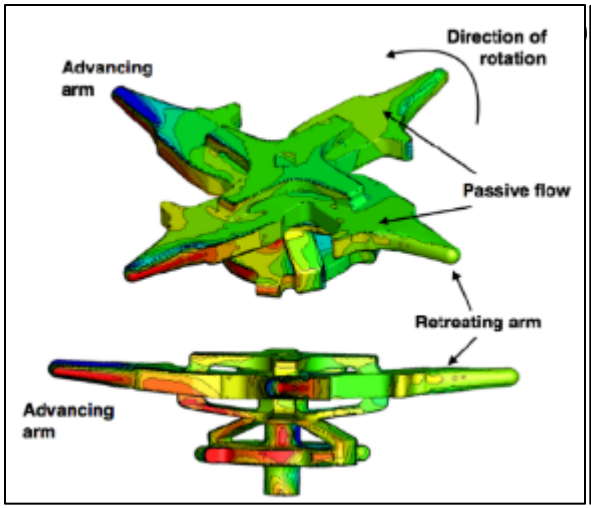
PhD, University of Maryland College Park, USA

Associate Professor, Aerospace Engineering

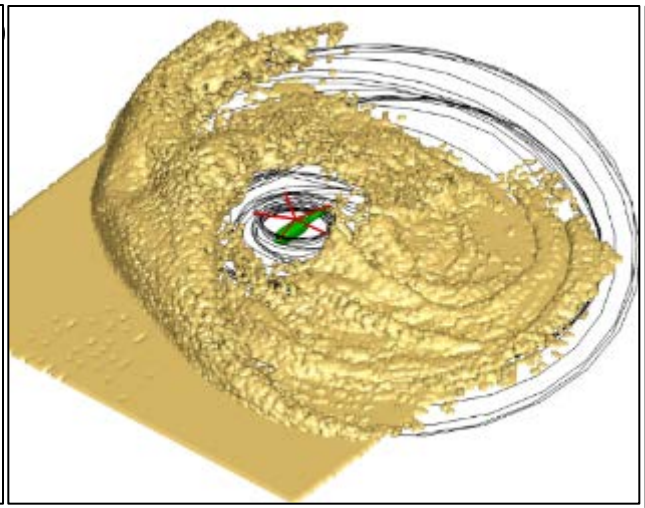
044-2257-4030; bharath@iitm.ac.in

https://www.mgbharath.com/

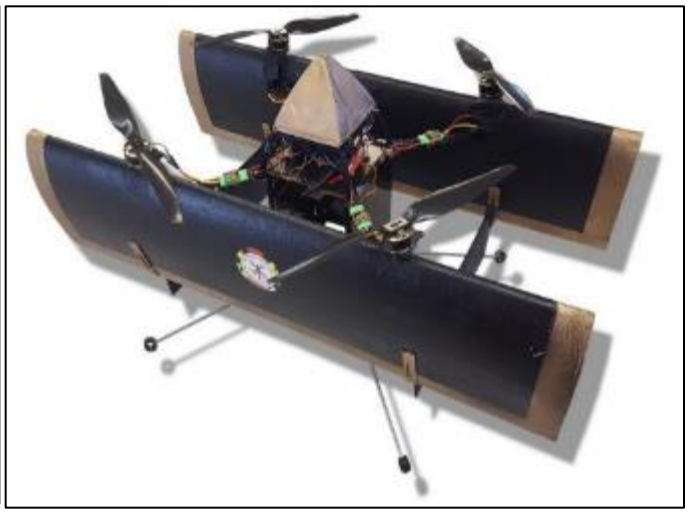
- Numerical modeling of aerodynamics flows: Vortex methods, particle methods
- CFD: Rotorcraft flows, FVM based solvers, moving/deforming (overset) meshes



Surface pressure distribution on a rotating rotor hub (RANS-CFD)



Single main rotor encountering brownout conditions (vortex method)



Quad-Rotor Bi-Plane Tailsitter configuration for efficient VTOL/forward flight

Dr. K Bhaskar

PhD, IIT Madras

Professor, Aerospace Engineering

044-2257-4010; kbhas@iitm.ac.in

http://www.iitm.ac.in/~kbhas/kbhas.htm

- Beams, Plates and Shells/ Statics, Dynamics and Stability
- Three-dimensional Analysis using Theories of Isotropic / Anisotropic Elasticity
- Theoretical Modelling of Composite Laminates

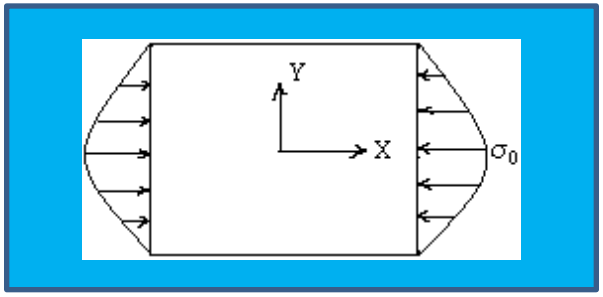
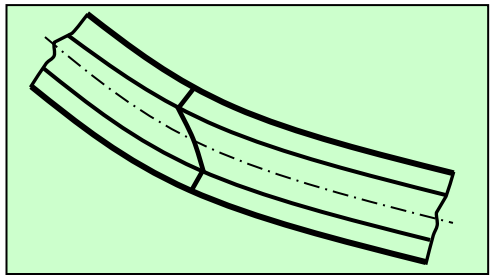


Plate buckling under non-uniform compression



A zigzag type higher-order laminate model

Dr. David Kumar

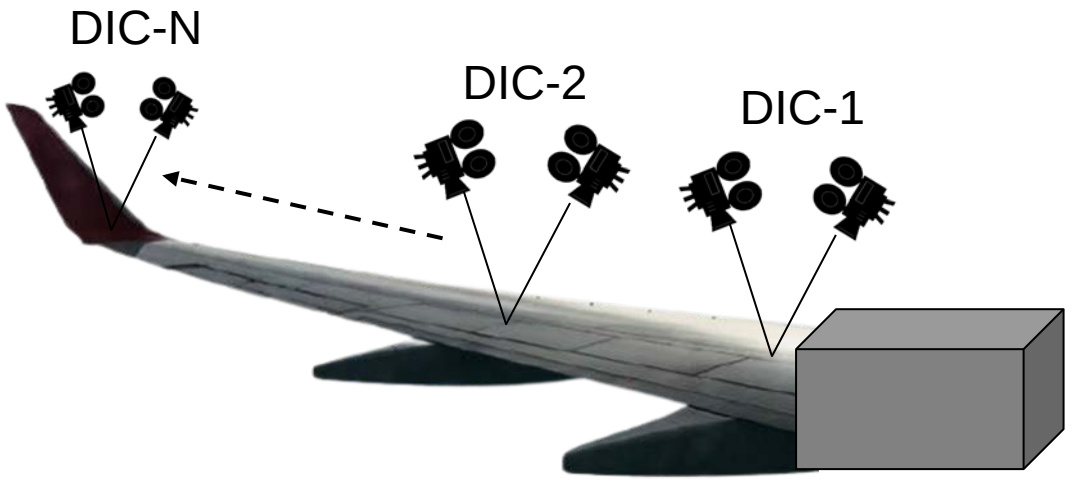
PhD, IIT Kanpur, India

Assistant Professor, Aerospace Engineering

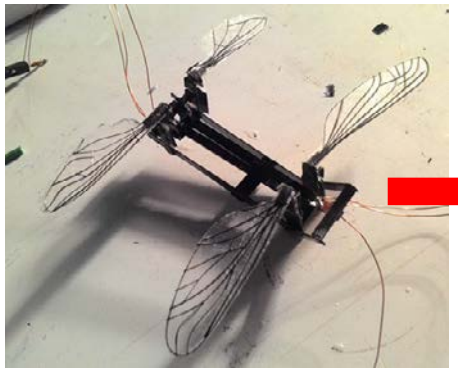
044-2257-4029; david@iitm.ac.in

Research Areas:

- **Exp. Structural Mechanics**
- **U n m anned Aerial Vehicles**
- **Digital Image Correlation Techs.**
- **Smart Materials & Structures**
- **Structural Health Monitoring**



Multi-camera DIC technique for vibration study of large structures



Bioinspired Micro Aerial Vehicles

Dr. Devaprakash Muniraj

PhD, IIT Madras

Assistant Professor, Aerospace Engineering

044-2257-4034; deva@ae.iitm.ac.in

Major Areas of Research

- Dynamics and control of unmanned aircraft systems (UAS)
- Security-aware design of UAS
- Verification of safety-critical cyber-physical systems

Source:Faculty website

Dr. Joel George M

PhD, Indian Institute of Science, Bangalore

Associate Professor, Aerospace Engineering

044-2257-4006; joel@ae.iitm.ac.in

- Navigation, guidance, and control of aerospace vehicles
- Flight dynamics
- Multi-agent systems theory as applied to multiple Unmanned Aerial Vehicle missions

Immediate objectives include setting up a multi-vehicle facility, with quad-rotor platforms, to develop and test various decentralized control and estimation algorithms

Dr. Luoyi Tao

PhD, University of Pittsburgh, USA

Professor, Aerospace Engineering

044-2257-4003; luoyitao@iitm.ac.in

http://www.ae.iitm.ac.in/people/faculty/luoyi.html

- Continuum Mechanics: Issues on the foundation of constitutive theory
- Turbulence Modelling: Application of information theory, optimal control and optimization
- Interested in mathematical model construction and analysis of (physical) systems and processes within the constraint of information/data availability.

Dr. Manikandan Mathur

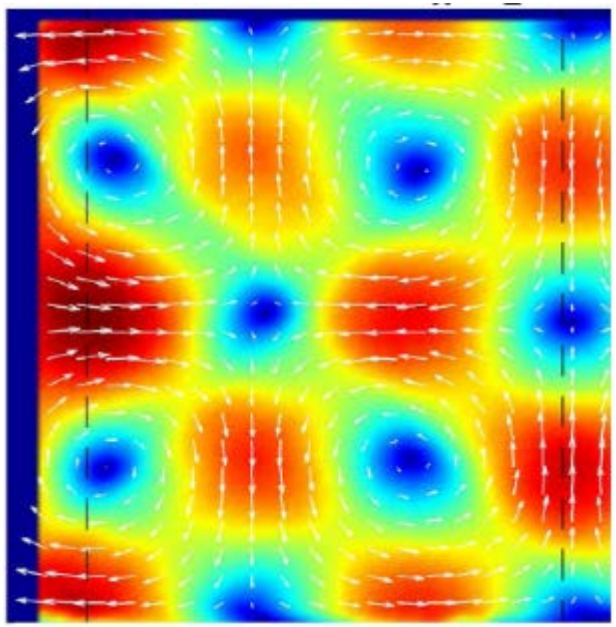
PhD, Massachusetts Institute of Technology, USA

Professor, Aerospace Engineering

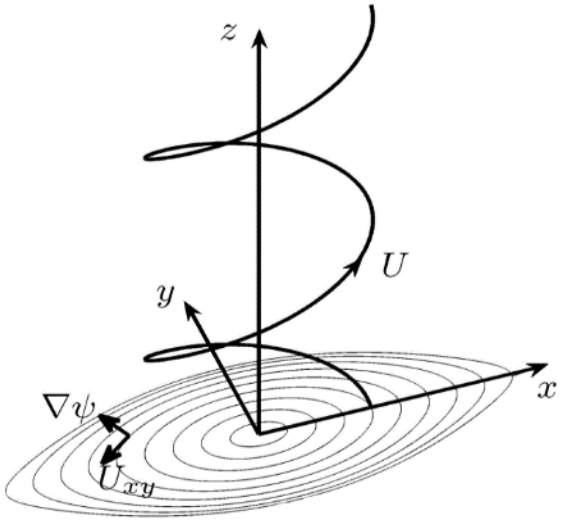
044-2257-4025; manims@ae.iitm.ac.in

https://sites.google.com/site/mathur2m/

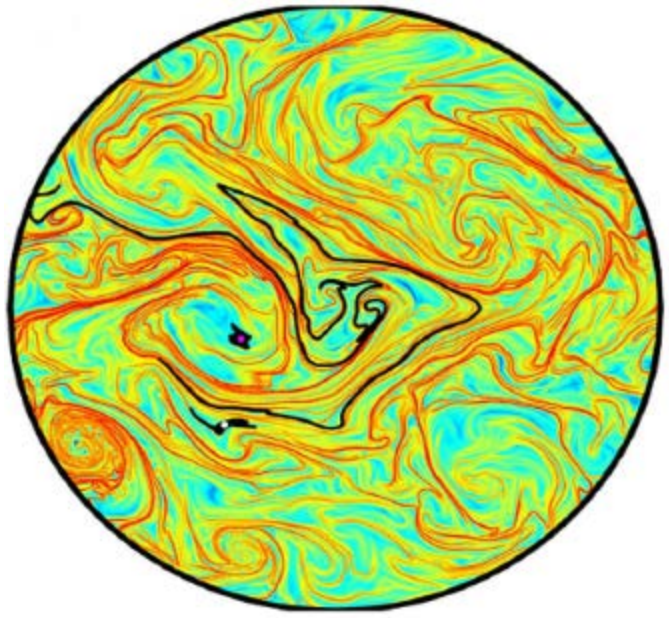
- Rotating and Stratified Flows – Bistability, Internal Gravity Waves,
- Vortex Stability – Non-parallel flows, Compressible flows, Magneto hydrodynamics
- Lagrangian Coherent Structures (LCS) – Mixing of passive and diffusive tracers



Internal waves in the lab



A swirling jet



Mixing in Turbulence

Dr. Murthy H S N

PhD – Purdue University

Professor, Aerospace Engineering

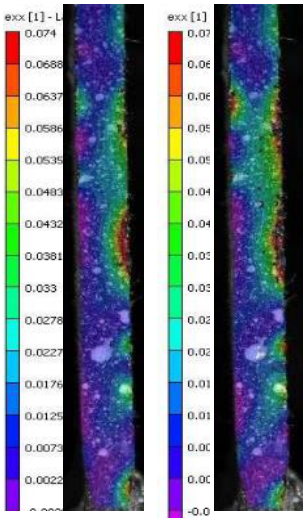
044-2257-4014; mhsn@ae.iitm.ac.in

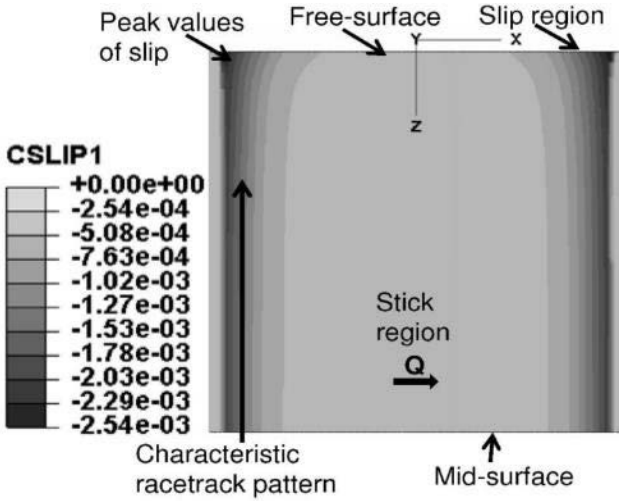
Major Areas of Research

Damage mechanisms in metals & composites (fatigue & fracture), contact mechanics & tribology, fretting, constitutive modeling of visco-elastic materials

Currently Working on:

1. Damage evolution around machined holes in composites due to fatigue loads: damage mapping using NDT (*digital image correlation-DIC, infra-red thermography*); modeling - continuum & stochastic.
2. Fretting fatigue of polycrystalline & single crystal material: experimental studies; analytical modeling to obtain stresses; life estimation using multi-axial fatigue parameters & fracture mechanics.
3. Manufacturing of fine grained materials using machining for severe plastic deformation: mechanical characterization
4. Three dimensional (3D) effects in contacts
5. 2D contact analysis of functionally graded & coated materials
6. Constitutive modelling of solid





Future Interests:

Modeling of biological contacts

Dr. T M Muruganandam

PhD, Georgia Institute of Technology, USA

Professor, Aerospace Engineering

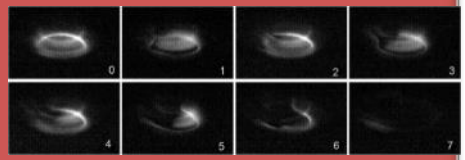
044-2257-4022; murgi@ae.iitm.ac.in

http://www.ae.iitm.ac.in/~murgi/index.html

- Flame stabilisation, Burner Development, Blowout prediction, Precursors to blowout, detection of imminent blowout, unsteady combustion: experimental & analytical
- Optical diagnostics of high speed and reacting flows: Spectroscopic diagnostics, Chemiluminescence, Mie Scattering, LII, PLIF, TDLAS, Schlieren, Tomography (TDLAS, PLIF, Schlieren)
- High speed flows, intakes studies, unsteady movement of shocks, Shock-Boundary Layer Interaction(SBLI), Micro Vortex Generators.

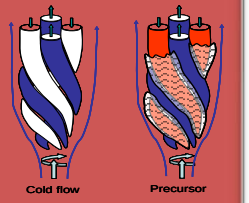
Flame Loss/Stabilisation

Multiple stabilisations



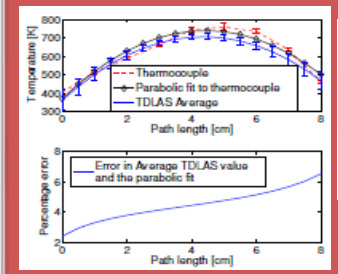
Stagnation stabilisation loss

Shear stabilisation

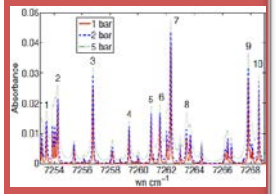


LBO precursor
Swirl stabilization

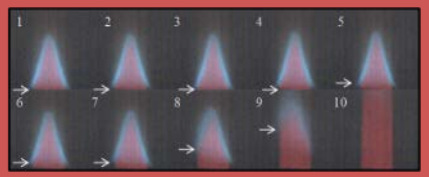
Diagnostics



TDLAS

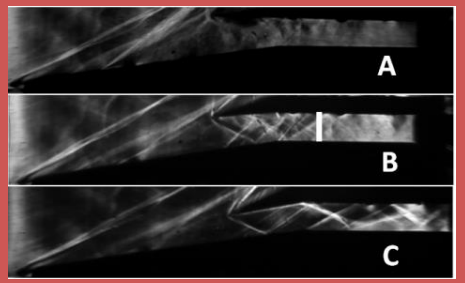


H2O spectrum

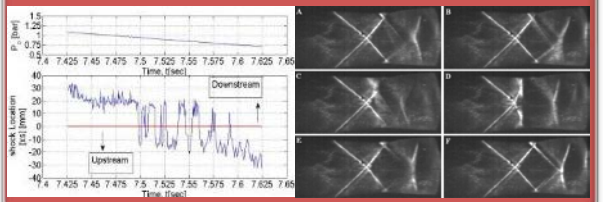


Mie scattering of reactants

Shock Dynamics



Intake start/ unstart



Shock in diffuser

Dr. Nagabhushana Rao Vadlamani

PhD, University of Cambridge, UK

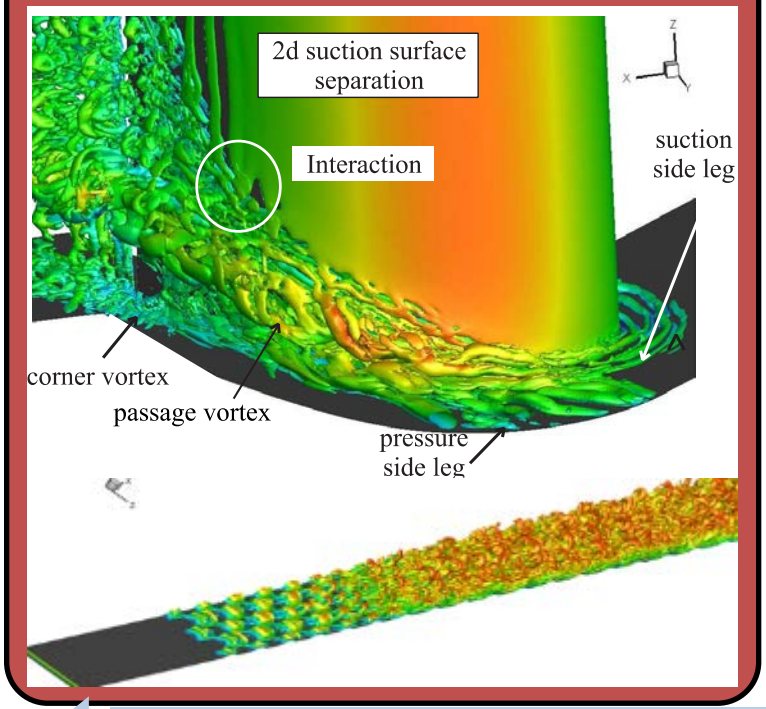
Associate Professor, Aerospace Engineering

044-2257-4037; nrv@ae.iitm.ac.in

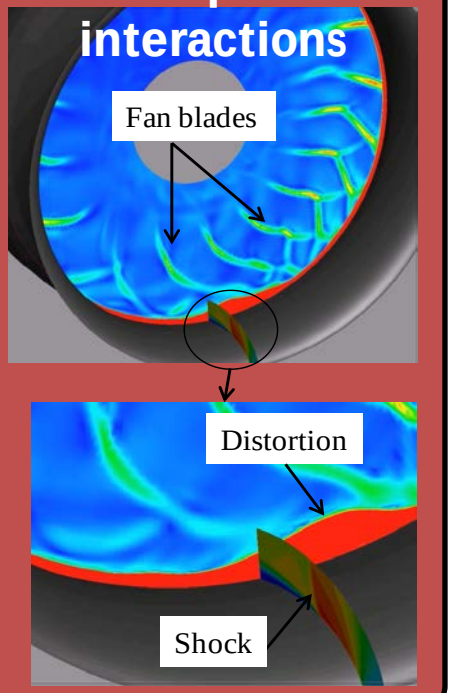
http://www.ae.iitm.ac.in/~nrv/index.html

- CFD for Turbomachines: DNS, LES, Hybrid RANS/LES, Low-order modelling
- Transition to turbulence, Coupled interactions, flow control
- High-order solver COMP^2 development, High performance computing (HPC)

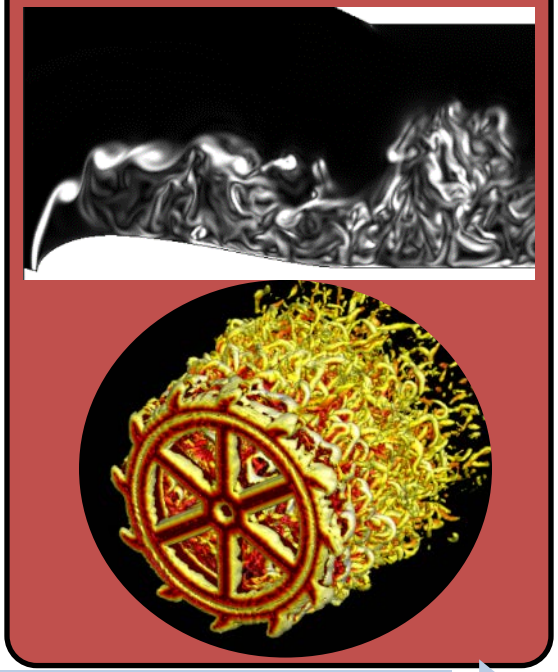
Transitional flows



Coupled interactions



DNS/LES solver on HPC



Develop numerical frameworks to predict complex flow physics in turbomachines

Dr. K V Nagendra Gopal

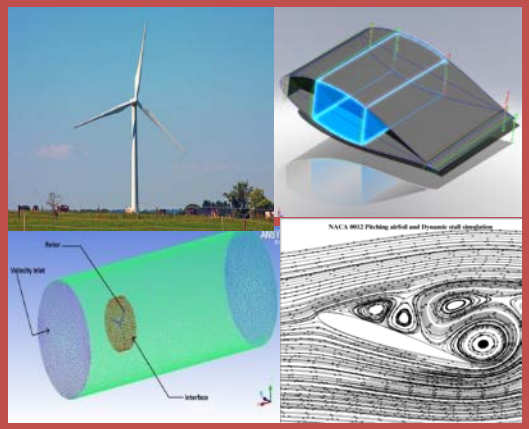
PhD, Indian Institute of Science, Bangalore

Professor, Aerospace Engineering

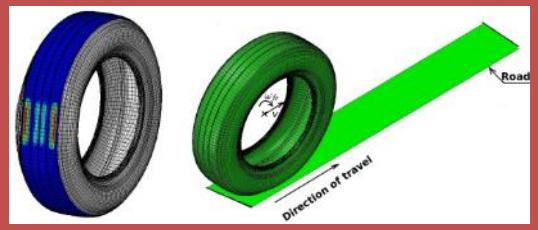
044-2257-4015; gopal@iitm.ac.in

http://www.ae.iitm.ac.in/~gopal/

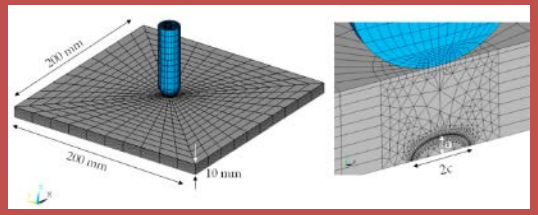
- Aero elasticity of wind turbines, design of smart composite blades using aero elastic tailoring; analytical and computational modelling using coupled numerical methods
- Analytical and computational modeling of the mechanics of multifunctional structures made of advanced materials, multi-scale modelling, dynamics of automotive tyres
- Fracture mechanics - Crack growth analysis in metallic and composite structures



Modelling aeroelastic behaviour of Wind Turbine Rotors using coupled FEA-CFD methods; Dynamic stall in wind turbines

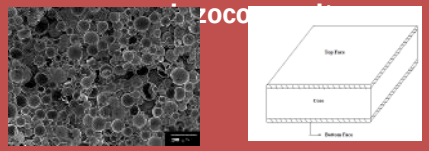


Tyre Dynamics; Rolling Resistance Estimation

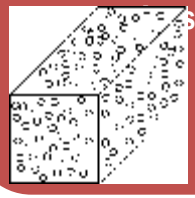


Low velocity impact in functionally graded plates with cracks

Fiber-matrix debonding in



Foam core sandwich



Modelling crack growth in particulate composites using XFEM

Modelling of the Mechanics of Multi-functional and Multi-physics Systems

Dr. Nandan Kumar Sinha

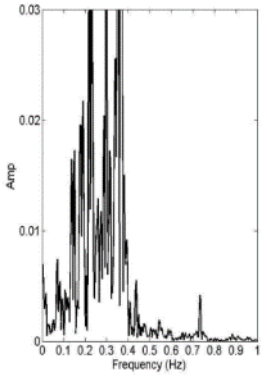
PhD, IIT Bombay, India

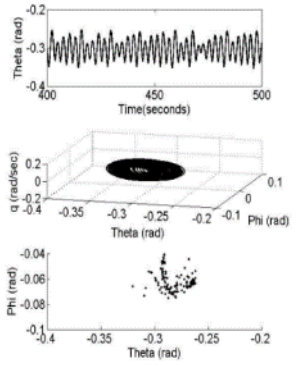
Professor, Aerospace Engineering

044-2257-4021; nandanks@iitm.ac.in

http://www.ae.iitm.ac.in/~nandan/nandan.html

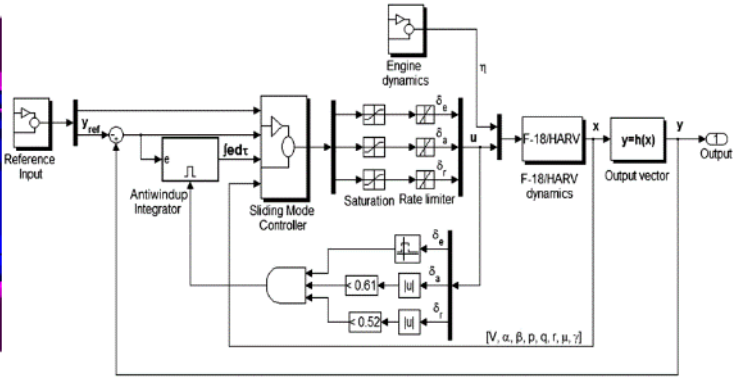
- Nonlinear dynamics, bifurcation & chaos: Modeling nonlinear phenomena in dynamical systems exhibiting bifurcations and chaos under parametric variations
- Advanced six dof simulation: Missile-aircraft engagement simulation with/or without flares, optimization of countermeasure system parameters
- Flight dynamics and control: Inverse design of vehicles, controller development for maneuvers/accident simulation, high angle-of-attack





(a). No flare

(b). With flare



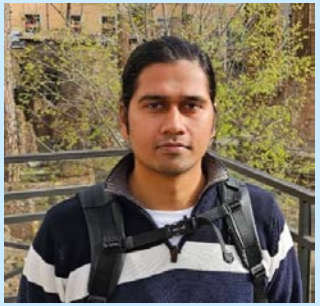
Design, modelling, simulation, and control of aerospace vehicles

Dr. Nidish Narayanaa Balaji

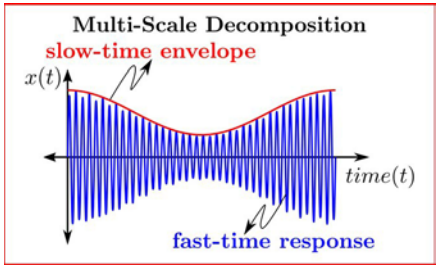
PhD, Rice University, USA

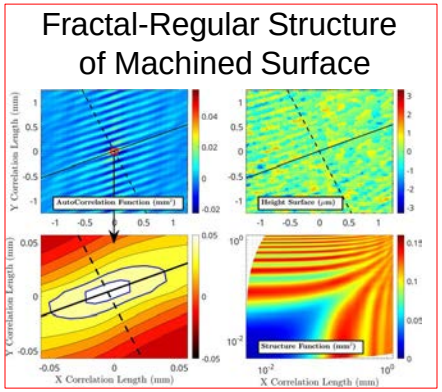
Assistant Professor, Aerospace Engineering

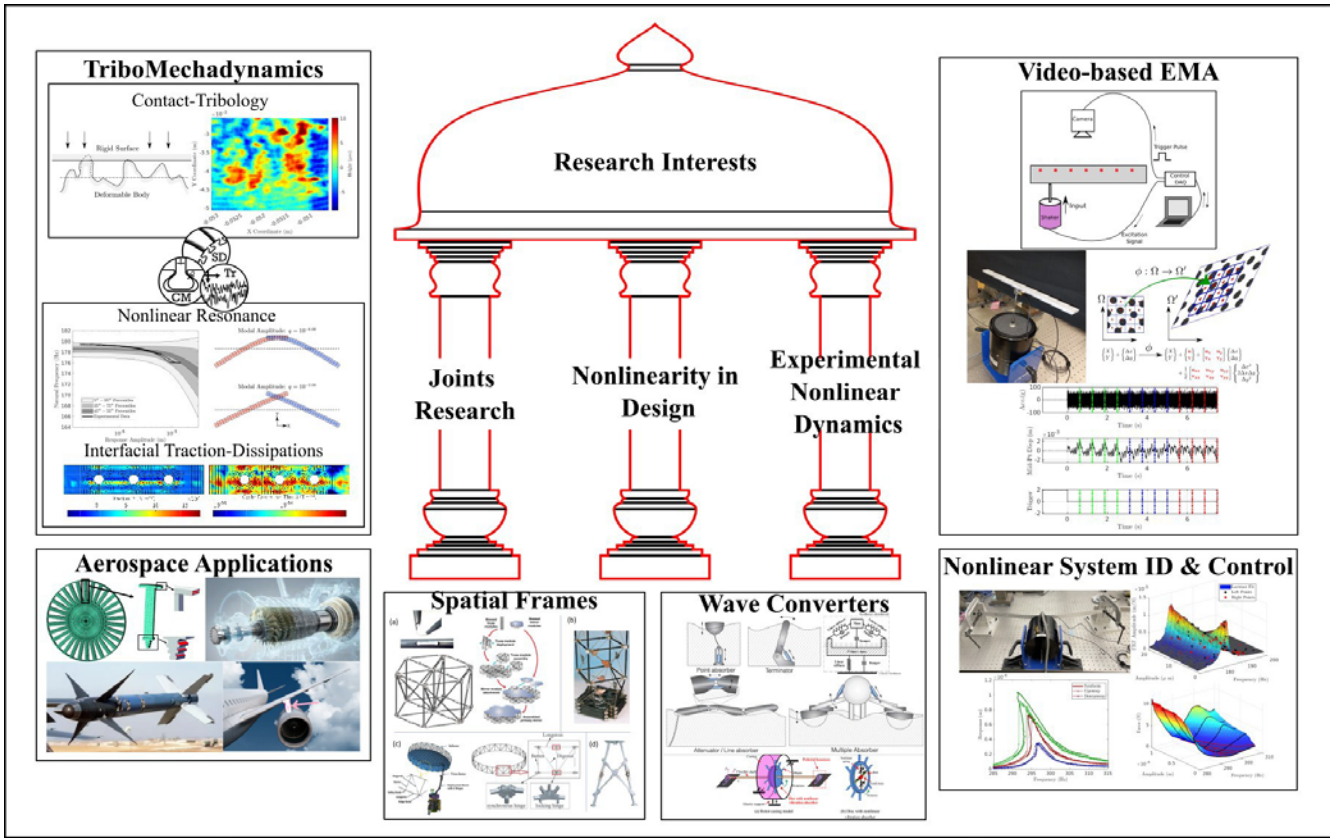
044-2257-4042; nidish@iitm.ac.in



- Nonlinear Structural Dynamics
- Vibrations, Modal Testing, and System Identification
- Jointed Systems







Dr. Nikhil Khobragade

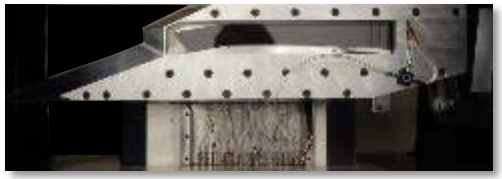
PhD, Florida State University

Assistant Professor, Aerospace Engineering

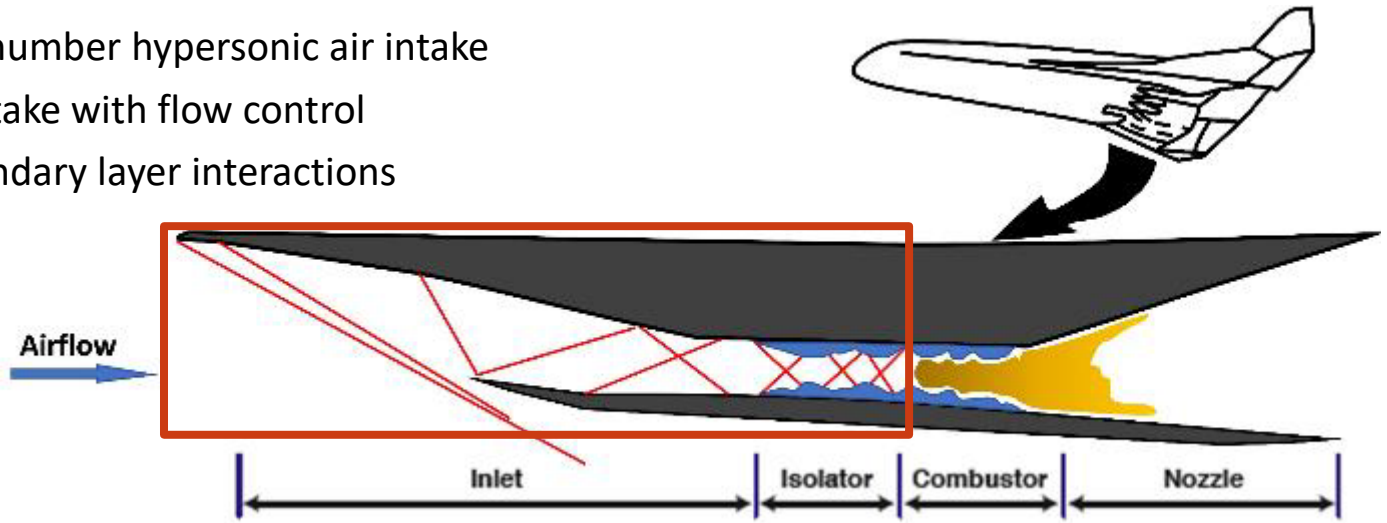
Areas of Research: Experimental Aerodynamics, Aero-propulsion, Flow Control

Objectives:

- Design of variable Mach number hypersonic air intake
- Wind tunnel testing of intake with flow control
- Study of shock wave boundary layer interactions



Test Model



Summary: We work towards understanding the internal and external flow physics of high speed vehicles and provide engineering solutions to achieve the desired outcomes, supporting the military and space programs.

Dr. Prashant Rawat

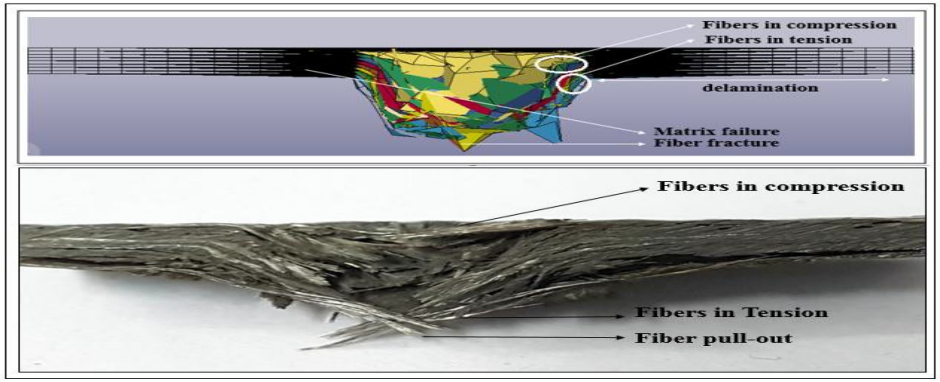
PhD, IIT (ISM) Dhanbad, India

Assistant Professor, Aerospace Engineering

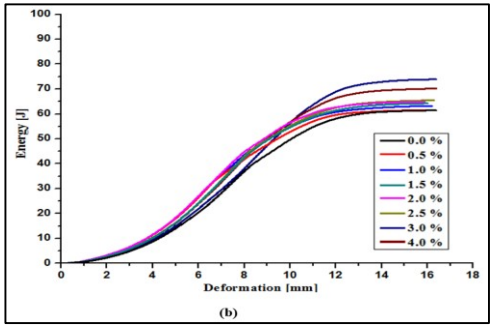
044-2257-4038; prashant.rawat@iitm.ac.in

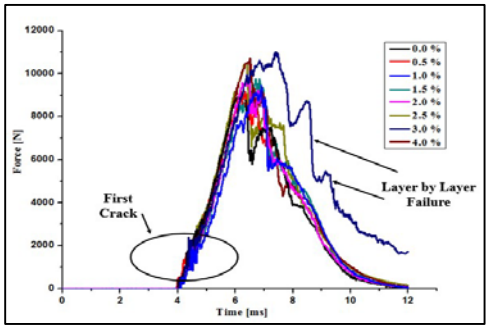
- Fiber reinforced polymer composites, Nanocomposites
- Fabrication, Experimental and Numerical Analysis of material behavior
- Design and development of Bio-inspired armors

Mixing of nanoparticles in epoxy resin

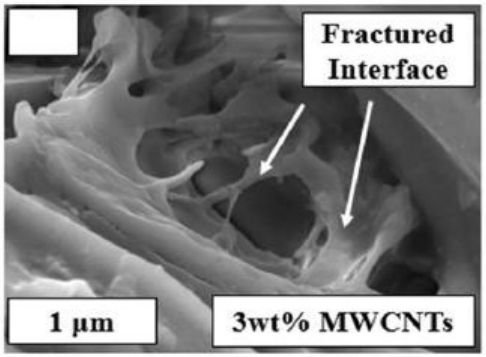


Impact analysis of low velocity impact of GFRP and simulation





Experimental results



Fractured surface

Dr. Pravendra Kumar

PhD (The University of Tokyo, Japan)

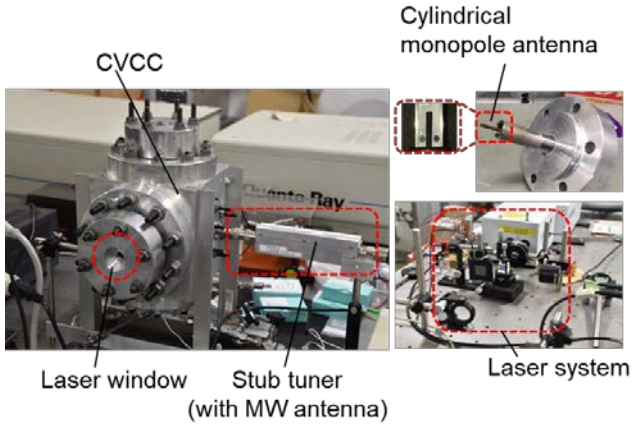
Assistant Professor, Aerospace Engineering

044-2257-4000; pkumar@ae.iitm.ac.in

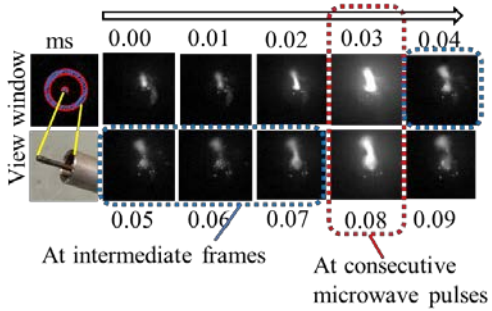
Major Areas of Research

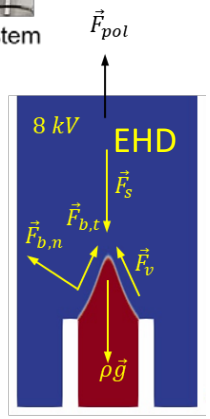
- **Plasma** technologies for aerospace applications
- **Biofuels/Sustainable aviation fuels** (renewable fuels)
- Gas separation using pressure swing adsorption (PSA)
- **Electric propulsion**
- Numerical modeling of reacting flows
- Micro/meso-scale combustors

CVCC

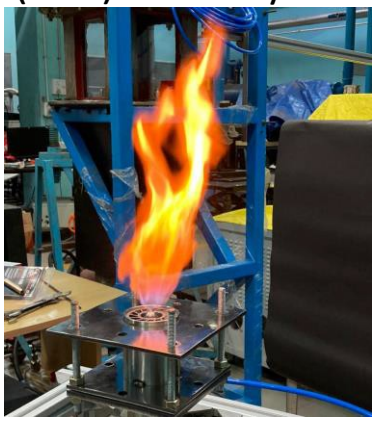


Plasma-assisted ignition





Bio-fuels



Gas separation unit (PSA cycle)

Dr. G Rajesh

PhD, Andong National University, South Korea

Professor, Aerospace Engineering

044-2257-4032; grajesh@iitm.ac.in

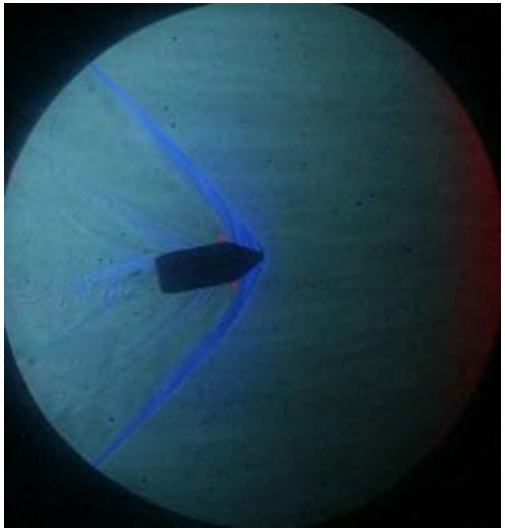
http://www.ae.iitm.ac.in/~rajesh

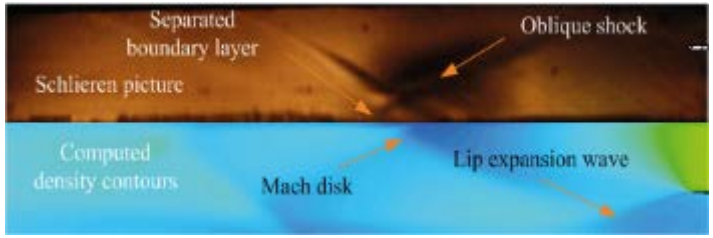
- Launch Dynamics, Unsteady Aerodynamics
- Wind Tunnel, Shock Tube and Gas Gun Experiments
- Shockwave dynamics

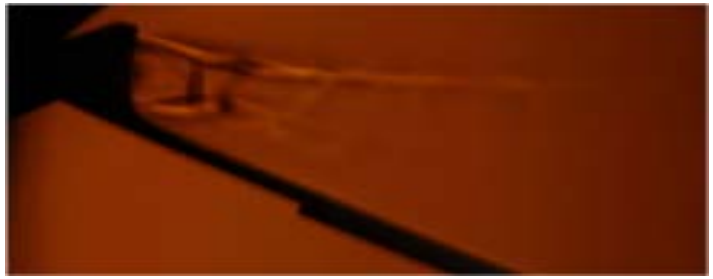
Projectile and sabot design
Re-entry aerodynamics
Transonic vehicle design

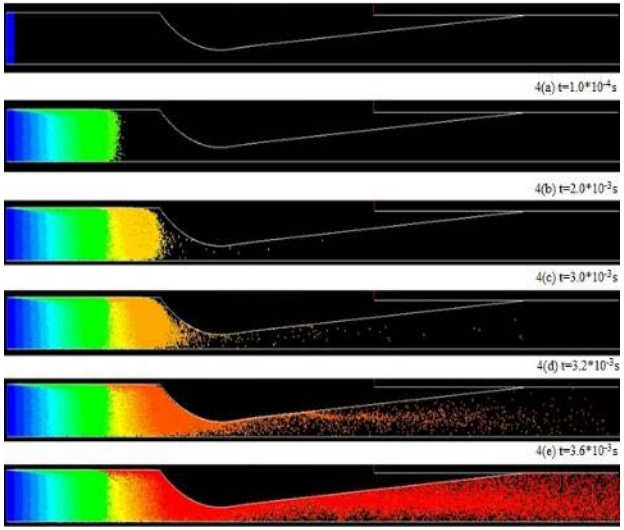
Vacuum ejector systems
High altitude system design
Altitude adaptation nozzles

Transdermal drug delivery
Needle-less biolistic systems









Dr. Ramakrishna M

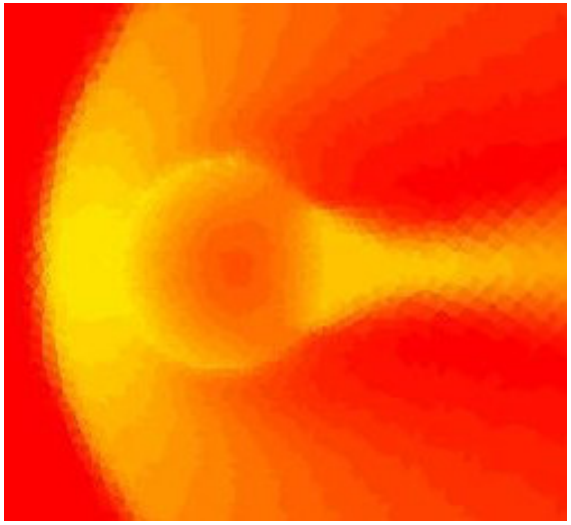
PhD, University of Texas at Arlington, USA

Professor, Aerospace Engineering

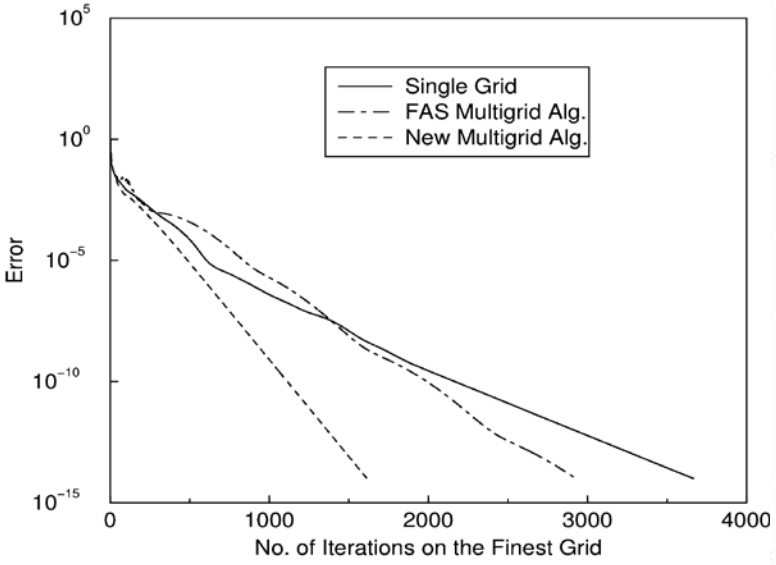
044-2257-4005; krishna@ae.iitm.ac.in

http://www.ae.iitm.ac.in/~krishna/ramakrishnam.html

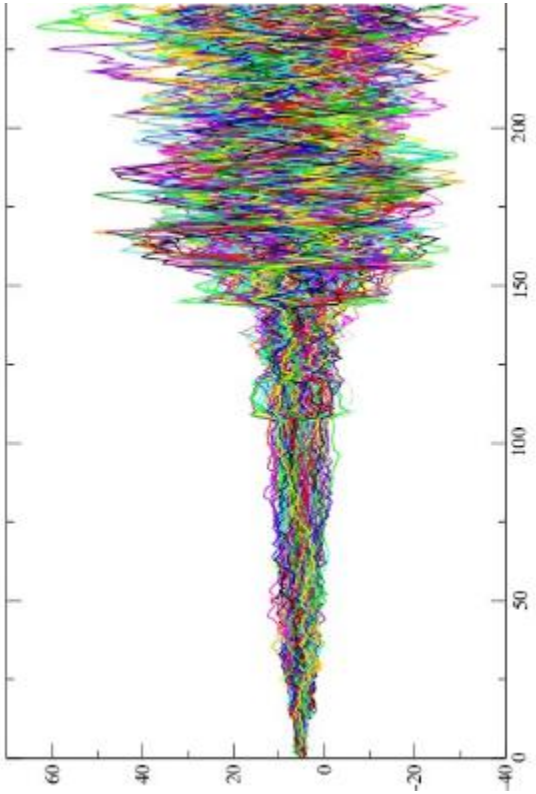
- Aerodynamics / Fluid mechanics
- Develop new numerical schemes / algorithms



Mach 3.0 Flow past a cylinder



Convergence plot for a new Multi-grid scheme



Stochastic differential eq & Monte-Carlo methods

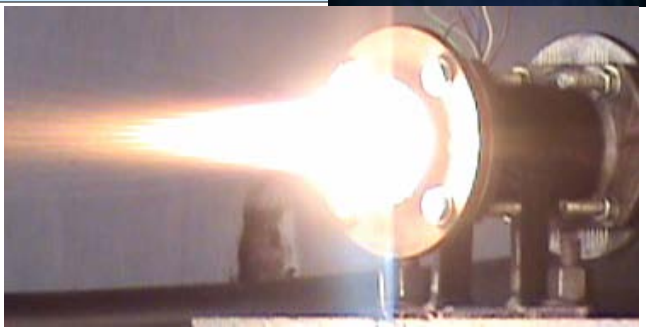
Dr. Ramakrishna P A

Professor, Aerospace Engineering

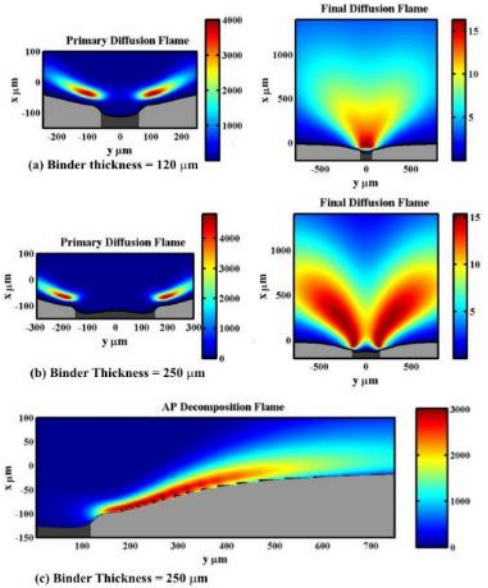
044-2257-4018; parama@ae.iitm.ac.in

Major Areas of Research

- Modeling the combustion of solid propellants
- Understanding the mechanism of solid propellant catalyst action
- Understanding the energy separation mechanism in vortex tubes
- Development of high burn rate solid propellants
- Development of fast burning hybrid rocket fuels
- Development of fuel rich propellants for scramjets and ramjets
- Development of high power to weight ratio IC engines



Hybrid rocket motor



Flame structure of composite propellant

Dr. Ranjith Mohan

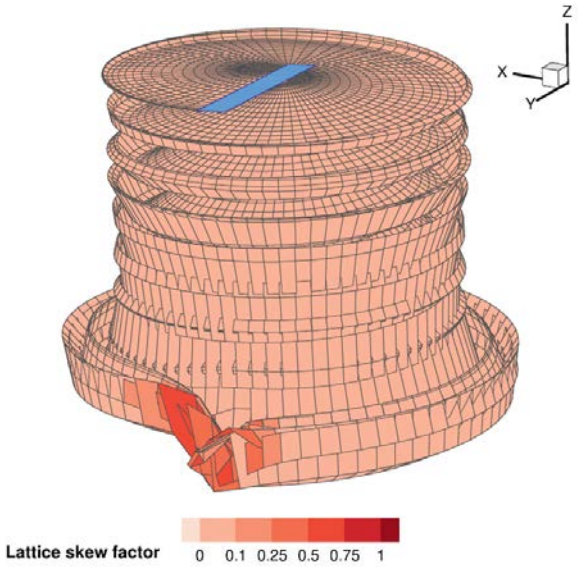
PHD, Florida Atlantic University, U.S.A.

Associate Professor, Dept. of Aerospace Engineering

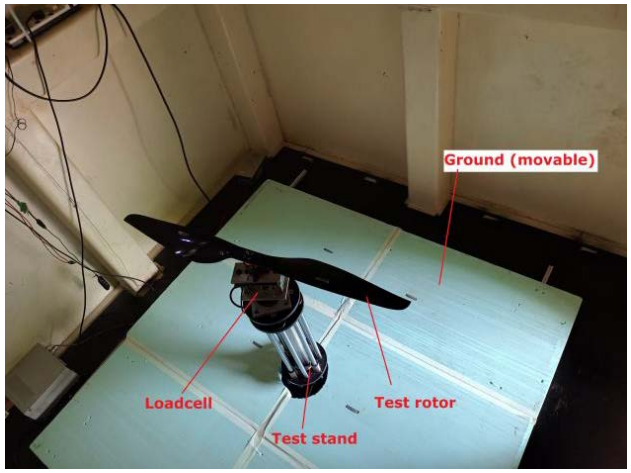
044-2257-4026; ranjith.m@iitm.ac.in

- Helicopter dynamics
- Flight mechanics and control
- Unmanned aerial vehicles
- Optimal trajectory generation

- Simulations:
  - Aerial War game
  - SITL, PITL and HITL
  - Autonomous/Intelligent Multi UAV Combat
  - Helicopter and aircraft operations



Free wake modeling



Low density experimental facility

Dr. Sameen A

Professor, Aerospace Engineering

044-2257-4013; sameen@ae.iitm.ac.in

https://home.iitm.ac.in/sameen/index.html

Major Areas of Research

- **Vorticity Dynamics**
- **Turbulence: Theory and Simulations**
- **Simulations of Flow Regimes Beyond Continuum**

Source: Faculty website

Dr. Santanu Ghosh

Professor, Aerospace Engineering

044-2257-4031; sghosh1@ae.iitm.ac.in

https://sghosh11.wixsite.com/santanu-ghosh-iitm

Major Areas of Research

- **Immersed Boundary Methods for all speeds**
- **Aerodynamics of flapping, morphing flight**
- **Zero-equation Transition model development**

Source: Faculty website

Dr. Satadal Ghosh

Associate Professor, Aerospace Engineering

044-2257-4036; satadal@ae.iitm.ac.in

Research Areas

- Sampling-based offline motion planning
- Online reactive motion planning
- Application-specific Guidance
- Path-following, all-aspect approach, UAV landing, formation control
- Intelligent control for aerospace applications
- Source localization
- Spacecraft applications
- Soft landing, close-range rendezvous

Source: Faculty website

Dr. Senthil Murugan M

Assistant Professor, Aerospace Engineering

044-2257-4027; murugan@ae.iitm.ac.in

Major Areas of Research

- **Aeroservoelasticity**
- **Helicopter dynamics**
- **Morphing Structures**
- **Dynamics and control**

Source: Faculty website

Dr. Shankar Ghosh

Assistant Professor, Aerospace Engineering

044-2257-4023; gshankar@ae.iitm.ac.in

Major Areas of Research

- **Hypersonic Flow Simulation**
- **Turbulence**
- **Nonequilibrium Effects**

Source: Faculty website

Dr. Shantanu Shashikant Mulay

Professor, Aerospace Engineering

044-2257-4016; ssmulay@ae.iitm.ac.in

Major Areas of Research

- **Continuum damage mechanics, elasticity, continuum mechanics, large deformation of materials, fracture mechanics, and plasticity**

- **Multi-physics and multi-scale modelling of materials, micro-macro transition**

- **Finite Element Analysis, Meshless methods, phase field method.**

Source: Faculty website

Dr. Shyam Keralavarma

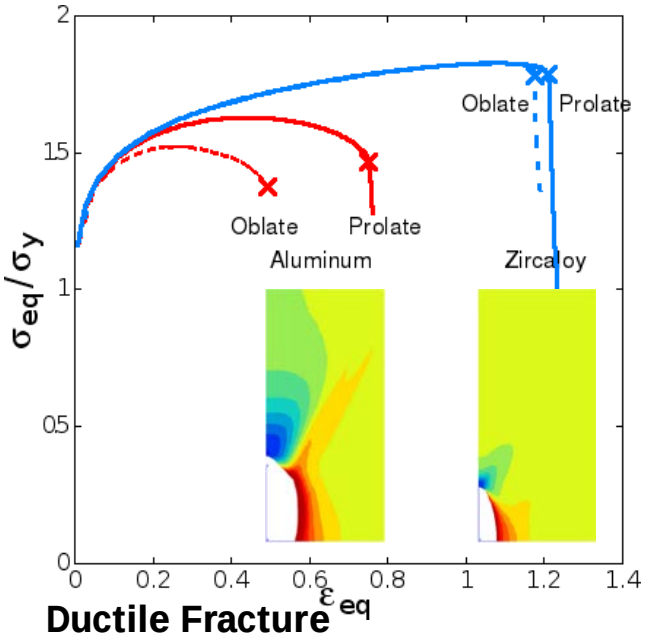
PhD, Texas A&M University, USA

Associate Professor, Aerospace Engineering

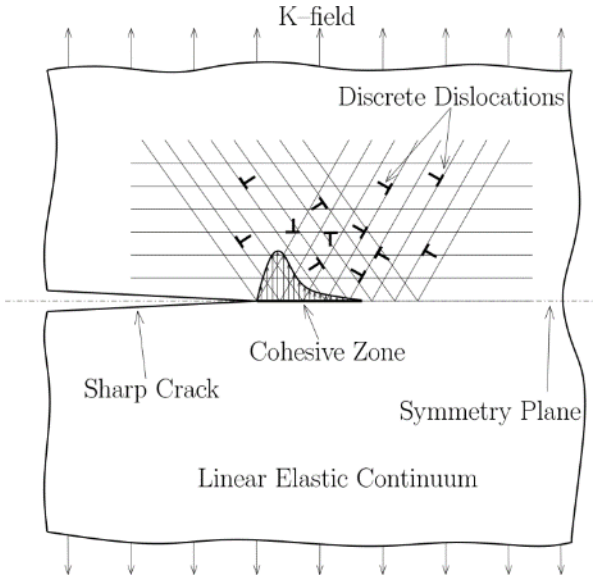
044-2257-4009; shyam@iitm.ac.in

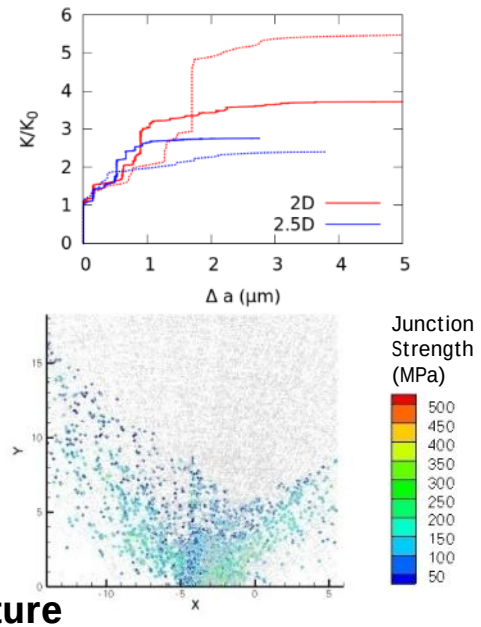
http://www.ae.iitm.ac.in/people/faculty/shyam.html

- ***Plasticity: discrete dislocation plasticity, crystal plasticity, development of continuum constitutive models using micromechanics.***
- ***Fracture Mechanics: ductile fracture by void growth, low triaxiality fracture, discrete dislocation simulation of crack-tip plasticity.***
- ***Multi-scale Materials Modelling: development of multi-scale models for plasticity, dynamic strain aging, creep and fracture in metals.***



Ductile Fracture





Cleavage Fracture

Dr. Sivasambu Mahesh

PhD, Cornell University

Professor, Aerospace Engineering

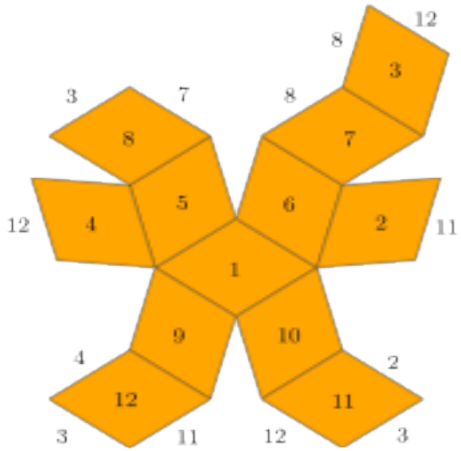
044-2257-4008; smahesh@iitm.ac.in

http://www.ae.iitm.ac.in/~smahesh/

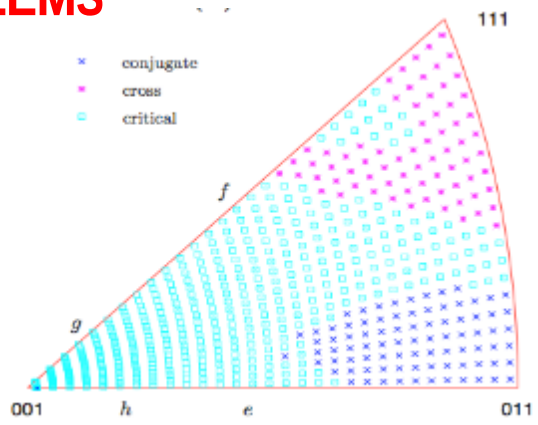
Major Areas of Research

- Solid mechanics analysis of aerospace materials
- Plasticity, fracture, and creep modeling and experimentation

SOME RECENT RESEARCH PROBLEMS



Micromechanical modeling of creep rupture in steels



Continuum model of substructure formation during plastic deformation

Dr. P Sriram

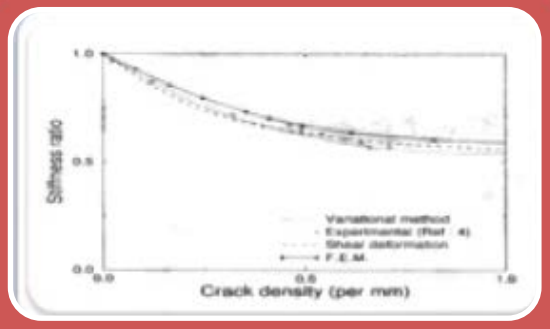
PhD, Georgia Institute of Technology, USA

Professor, Aerospace Engineering

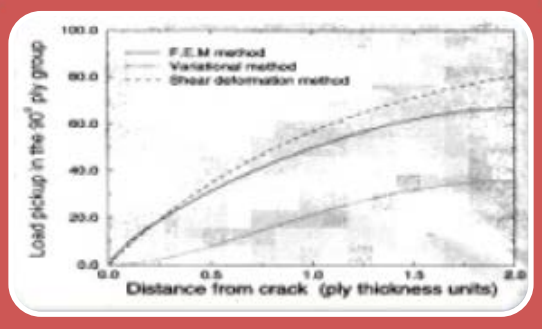
044-2257-4007; sriram@iitm.ac.in

http://ae.iitm.ac.in/~sriram

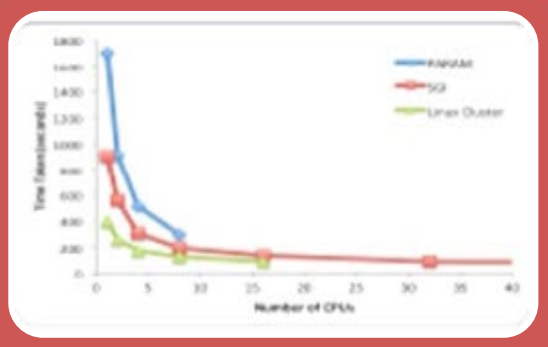
- Fatigue and Fracture Mechanics
- Composite Materials
- Parallel Computing



Approximate Modeling of Delamination



Progressive Damage of Layered Composite



Parallel Speed up – Various architectures

Dr. Sriram Rengarajan

Assistant Professor, Aerospace Engineering

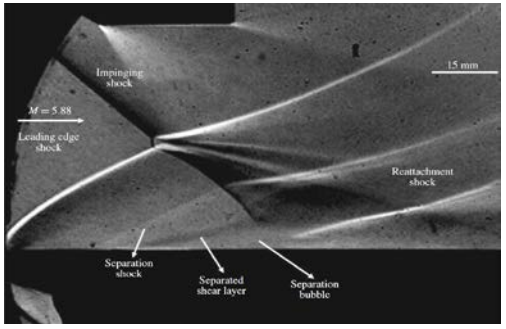
044-2257-4020; r.sriram@iitm.ac.in, r.sriram@ae.iitm.ac.in

https://www.iitm.ac.in/info/fac/r.sriram

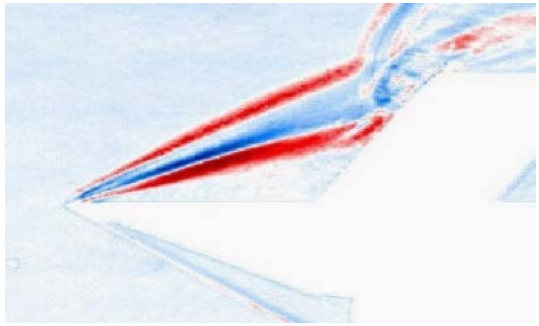
https://scholar.google.co.in/citations?user=IAIQA6wAAAAJ&hl=en

Major Areas of Research

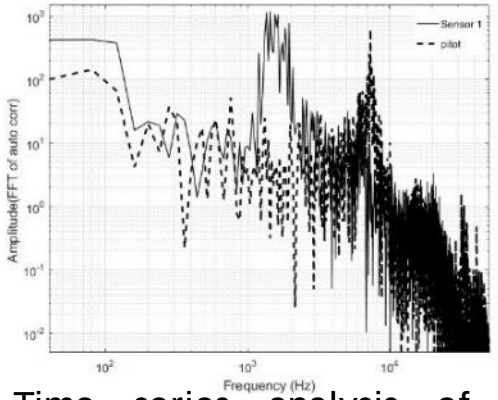
- **Unsteady high-speed flows**
- **Shockwave boundary layer interaction**
- **Flow control**



Shockwave boundary layer interaction



Dynamic mode decomposition analysis of shock induced unsteady leading edge separation



Time series analysis of unsteady pressure signals

Dr. R I Sujith

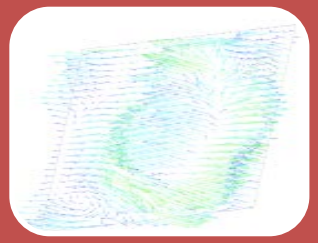
PhD, Georgia Institute of Technology, USA

Professor, Aerospace Engineering

044-2257-6012; sujith@iitm.ac.in

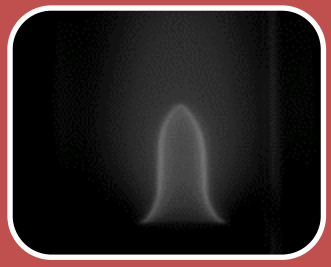
http://www.ae.iitm.ac.in/~sujith

- Research Area: Combustion Instability; Focus Nonlinear dynamics; precursors
- Research Area: Optical flow diagnostics; Focus PIV, PLIF, LDV & PDPA, high speed imaging & image processing



Combustion Instability in Aero & land based gas turbines

Application of laser diagnostics to study combustion Instability



Fundamental studies on laboratory flames

Understanding combustion instability, and mitigate it in industrial applications

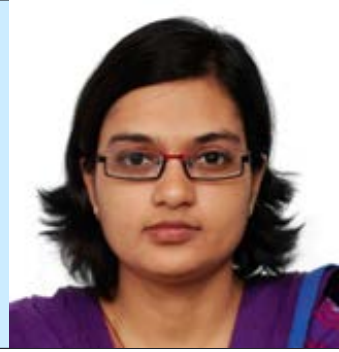
Dr. Sunetra Sarkar

PhD, Indian Institute of Science, India

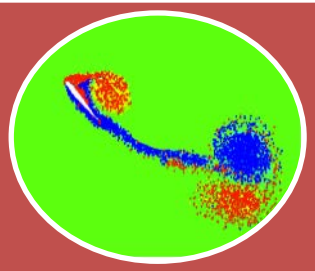
Professor, Aerospace Engineering

044-2257-4024; sunetra@iitm.ac.in

http://www.ae.iitm.ac.in/~sunetra/sunetra1.htm

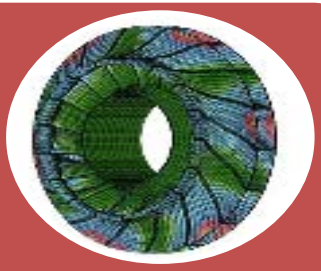


- Unsteady Aerodynamics of Flapping Bodies, Fluid-Structure Interactions
- Nonlinear Aero elasticity, Uncertainty Quantification
- Computational Fluid Dynamics, Particle Based Tools



Resolving the flow-field of flapping insects and MAVs

Wind turbine rotor aero elasticity with nonlinearities and uncertainties



Impeller acoustoelasticity and effect of dense gases on the combined fluid-structure dynamics

Unsteady Aerodynamics and Fluid-Structure Interactions of Engineering Systems

Dr. R Velmurugan

PhD, Indian Institute of Technology, Delhi

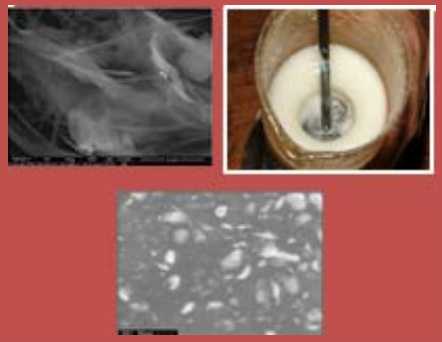
Professor, Aerospace Engineering

044-2257-4017 ramanv@iitm.ac.in

http://www.iitm.ac.in/ramanv

- Research Area/Focus 1 : Composite Materials
- Research Area/Focus 2 : Nano Composites
- Research Area/Focus 3 : Impact Mechanics and Structural Crashworthiness

Characterization studies of Composite Materials (polymer, metallic and natural composites)



Characterization and analytical studies of composites materials with nano fillers for improvement of functional properties in structural applications

Studies of different composite materials for impact loading and crashworthiness applications

INDIVIDUAL FACULTY PROFILE

DEPARTMENT OF APPLIED MECHANICS

LIST OF FACULTY

- Abhijit Chaudhuri
- Aditi Kathpalia
- Amit Nain
- Anubhab Roy
- Anuradha Banerjee
- Arockiarajan A
- Arul Prakash K
- Arun K Thittai
- Babji Srinivasan
- Baburaj A P
- Danny Raj M
- Ganesh Tamadapu
- Ganga Prasath
- Ilaksh Adalkha
- Kannabiran Seshasayanan
- Kiran Raj M
- Kundanati Lakshminath
- Lakshmana Rao C
- Mahesh V Panchagnula
- Manivannan M
- Pijush Ghosh
- Prasad Patnaik B S V
- Raghavendra Sai V V
- Ramakrishnan S
- Rinku Mukherjee
- Sarith P Sathian
- Satyanarayanan S
- Saumendra K Bajpai
- Sayan Gupta
- Shaikh Faruque Ali
- Shuvrangsu Das
- Sivakumar M Srinivasan
- Sujatha N
- Swathi Sudhakar
- Vagesh D Narasimhamurthy
- Varadhan S K M
- Vengadesan S

Dr. Abhijit Chaudhuri

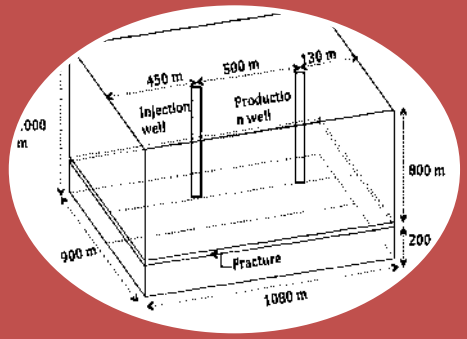
PhD, Indian Institute of Science, Bangalore, India

Professor, Applied Mechanics & Biomedical Engineering

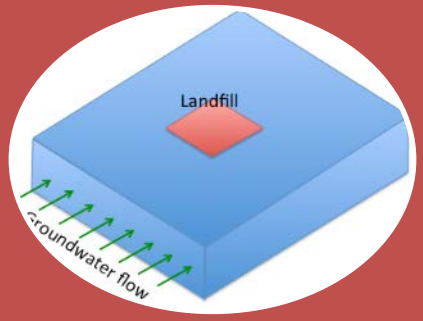
044-2257-4074; abhijit.chaudhuri@iitm.ac.in

http://apm.iitm.ac.in/fmlab/abhijit/index.html

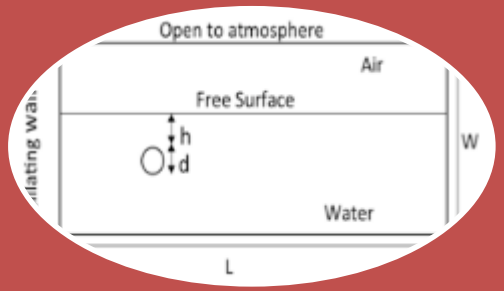
- Geothermal system: Coupled processes simulation
- Subsurface hydrology: Conditional and inverse stochastic analysis
- Fluid structure interaction, Water waves



Geothermal heat extraction, Carbon sequestration



Groundwater hydrology, contamination from landfill/nuclear waste repository.



Flow induced vibration, wave interaction to automatic underwater vehicle.

Alternative energy resources and environmental safety assessment

Dr. Aditi Kathpalia

PhD, National Institute of Advanced Studies, India

Assistant Professor, Applied Mechanics & Biomedical Engineering

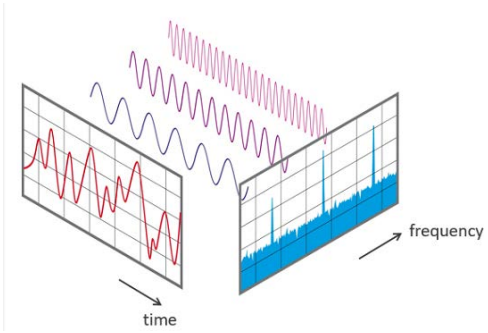
aditi@iitm.ac.in

- Information theory based spectral analysis techniques
- Characterization of linear, nonlinear, chaotic and noisy time series
- Distinguishing healthy and abnormal cardiovascular dynamics, healthy and diseased brain states

***Information content* at different *scales* and its properties**

Fourier Spectral Analysis

$$X(\omega) = \int_{-\infty}^{+\infty} x(t)e^{-j\omega t}dt$$

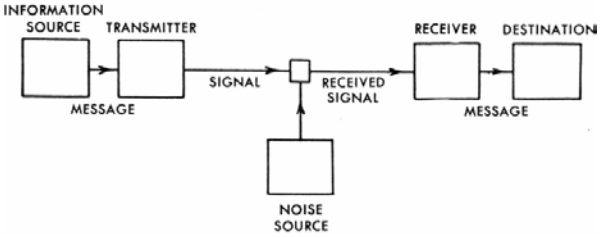


Signal processing, Frequency analysis, design of linear filters

…all things linear

Shannon's Information Theory

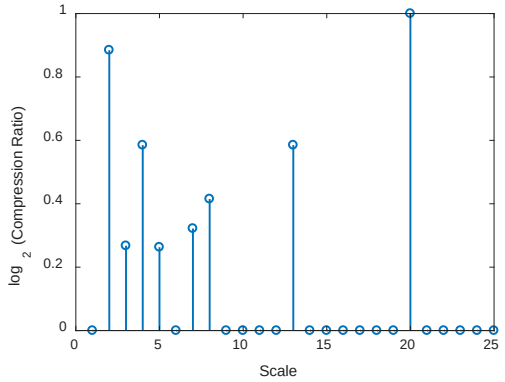
$$H(X) = -\sum_{x} P(x) \cdot \log P(x)$$



For quantifying Information content, Mutual information, Channel capacity, Data Compression, Theory of Communication

…all things probabilistic

Information Spectrum/ Compression Spectrum



Example Compression spectrum of a sinusoid

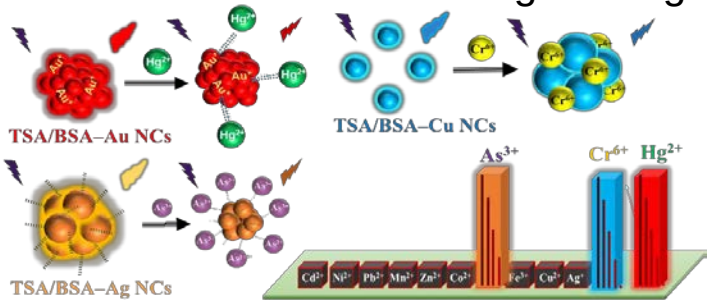
Dr. Amit Nain

PhD, National Tsing Hua University Taiwan

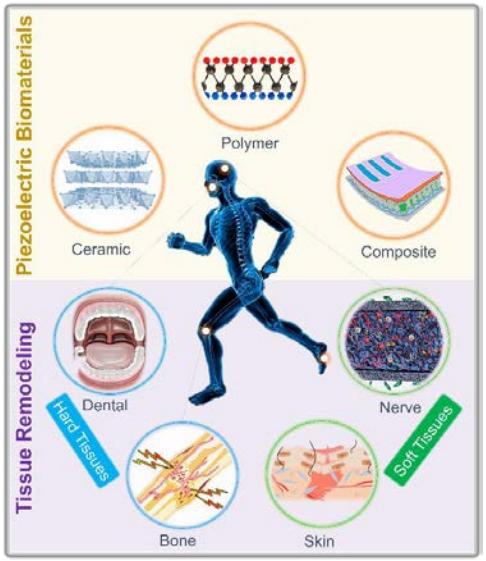
Assistant Professor, Applied Mechanics & Biomedical Engineering

+91 9944147316; amit@iitm.ac.in

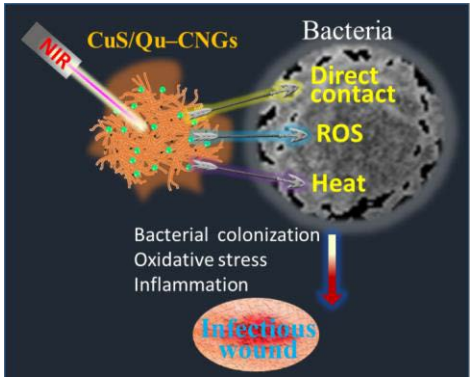
1. Nanomaterial design and engineering
2. Self-powered medical devices
3. 4D printing of programmable structures
4. Biomaterials and tissue engineering



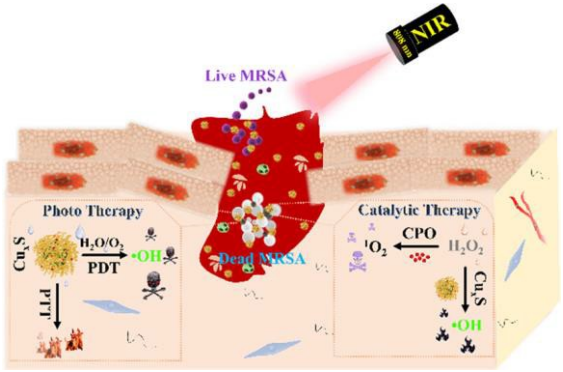
DOI: 10.1016/j.snb.2020.128539
Sen. Actuators. B Chem. 2020



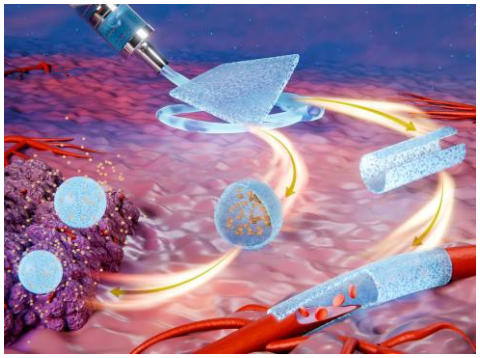
DOI: 10.1016/j.biomaterials.2024.122528
Biomaterials, 2024



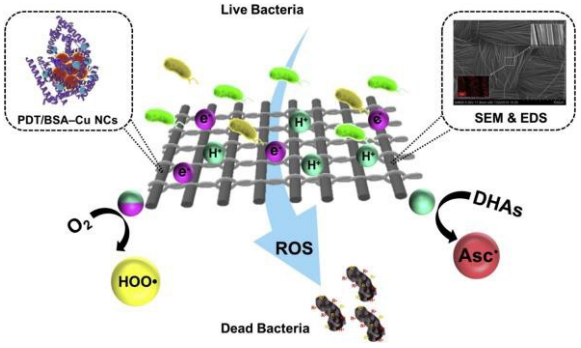
Nain et al Nanoscale Horiz., 2023
DOI: 10.1039/D3NH00275F



DOI: 10.1021/acsami.0c18999
ACS Appl. Mater. Interfaces, 2021



DOI: 10.1039/D3BM02044D
Biomater. Sci., 2024



DOI: 10.1016/j.jhazmat.2019.121821
J. Hazard. Mater. 2020

Dr. Anubhab Roy

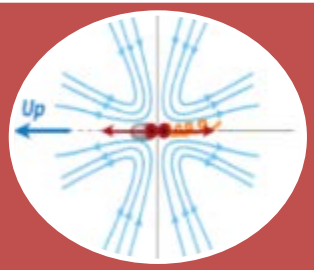
Associate Professor, Applied Mechanics & Biomedical Engineering

044-2257-4080; anubhab@iitm.ac.in

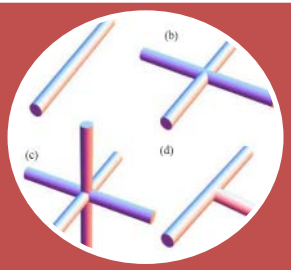
https://home.iitm.ac.in/anubhab/

Major Areas of Research

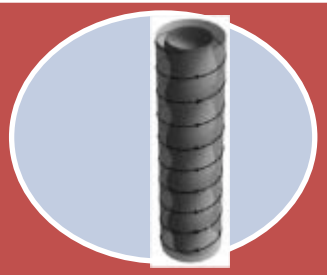
- Living fluids – Dynamics of swimming microorganisms
- Hydrodynamic Stability
- Suspension Mechanics



Active stresses due to swimming bacteria



Orientation dynamics of anisotropic particles in viscous fluids



Stability of rotating flows

Applying modeling and simulations to solve problems in fluid mechanics

Dr. Anuradha Banerjee

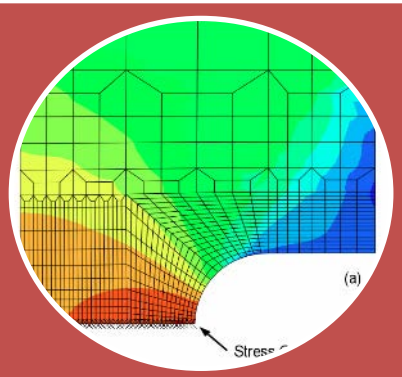
PhD, University of Glasgow, UK

Professor, Applied Mechanics & Biomedical Engineering

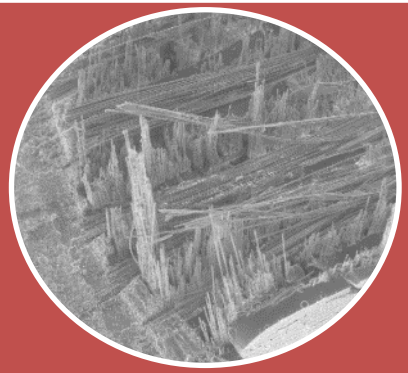
044-2257-4075; anuban@iitm.ac.in

http://apm.iitm.ac.in/smlab/anu/Site/Welcome.html

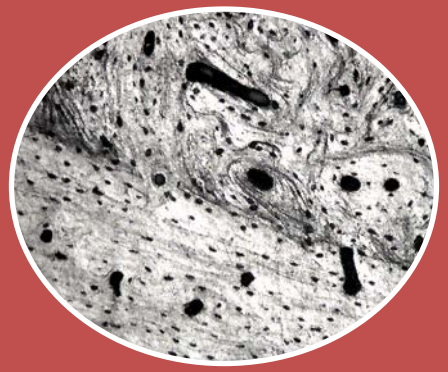
- Fracture and Fatigue of Materials
- Biomaterials/Hard Tissues
- Composites



Fracture Models



Material Characterization



Mechanics of Bone

Theoretical, Experimental and Computational Mechanics of Materials

Dr. A Arockiarajan

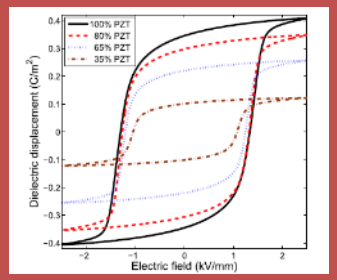
PHD, University of Kaiserslautern, Germany

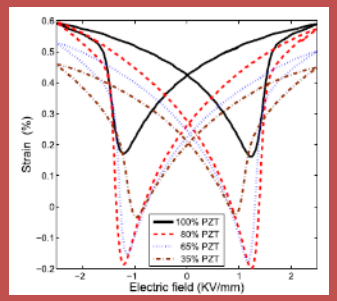
Professor, Applied Mechanics & Biomedical Engineering

044-2257-4070; aarajan@iitm.ac.in

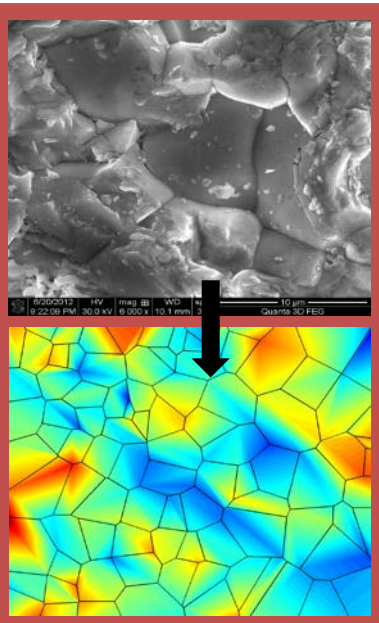
http://apm.iitm.ac.in/smlab/rajan/index.html

- Smart/Functional Materials
- Material Modelling
- Experimental characterization

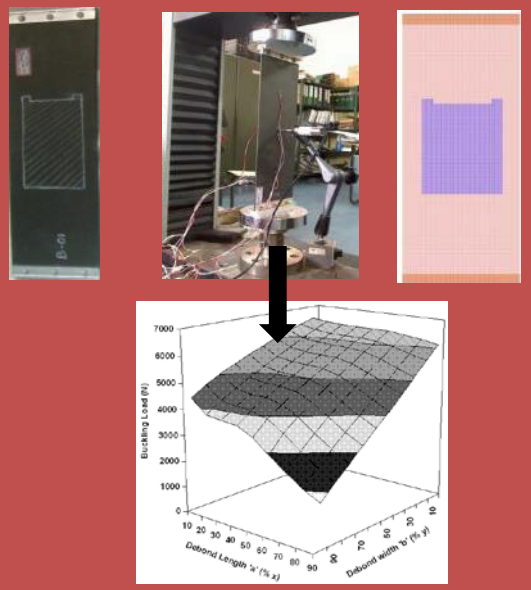




Performance of ferroelectrics



Microstructural modelling



Debonding on composites

Dr. K Arul Prakash

PhD, Indian Institute of Technology Kanpur, India

Professor, Applied Mechanics & Biomedical Engineering

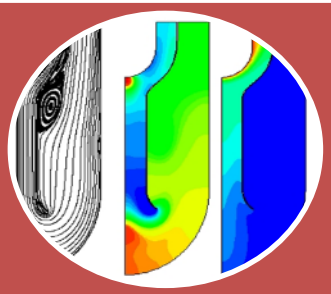
044-2257-4066; arulk@iitm.ac.in

http://apm.iitm.ac.in/fmlab/arul/index.html

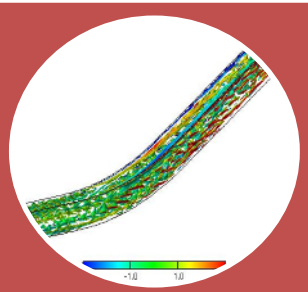
Major Areas of Research

- Computational Fluid Dynamics and Heat Transfer – Development of Algorithms
- Turbulence Modeling, Large Eddy Simulation and related techniques
- Thermal Hydraulics
- Aerodynamics, Fluid Structure Interaction

Applications



Thermal Hydraulics - Accelerator Driven nuclear reactor System



Large Eddy Simulation – Cooling duct of Ariane II rocket engine

Aerodynamics – Fluid flow characteristics past elliptic cylinder

Energy and Environment

Dr. Arun K Thittai

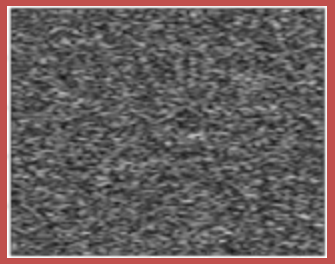
Professor, Applied Mechanics & Biomedical Engineering

044-2257-4053; akthittai@iitm.ac.in

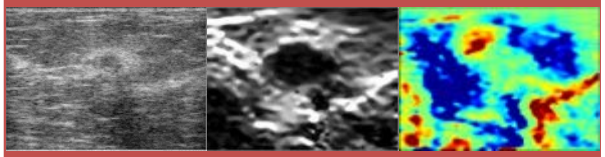
https://home.iitm.ac.in/akthittai/

Major Areas of Research

- Biomedical Ultrasound Imaging (Clinical and Pre-clinical)
- Ultrasound Elastography
- Ultrasound guided Treatment monitoring
- Ultrasound Guided Biopsy



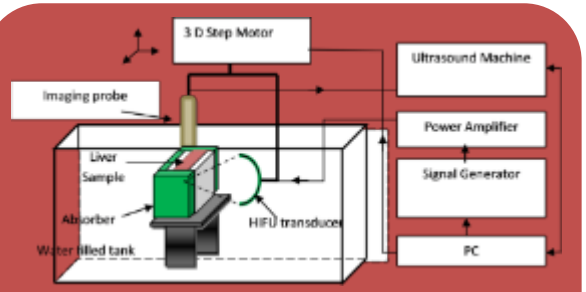
Ultrasound Image Formation Techniques for Biomedical Applications



Sonogram | Axial-strain | Axial-Shear Strain

Ultrasound Elastography

Measurement and Imaging of the Tissue Elastic Properties



High Intensity Focused Ultrasound (HIFU) Treatment and Real-time monitoring of it by Ultrasound Imaging Techniques

Exploiting Ultrasound Signals for Wide Ranging Bio-Medical Applications

Dr. Babji Srinivasan

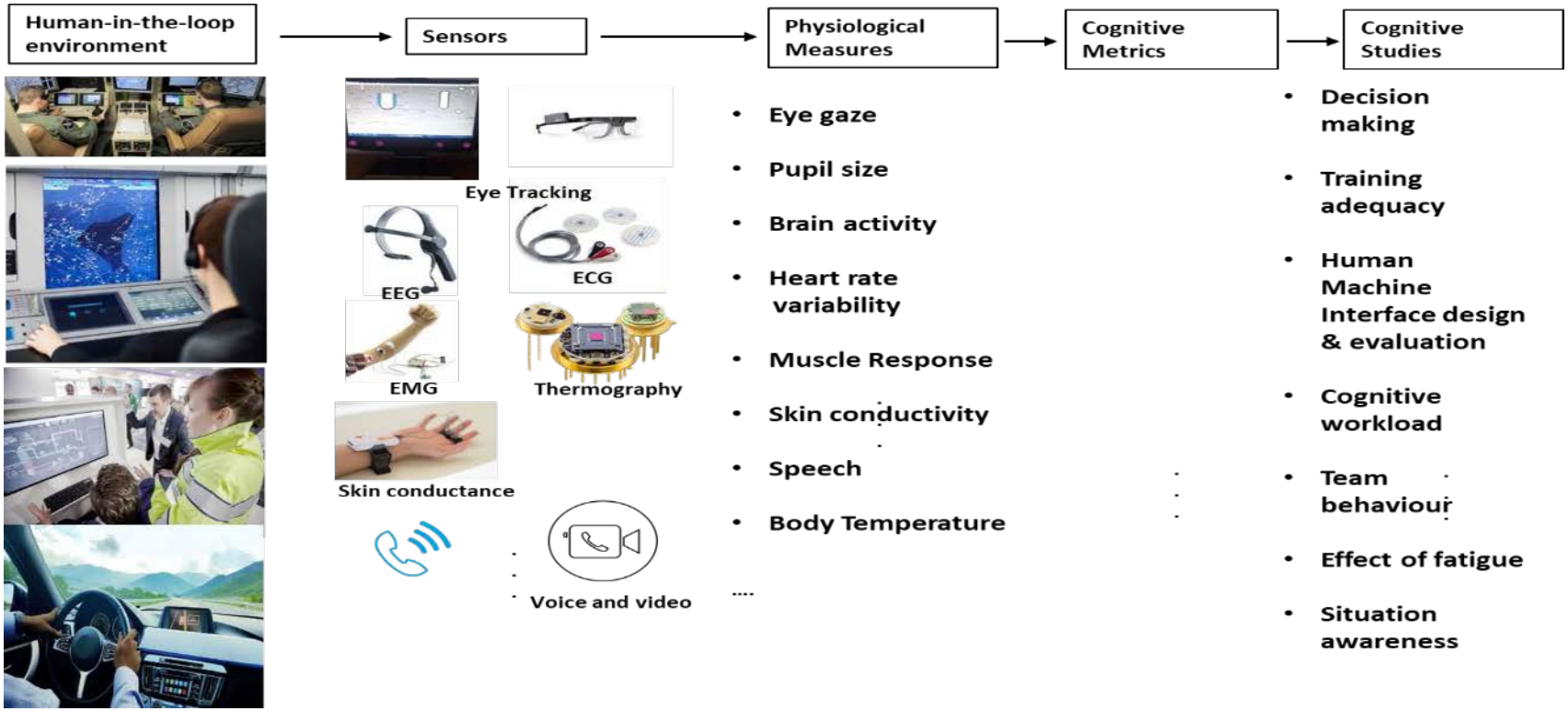
PhD, Texas Tech University University, USA

Professor, Applied Mechanics & Biomedical Engineering

044-2257-4085; babji.srinivasan@iitm.ac.in

Major Areas of Research

Cognitive Systems Engineering, Human Cyber Physical Systems, Neuroergonomics, Physiological Control Systems



Dr. A P Baburaj

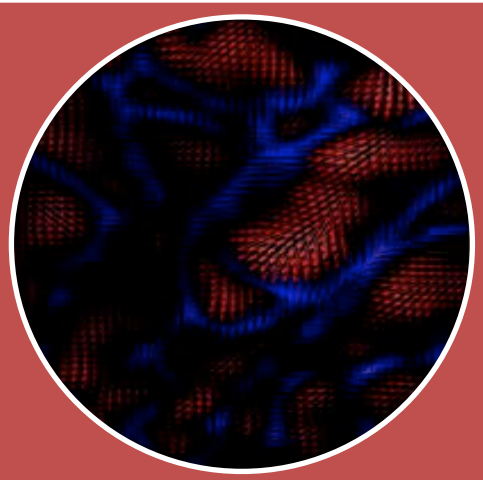
PhD, IISC Bangalore, India

Professor, Applied Mechanics & Biomedical Engineering

044-2257-4065; apbraj@iitm.ac.in

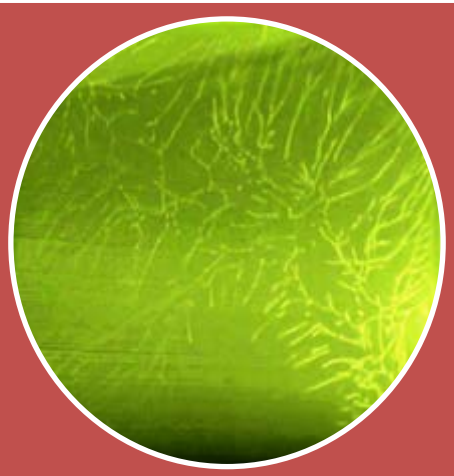
http://apm.iitm.ac.in/fmlab/raj/index.html

Turbulent convection



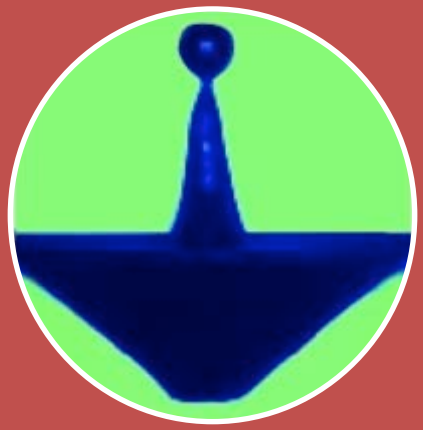
Top view of the velocity field just above a horizontal hot surface

Transport across membranes



Pattern of density driven mass transfer above a horizontal membrane

Interfacial phenomena



Last two stages of bubble collapse at an interface

The research encompasses study of organised motion in turbulence, pattern formation, interaction of boundary layers with ambient flows, dynamics of bubbles, drops and aerosols.

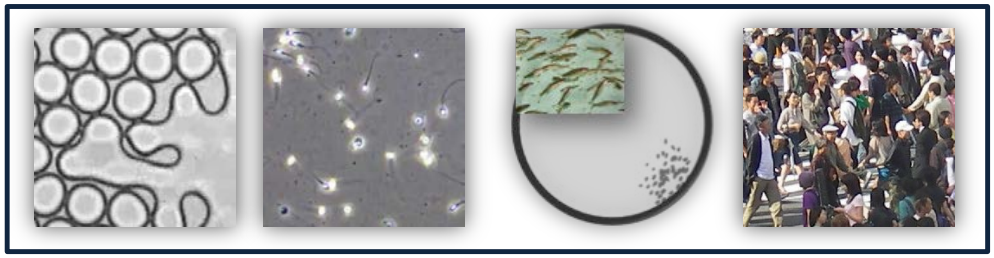
Dr. Danny Raj M

PhD, IIT Madras, Chennai, India

Assistant Professor, Applied Mechanics & Biomedical Engineering

044-2257-4090; danny@iitm.ac.in

COLLECTIVE PHENOMENA RESEARCH



Collective systems are composed of many interacting entities.
Examples: from **droplets**, **cells**, **organisms** to **human** groups.

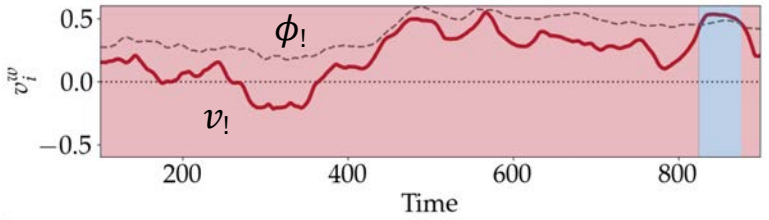
RESEARCH THEMES:

1. Modelling collective systems (Agent based framework),
2. Inverse problems in collectives (Optimization methods),
3. How group behavior emerges (Network methods),
4. Inferring collective from data (Data-driven methods).

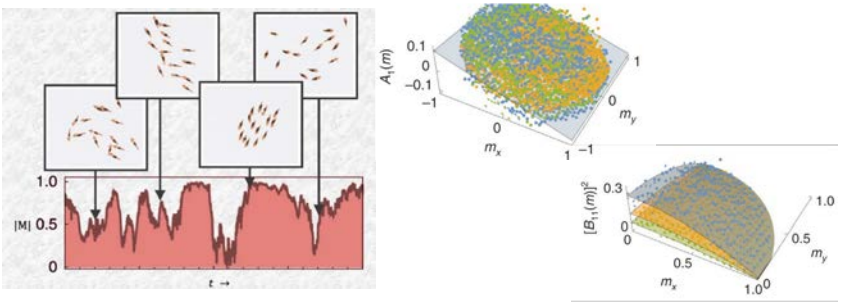
APPLICATIONS:

1. **Droplet engineering:** Microfluidic devices for applications like drug discovery,
2. **Male infertility research:** Methods to accurately infer sperm cell motility from movement information,
3. **Traffic engineering:** Understanding the peculiarities of Indian traffic & pedestrian movement.

A "*Peek*" into some published work



Physics based classifiers that integrate neighbor information to distinguish agents with different intrinsic characteristics.
Nabeel A and Danny RM, Chaos, 2022.



Equation learning method applied to real fish schooling. We find that order is counter-intuitively noise-induced!
Jhawar J, Morris RG, Kumar URA, Danny RM, Rogers T, Harikrishnan R., Guttal V, Nature Physics, 2020.

More details: https://www.dannyraj.com/

CoPhe Lab
collective phenomena research

Dr. Ganesh Tamadapu

PhD, IIT Kharagpur

Associate Professor, Applied Mechanics & Biomedical Engineering

044-2257-4081; gt@iitm.ac.in

https://apm.iitm.ac.in/ganesh.html

Major Areas of Research

- **Nonlinear Mechanics**
- **Applied Mathematics**

Source: Faculty website

Dr. Ilaksh Adlakha

Associate Professor, Applied Mechanics & Biomedical Engineering

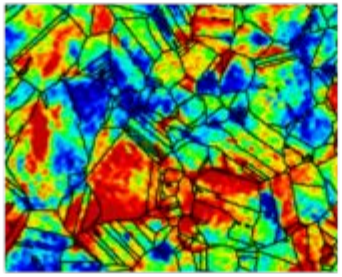
044-2257-4082; ilaksh.adlakha@iitm.ac.in

https://home.iitm.ac.in/ilaksh.adlakha/

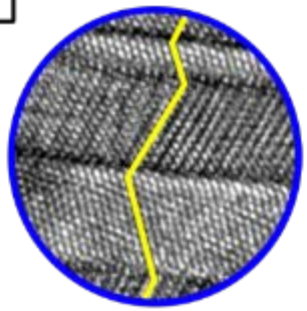
Integrated Research Vision

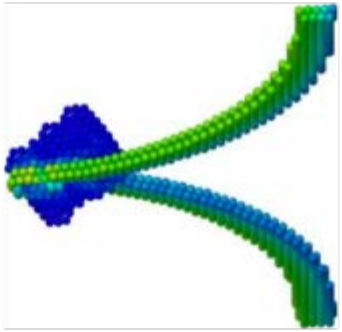
- *Stress Assisted Corrosion*
- *Hydrogen Embrittlement*
- *Application of Data Science in Mechanics*
- *Lightweight Alloys*
- *Role of Grain Boundaries during Fatigue*

Crystal Plasticity



Phase Field Modeling





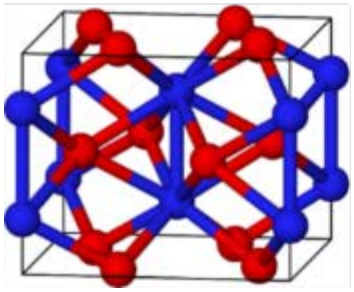
Atomistic Simulations

Mechanical Testing

- *Fatigue*
- *Nanoindentation*
- *Hopkinson Bar*

Electrochemical

- *Potentiodynamic Measurements*
- *EIS*



QM/MM

DFT

Characterization

DIC *SEM*
EBSD *TEM*

MultiScale Mechanics Lab

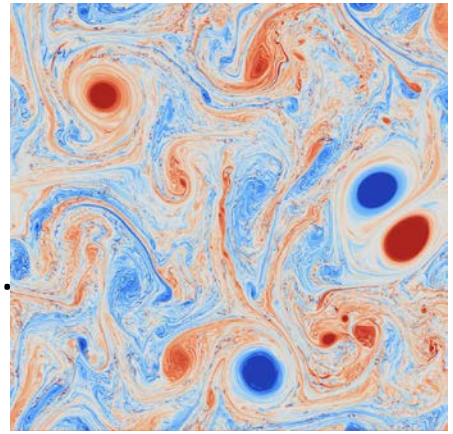
Dr. Kannabiran Seshasayanan

PhD, Ecole Normale Superieure, France

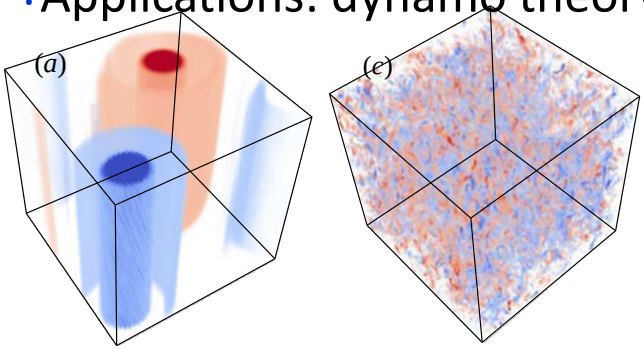
Assistant Professor, Applied Mechanics & Biomedical Engineering

044-2257-4077; kanna@iitm.ac.in

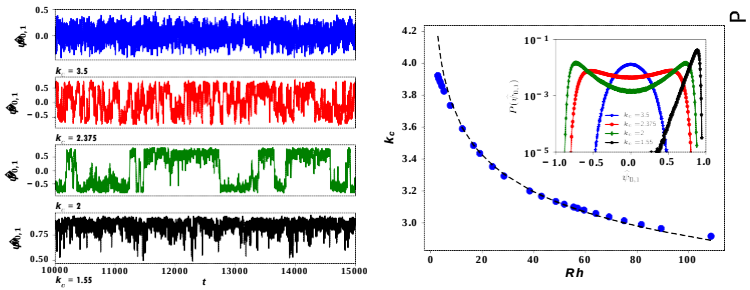
- Instabilities on a turbulent background
- Role of extreme fluctuations in triggering turbulent transitions.
- Applications: dynamo theory, geophysical flows, climate systems.



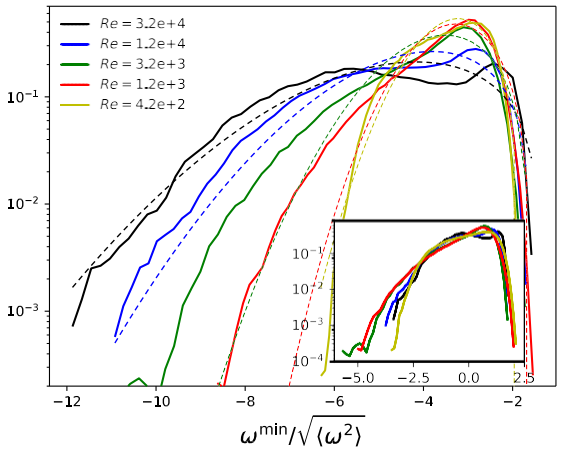
2-dimensional MHD flows



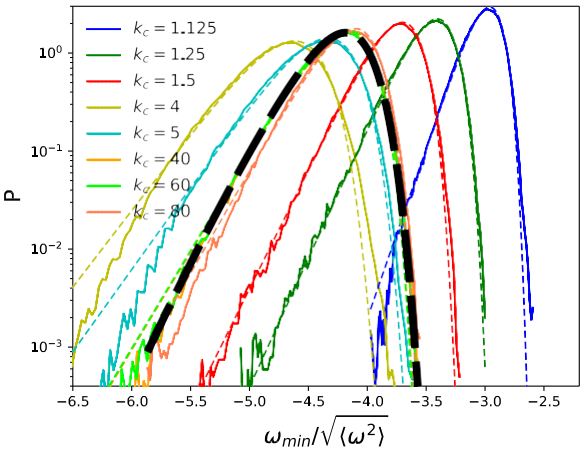
Transition between 2D turbulence and 3D turbulence



Transitions between zonal jets



Vorticity extremes in Navier Stokes



Vorticity extremes in Truncated Euler equations following Gumbel

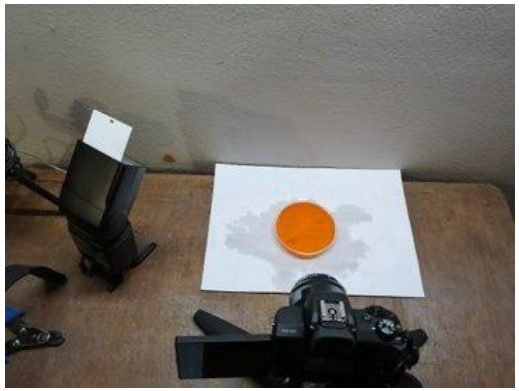
Dr. Kiran Raj M

PhD, Indian Institute of Technology Kharagpur

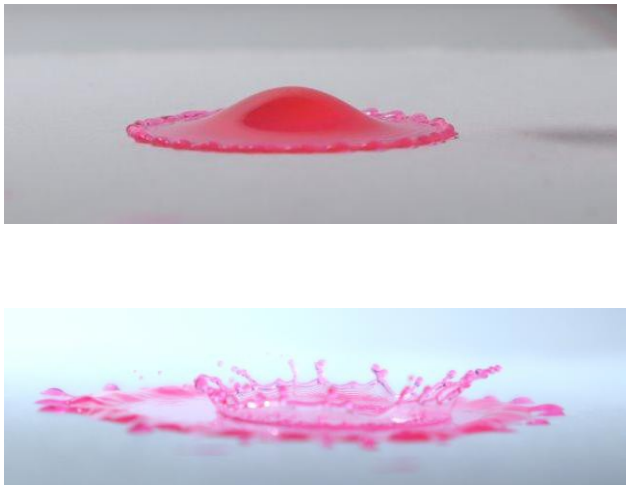
Assistant Professor, Applied Mechanics & Biomedical Engineering

044-2257-4089; kiran@iitm.ac.in

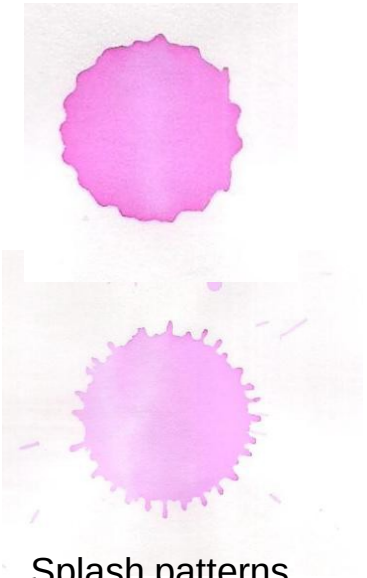
- Impact and wetting characteristics of droplets on porous surfaces
- Splash patterns of complex fluids on porous surfaces
- To estimate the nature of impact from splash patterns



Experimental setup for splash imaging



High speed imaging of splash



Splash patterns

Dr. Lakshmi Kundanati

PhD, Indian Institute of Science

Associate Professor, Applied Mechanics & Biomedical Engineering

044-2257-4088; lakshminath@iitm.ac.in

- Structure and Mechanics of Biological Materials
- Bioinspired engineering materials
- Sustainable materials for future

Source: Faculty website

Dr. C Lakshmana Rao

Doctor of Science, Massachusetts Institute of Technology, USA

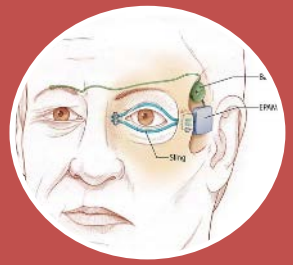
Assistant Professor, Applied Mechanics & Biomedical Engineering

044-2257-4059; lakshman@iitm.ac.in

http://apm.iitm.ac.in/smlab/clr/index.html

- Ballistic Impact and Blast Mitigation on Structures
- Characterization of Piezopolymers
- Buckling Control of Structures using Smart Materials

MILITARY VEHICLES



SENSORS AND ACTUATORS

SPACE STRUCTURES

Dr. Mahesh V Panchagnula

PhD, Purdue University, USA

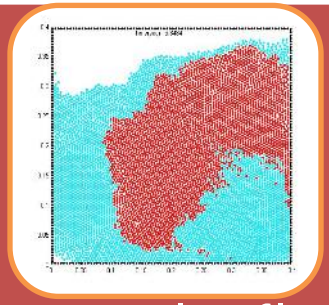
Professor, Applied Mechanics & Biomedical Engineering

+91-44-2257 4056; mvp@iitm.ac.in

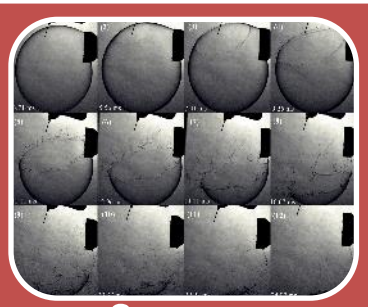
http://apm.iitm.ac.in/fmlab/mvp/index.html

- Liquid Atomization and Spray Combustion
- Multiphase Fluid Mechanics
- Wetting and contact angle hysteresis

Wetting and hysteresis (Microscale)



Wet granular flows (Mesoscale)



Sprays (Macroscale)

Multiscale multiphase flows - spanning a range of length and time scales

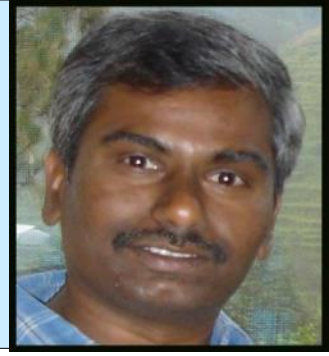
Dr. Manivannan M

PhD, IISc India

Professor, Applied Mechanics & Biomedical Engineering

+91-44-2257 4064; mani@iitm.ac.in

http://apm.iitm.ac.in/biomedical/mani



- Haptics/Touch Feedback, Medical Simulation, Advanced Robotics
- Biomechanics: Soft Tissue Multiscale Modeling and Simulation
- Quantitative Physiology: Arterial Pulse Modeling and Simulation

Laparoscopic Simulator Hardware For Haptic Feedback Designed In house

Mannequin Based Simulation For Training on Diagnosing and Treating Heart Attack

Dr. Pijush Ghosh

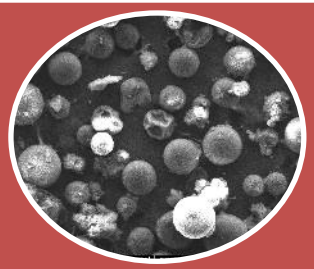
PhD, North Dakota State University, USA

Professor, Applied Mechanics & Biomedical Engineering

044-2257-4060; pijush@iitm.ac.in

http://apm.iitm.ac.in/smlab/pijush/Pijush_index.html

- Self-Healing Materials/Focus 1
- Polymer Thin Films/Focus 2
- Molecular Dynamic Simulation/Focus 3

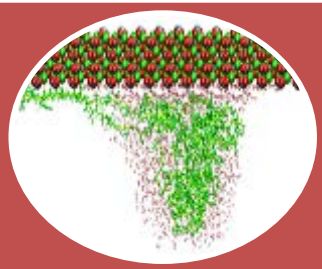


Self-Healing of Cracks in polymeric matrix

Surface Modification applying Microencapsules

Polymer Functional (thermal, anti-hydration) Coatings

Polymer Ceramic (cement)Interface



Organic-Inorganic Interaction at the interface

Mechanics of Polymeric and Protein Molecules

Automobile, Aviation, Polymer Composites, Construction Materials Industries >> Mechanics of thin films, nanocomposites, interface mechanism, polymeric nanofilms, microencapulations, MD simulations

Dr. Prasad Patnaik BSV

Ph.D., IIT Madras, Chennai, INDIA

Professor, Applied Mechanics & Biomedical Engineering

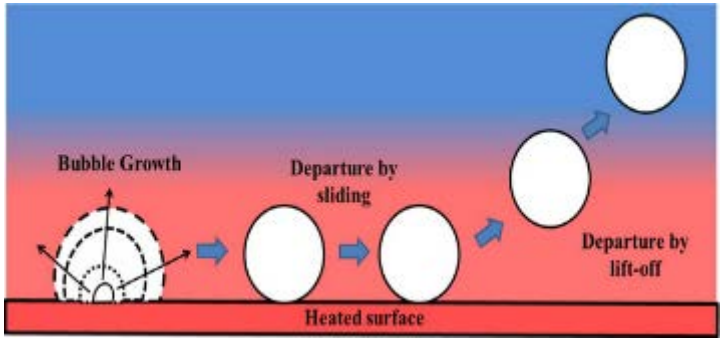
044-2257-4068; bsvp@iitm.ac.in

https://simbiotsiitm.github.io/Simbiots-Lab/

- CFD/FSI aided Hemodynamics Simulations for Cardio/cerebrovascular patient-specific studies for understanding Stroke and Myocardial Infraction (MI).
- Developing Clinical decision Support tools for Surgical planning, Biomedical device development and patient-specific studies for understanding vascular diseases.
- Convective Heat Transfer studies in Nuclear Thermal applications, BTMS for EV's

TAWSS

Bubble Growth



SIMBIOTS: Simulations in Bio-Fluids and Thermal Science

Dr. V V Raghavendra Sai

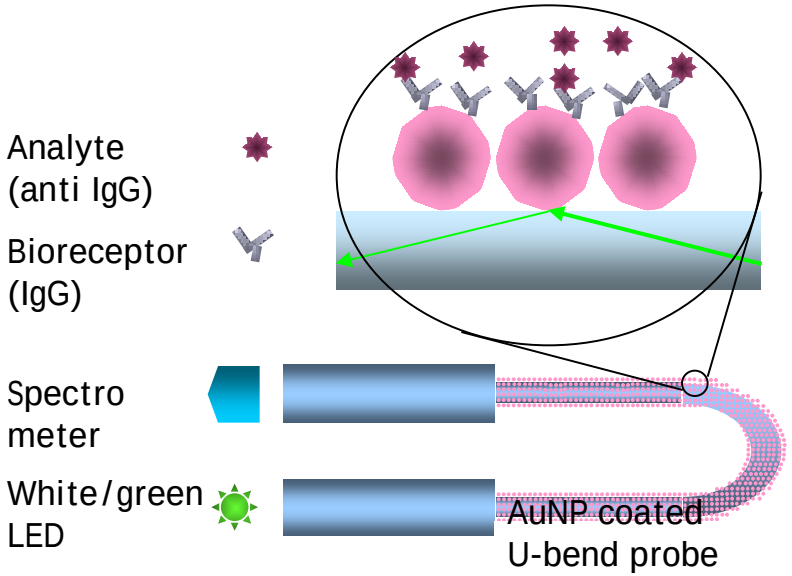
PhD from IIT Bombay, INDIA

Professor, Applied Mechanics & Biomedical Engineering

044-2257-4076; vvrsai@iitm.ac.in

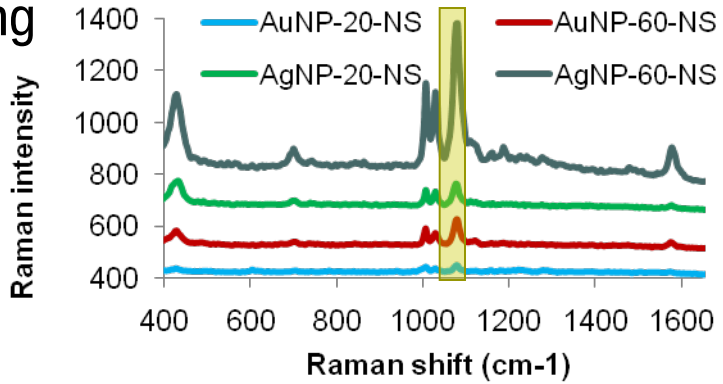
http://apm.iitm.ac.in/biomedical/sai/index.html

- Localized surface plasmon resonance (LSPR) and surface enhanced Raman scattering (SERS) based Optical Biosensors
- Clinical diagnosis & Environmental monitoring
- Detection of Explosives and Toxins



LSPR based Fiber optic biosensors for model analyte (IgG)

V V R Sai, et al 2009. *Biosens. & Bioelectron,* 24, 2804–09;



SERS mapping of AgNP 60nm coated SiO2 Nanosprings

Dr. S Ramakrishnan

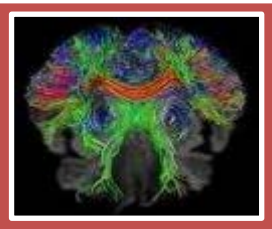
PhD, Indian Institute of Technology Madras, India

Professor, Applied Mechanics & Biomedical Engineering

MSB207B; 044-2257-4073; sramki@iitm.ac.in

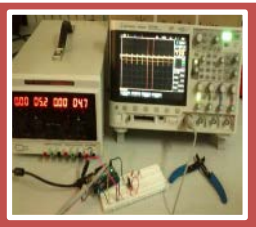
http://apm.iitm.ac.in/biomedical/ramki/index.html

- **Brain Image Analysis** - Characterization of Brain micro structure and Tractography in conditions such as Alzheimer's disorders.
- **Infrared Thermal Image Analysis** - Analysis of physiological variables using medical infrared thermograph in Human Breast and Hand.
- **Biomedical Instrumentation** - Enhancing the diagnostic relevance of medical equipment.
- **Signal analysis** - EMG signal generation, modeling, diagnosis of myopathy and neuropathy
- **Calibration of Medical Devices** - Design and development of test schemes for calibrating and standardizing medical devices



Brain Image Analysis

Thermal Image Analysis



Instrumentation & Calibration

EMG Signal Analysis

Dr. Rinku Mukherjee

PHD, North Carolina State University, USA, 2004

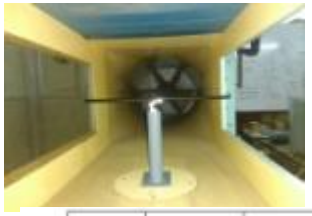
Associate Professor, Applied Mechanics & Biomedical Engineering

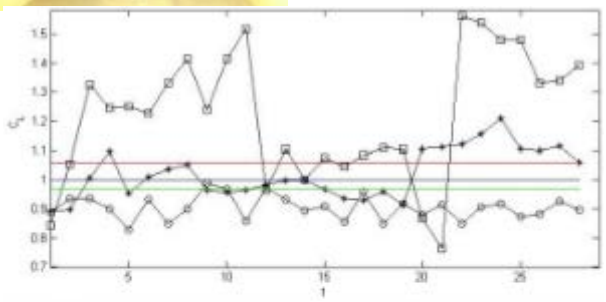
Scopus ID: 55535113700 Researcher ID: M-2111-2013

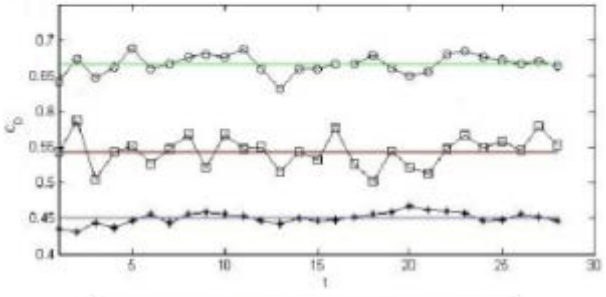
Aerodynamics (High-Alfa, Unsteady, Applied), Boundary Layers

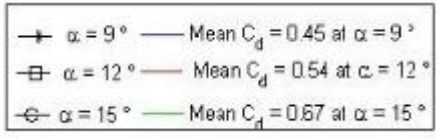
044-2257-4058; rinku@iitm.ac.in

http://home.iitm.ac.in/rinku

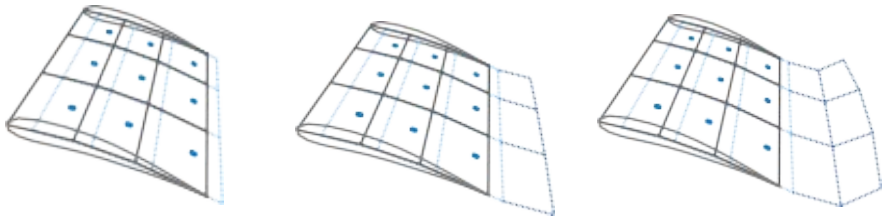




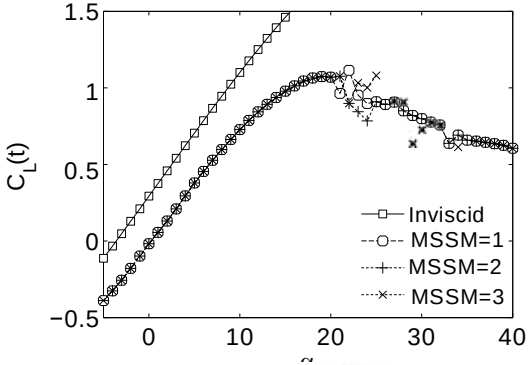


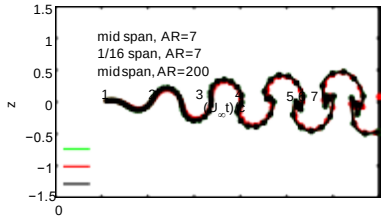


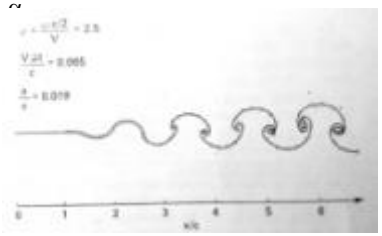
Experimental High-Alfa Aerodynamics



(i) time-step=1 (ii) time-step=2 (iii) time-step=3







(i) Present work (ii) Lliterature

Unsteady Aerodynamics

Dr. Sarith P Sathian

PhD, IIT Madras, India

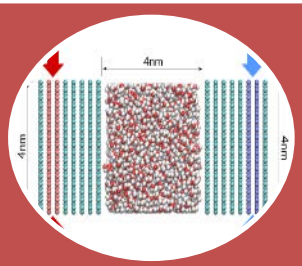
Professor, Applied Mechanics & Biomedical Engineering

044-2257-4062; sarith@iitm.ac.in

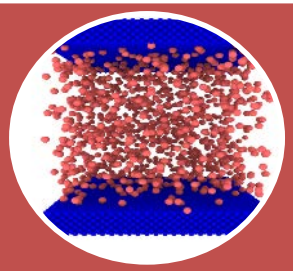
http://www.apm.iitm.ac.in/;

https://sites.google.com/site/sarithshomepage/profile/dr-sarith-p-sathian

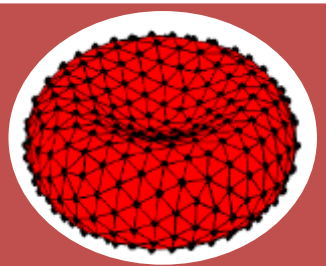
- Nanofluidics & Nanoscale heat transfer
- Compressible fluid flows & Molecular Gas Dynamics
- Computational Physics & Soft Matter simulations



Nanoscale heat transfer& Desalination



Gas sensing and gas transport



Modeling of Red Blood Cells

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

Dr. Satyanarayanan S

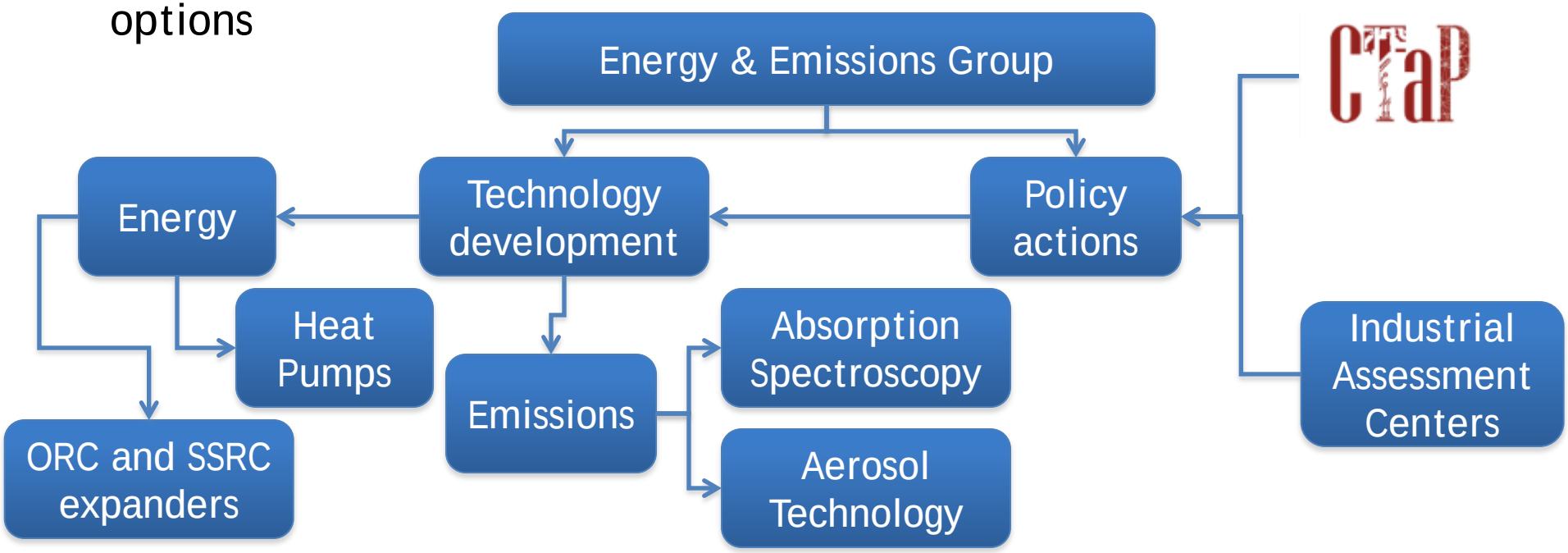
Associate Professor, Applied Mechanics & Biomedical Engineering

044-2257-4078; satya@iitm.ac.in

http://home.iitm.ac.in/satya

Major Areas of Research

- Aerosol Science and Technology Applications
- Emissions measurement and control
- Efficient utilization of energy through recovery, reuse and renewable options



Dr. Saumendra K Bajpai

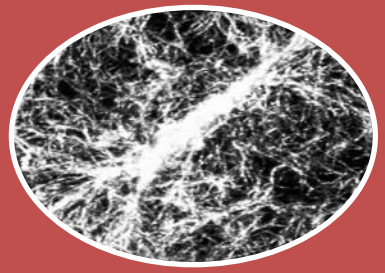
PhD, Johns Hopkins University

Assistant Professor, Applied Mechanics & Biomedical Engineering

+91-44-2257 4072; sbajpai@iitm.ac.in

http://home.iitm.ac.in/sbajpai/lab-overview.html/

- Cell mechanics and tissue-remodeling
- Multiple-scale characterization of soft-matter
- Bio-mimetic systems, design, and applications



3D cell-invasion

Cellular traction

Tissue mechanics

Assay development, diagnostics, and device design

Dr. Sayan Gupta

PhD, Indian Institute of Science, Bangalore

Professor, Applied Mechanics & Biomedical Engineering

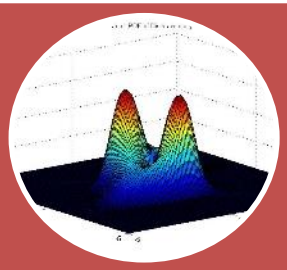
044-2257-4055; sayan@iitm.ac.in

http://apm.iitm.ac.in/smlab/sayan/Site/WELCOME.html

- Vibrations, Nonlinear dynamics and Chaos, Stochastic Dynamics
- Stochastic Load Modeling, Structural Reliability, Stochastic Finite Elements
- Damage detection & Life Assessment, Structural Health Monitoring

Stochastic load modeling in Fluid Structure Interaction problems, eg., wind turbines, offshore platforms

Detection of fatigue cracks from vibration measurements in aging infrastructure



Analysis of turbine blades for aero-elastic failures & random fatigue damage in stochastic flow

Energy harvesting from wind in bladeless windmills

Applications in stochastic dynamical systems

Dr. Shaikh Faruque Ali

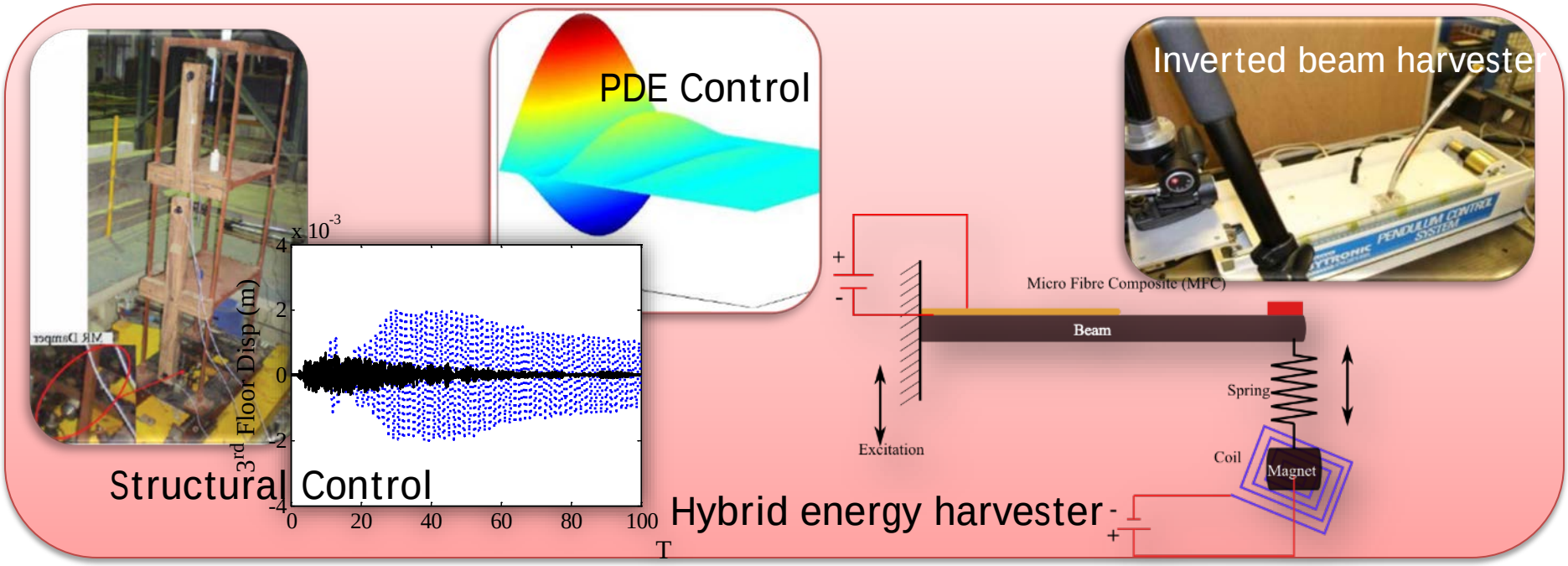
PhD, IISC, India

Professor, Applied Mechanics & Biomedical Engineering

044-2257-4054; sfali@iitm.ac.in

http://apm.iitm.ac.in/smlab/sfali/index.html

- Structural vibration and control
- Dynamics and control of nonlinear systems
- Nonlinear and hybrid energy harvesting



Dr. Shuvrangsu Das

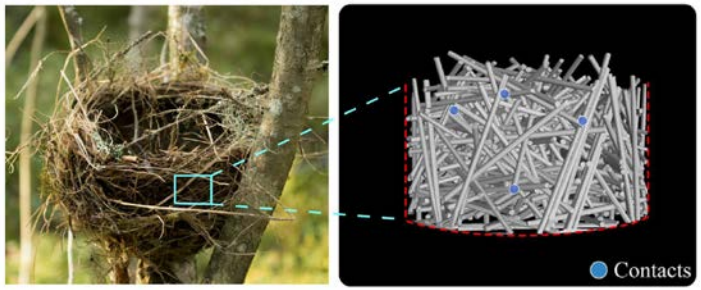
Assistant Professor, Applied Mechanics & Biomedical Engineering

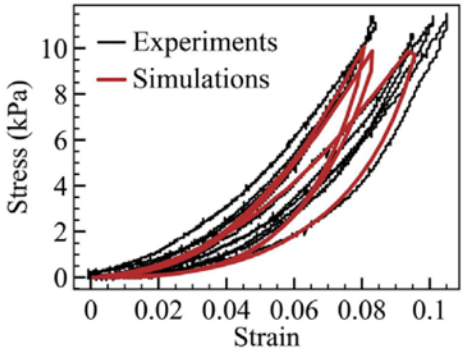
shuvra@iitm.ac.in

Entangled filaments: From bird's nest to carbon-fiber tow

- How fiber entanglements determine the overall mechanical behavior? Metric for fiber entanglements?
- How mechanical strength of bird's nest is provided by entanglements of fibers and frictional interactions between them?
- Correlating the load vs displacement characteristics of a pin drawn through the entangled filaments with underlying entanglements of filament network.

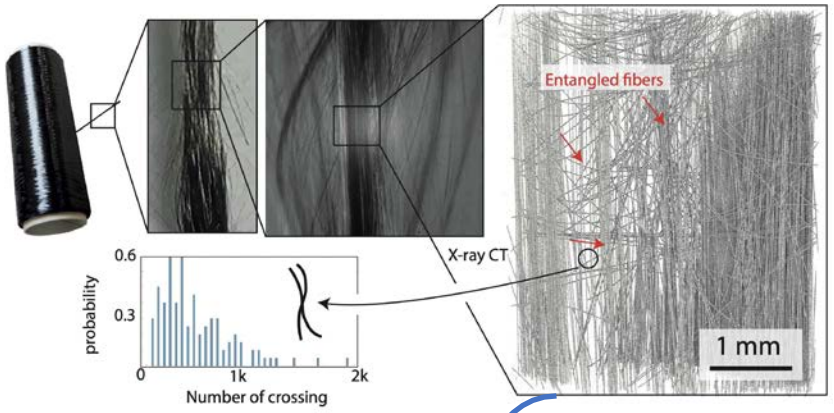
Bird's nest



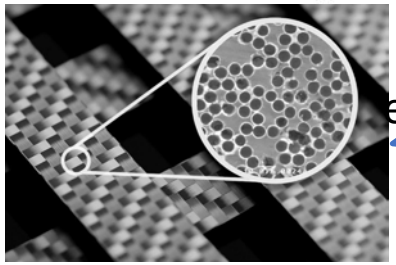


Effective behavior of bird's nest

Fiber row



Laminate



Carbon fibers are embedded in Epoxy resin to form carbon-fiber composites

Dr. Sivakumar M Srinivasan

PhD, Louisiana State University, USA

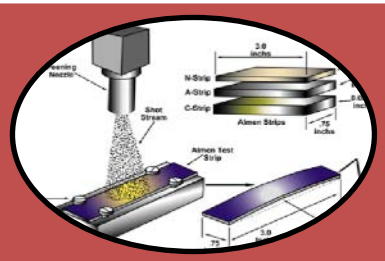
Professor, Applied Mechanics & Biomedical Engineering

044-2257-4061; mssiva@iitm.ac.in

http://apm.iitm.ac.in/smlab/mss/index.html

- Structural Mechanics / Analysis and design of thermo-mechanical structures
- Inelasticity of materials / modeling mechanics of plasticity, creep and fatigue
- Smart materials & composites / Shape mem alloys, piezos and magnetic
- Research Area/Focus 3

Smart Structures & Composites



Modeling mechanical processing effects

Low cycle fatigue of materials & structures

Inelastic Analysis and design of materials and engineering structures

Dr. N Sujatha

PHD (NTU Singapore)

Professor, Applied Mechanics & Biomedical Engineering

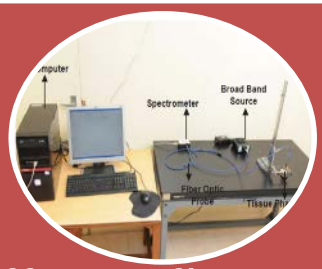
044-2257-4067; nsujatha@iitm.ac.in

http://apm.iitm.ac.in/biomedical/sujatha/index.html

- Non destructive imaging of tissue using laser speckle techniques
- Optical signal / image processing
- Biomedical optical spectroscopy instrumentation for in vivo diagnostics

Laser speckle contrast imaging for assessment of blood flow

Processing of laser Doppler signals for analysis of hemodynamics



Diffuse reflectance spectrum analysis for tissue hemoglobin assessment

NON-INVASIVE TISSUE DIAGNOSTICS USING DIFFERENT OPTICAL TECHNOLOGIES

Dr. Swathi Sudhakar

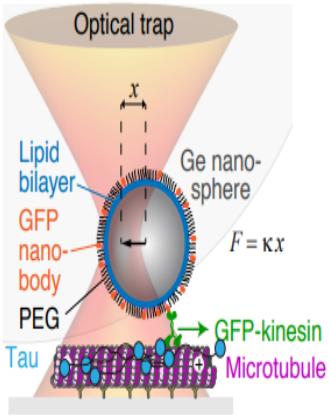
PhD,Eberhard Karls University Tübingen, Germany

Assistant Professor, Applied Mechanics & Biomedical Engineering

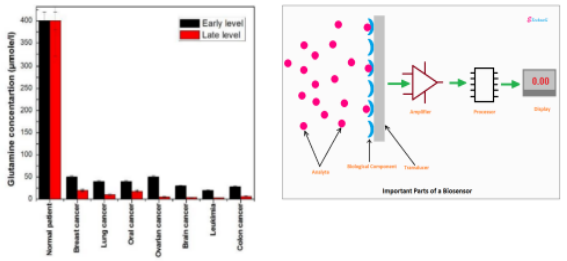
044-2257-4086; swathi.s@iitm.ac.in

- Synthesis of high spatiotemporal nanoparticles with biological application
- Manipulation of Protein nanomechanics and kinetics with super-resolution microscopic and spectroscopic techniques
- Single molecule biophysics
- Nano-Drug delivery systems

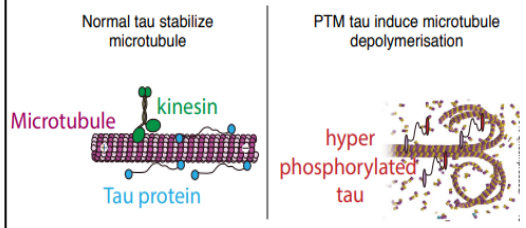
Unravelling kinesin nanomechanics in presence of tau with high spatio temporal nanoprobe in optical tweezers



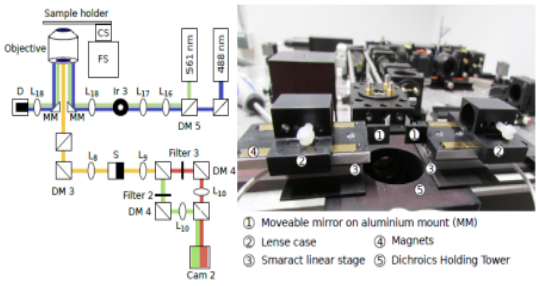
Glutameter- Development of pre-diagnostic nano-biosensor kit for cancer detection



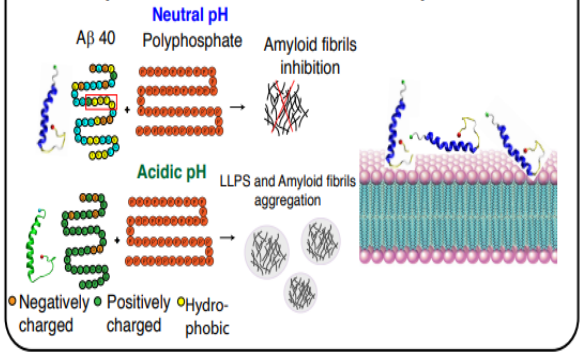
Real time fluorescence imaging on how PTM modified tau depolymerize microtubules using TIRFM



Building Total internal reflection and Interference reflection microscopy for super resolution imaging



Liquid- liquid phase separation studies on amyloid beta protein and their interaction on lipid membrane



Dr. Vagesh D Narasimhamurthy

PhD, NTNU, Norway

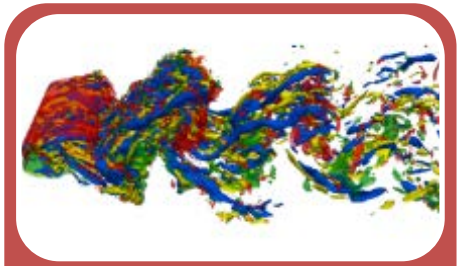
Professor, Applied Mechanics & Biomedical Engineering

+91-44-2257-4079; vagesh@iitm.ac.in

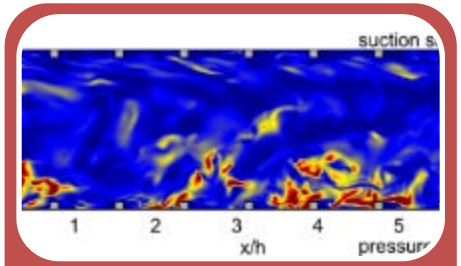
https://home.iitm.ac.in/vagesh/

Major Areas of Research

- CFD, DNS, transition & turbulence, bluff-body flows, wall-bounded flows
- Turbulent premixed combustion, gas-explosion safety
- Gas dispersion, two-phase flows (particulate dispersion)

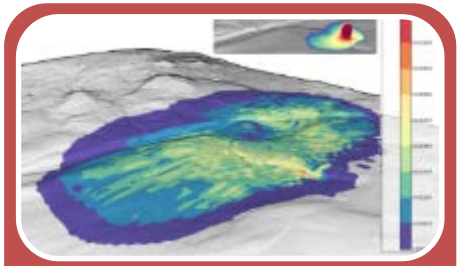


Direct numerical simulation of transitional and turbulent bluff-body flows



Direct numerical simulation of wall-bounded turbulent flows: mixing, Coriolis force and roughness effects

Turbulent premixed combustion modeling: Industrial gas-explosion safety analysis



Two-phase gas- and particulate-dispersion modeling of flammable, toxic or asphyxiating fluids

Computational fluid dynamics (CFD) studies ranging from laboratory to industrial scale

Dr. Varadhan S K M

PhD (The Pennsylvania State University, USA)

Associate Professor, Applied Mechanics & Biomedical Engineering

+91-44-2257-4071; skm@iitm.ac.in

http://apm.iitm.ac.in/biomedical/skm/index.html

Research Areas	Description
Neuromechanics	The neural basis of Biomechanics, understanding the central nervous system control strategies responsible for movement generation
Motor Learning	Understanding the mechanisms that underlie learning motor tasks, from simple, daily movements to special movements in art and sport
Rehabilitation	Development of Assist devices to be used in Rehabilitation of patients with neuro-motor disorders, such as stroke

Dr. S Vengadesan

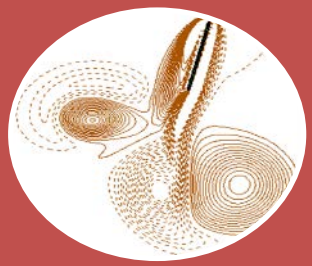
PhD, Kobe University, Japan

Professor, Applied Mechanics & Biomedical Engineering

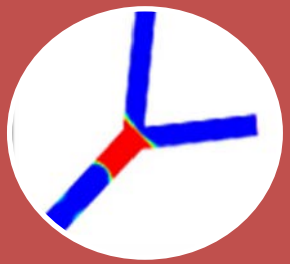
044-2257-4063; vengades@iitm.ac.in

http://apm.iitm.ac.in/fmlab/sv/index.html

- Insect Aerodynamics/ Aerodynamics of low flying insect under different operating condition
- Bubble transport in a micro channel/Investigation of a PFC bubble transport through a micro channel with bifurcation at different roll angle
- Bluffbody aerodynamics/characterisation of flow regime for elliptic cylinders



Pair of dipole formation at the end of upstroke



PFC bubble lodging at the bifurcation of a microchannel oriented at 45^0 roll angle

Identification of different flow regimes for flow past elliptic bodies

INDIVIDUAL FACULTY PROFILE

DEPARTMENT OF BIOTECHNOLOGY

LIST OF FACULTY

- Amal Kanti Bera
- Arumugam Rajavelu
- Athi Narayanan Naganathan
- Baskar R
- Chandraraj K
- Gopala Krishna Aradhyam
- Greeshma Thrivikraman
- Guhan Jayaraman
- Hamsa Priya Mohana Sundaram
- Himanshu Sinha
- Karthik Raman
- Kesavan V
- Krithika Ravi
- Madhulika Dixit
- Mahalingam S
- Manoj N
- Mamata Bhaskara Bangera
- Meiyappan Lakshmanan
- Michael Gromiha M
- Nathiya Muthalagu
- Ninitha Margret Julfiya
- Nirav Pravinbhai Bhatt
- Nitish Ranjan Mahapatra
- Rajamanickam Murugan
- Rayala Suresh Kumar
- Richa Karmakar
- Sanjib Senapati
- Santhosh Sethuramanujam
- Sathyanarayana Naidu G
- Shantanu Pradhan
- Smita Srivastava
- Subramaniam K
- Suraish Kumar G K
- Vani Janakiraman
- Vignesh Muthuvijayan

Dr. Amal Kanti Bera

PhD, University of Delhi, India

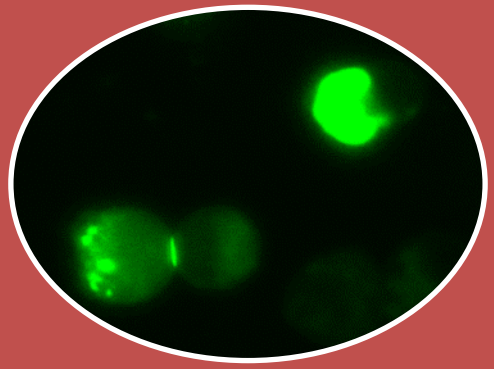
Professor, Biotechnology

044-2257-4121; amal@iitm.ac.in

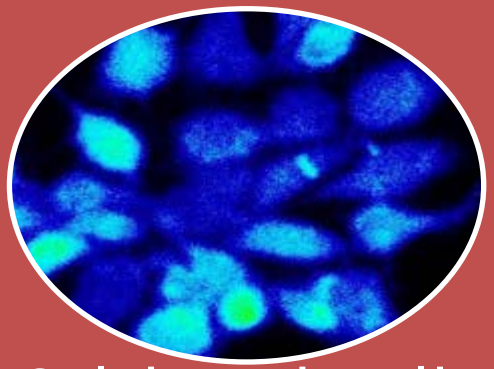
http://www.biotech.iitm.ac.in/faculty/amal

- Structure-function relationship of Ion Channels
- Regulation of Ion Channels
- Ion channels associated with Stroke and Heart attack

Patch clamp



Gap junction



Calcium signaling

Electrophysiology of Ion Channels

Dr Arumugam Rajavelu

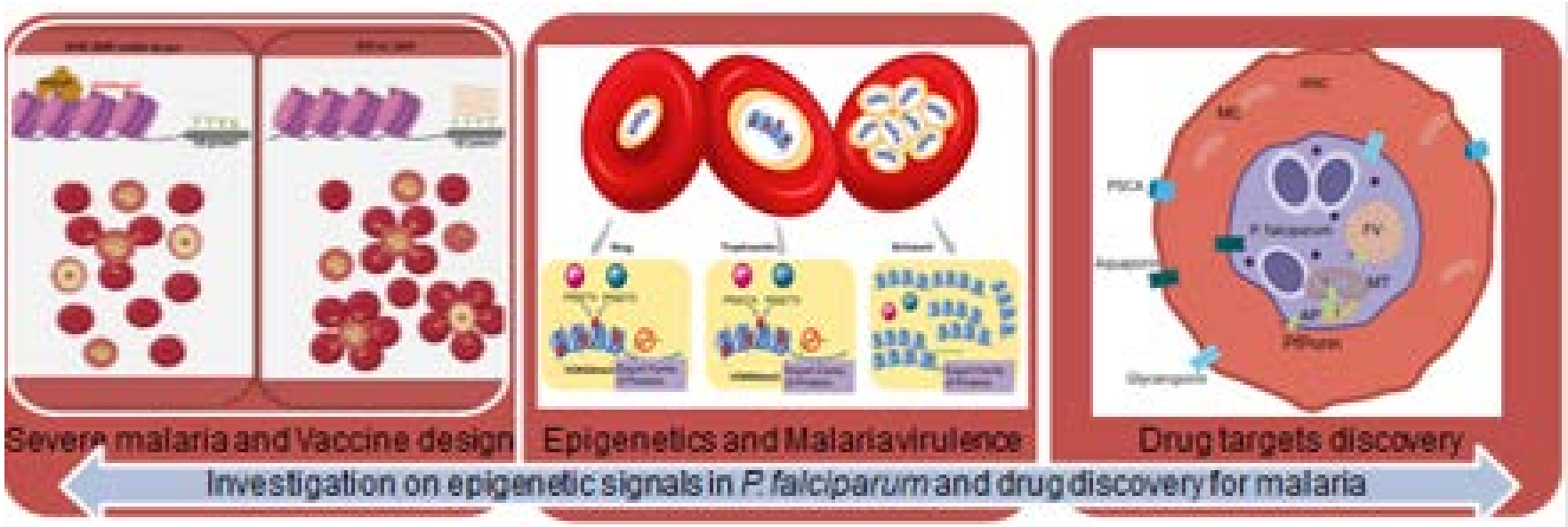
PhD, Jacobs University Germany

Associate Professor, Biotechnology

044-2257-4144; arumugam.rajavelu@iitm.ac.in

Major Areas of Research

- **Severe malaria and Vaccine Design**
- **Epigenetics and Malaria Virulence**
- **Drug targets discovery**



Dr. Athi N Naganathan

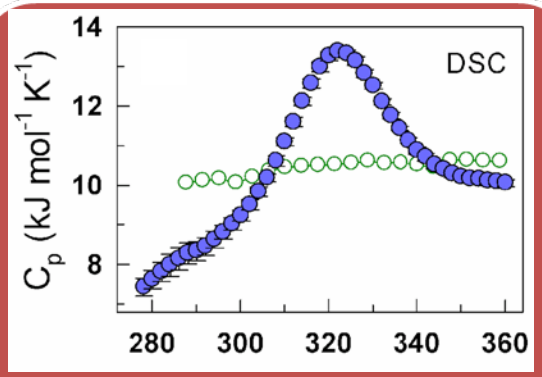
PhD, University of Maryland, USA

Professor, Biotechnology

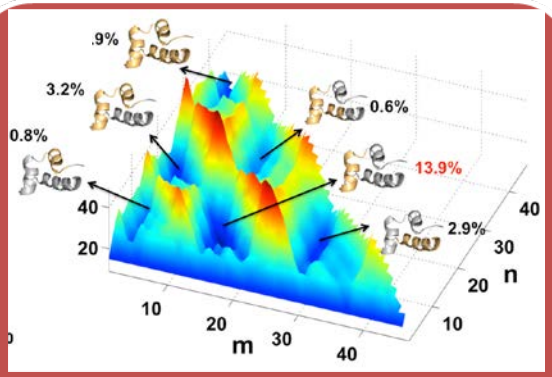
044-2257-4140; athi@iitm.ac.in

https://pbl.biotech.iitm.ac.in

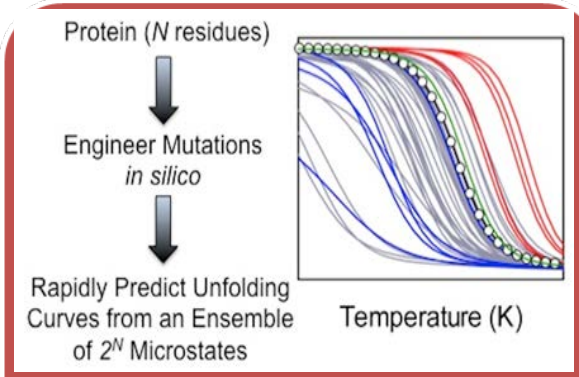
- Disorder-Folding-Function Determinants and Protein Evolution
- Modeling-Predicting Conformational Landscapes using Statistical Models
- Engineering Proteins, Allostery, and Phase Separation
- Designing Programmable Assemblies and Molecular Sensors



Equilibrium/Kinetics/Mutations



Folding-Function Landscapes



Protein Engineering & Design

Experimental-Computational Characterization of Protein Folding Landscapes

Dr. R Baskar

PhD, University of Maryland, USA

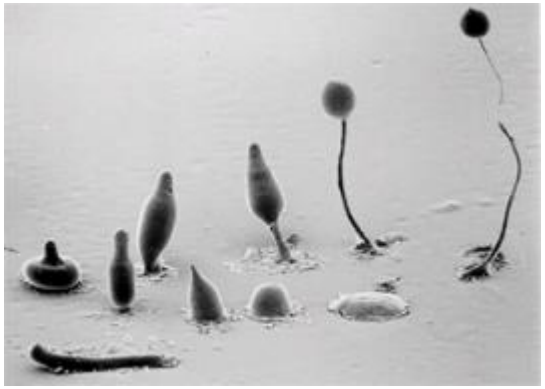
Professor, Biotechnology

044-2257-4110; baskar@iitm.ac.in

http://www.biotech.iitm.ac.in/Rbaskar

Major Areas of Research

- Pattern formation in cellular slime molds
- Estimating spontaneous mutation rates and meiotic recombination frequency during different biological events in flowering plants



***Dictyostelium* as a model to investigate:**

1. Mechanisms of caffeine action
2. Volatile mediated chemotaxis
3. Ageing

***Arabidopsis* as a model to investigate:**

1. Somatic mutation rates upon parental ageing, hybridization
2. Meiotic recombination rates

Dr. Chandraraj Krishnan

PhD, IIT Madras

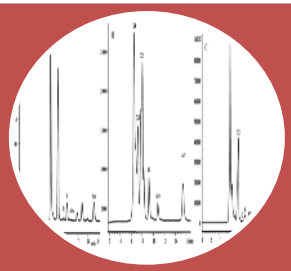
Professor, Biotechnology

044-2257-4111; kcraj@iitm.ac.in

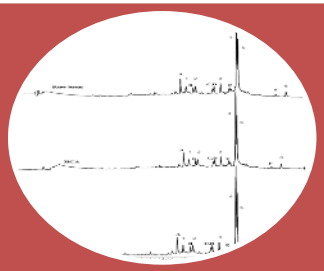
http://www.biotech.iitm.ac.in/faculty/kcr.php

- Biomass conversion/ Cellulosic bioethanol
- Functional Foods/ Oligosaccharides and phenolic acids
- Recombinant Enzymes/Amylases, Cellulases, Xylanases, Proteases

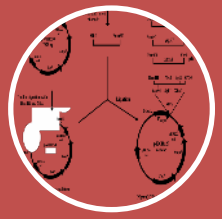
Cellulosic ethanol used as automobile fuels by blending with petrol



Functional oligosaccharides used as prebiotics in food products



Phenolic acids used as antioxidants in food formulations



Amylases, cellulases, xylanases, proteases applied in textile, bioethanol and leather industries

Conversion of Low Cost Agricultural Residues into Fuels and Chemicals

Dr. Gopala Krishna Aradhyam

PhD, NCL (CSIR). University of Pune, India

Professor, Biotechnology

044-2257-4112; agk@iitm.ac.in

http://www.biotech.iitm.ac.in/faculty/agk/home.html

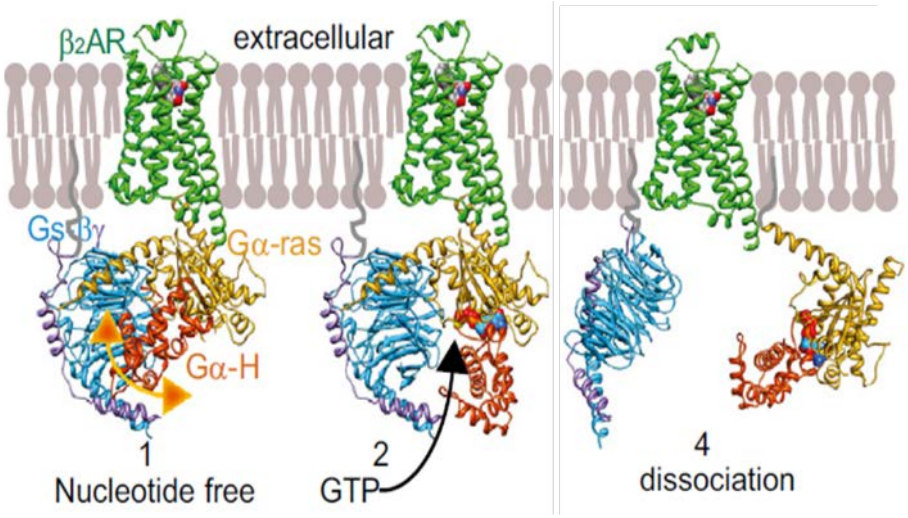
The Signal Transduction Lab

G Protein Coupled Receptors (GPCRs) **Ca^{2+}-binding proteins**

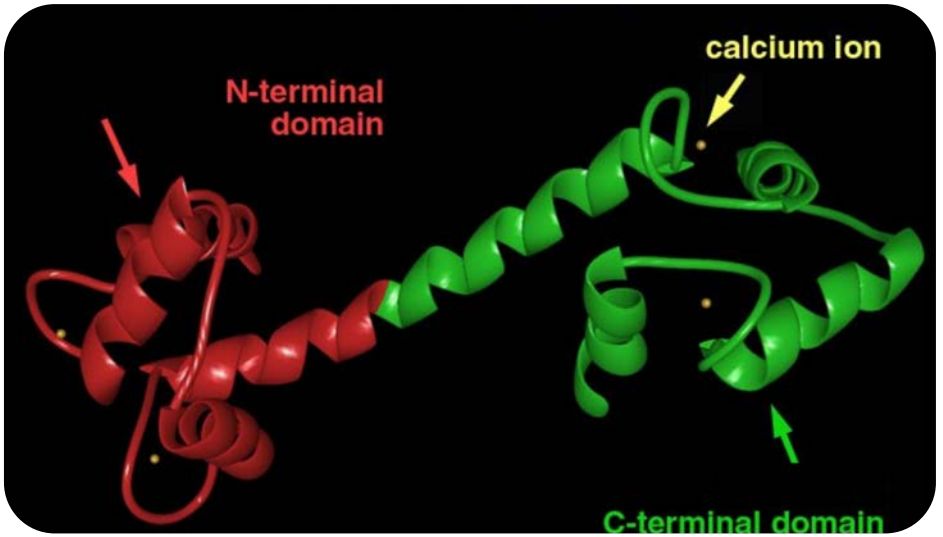
- The general focus of research in our lab is protein structure-function and biochemistry.
- Elucidating novel functions of proteins.

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

Signal Transduction by Membrane proteins



Signal Transduction by Ca^{2+}-binding proteins



Dr. Greeshma Thrivikraman

PhD, Indian Institute of Science Bangalore

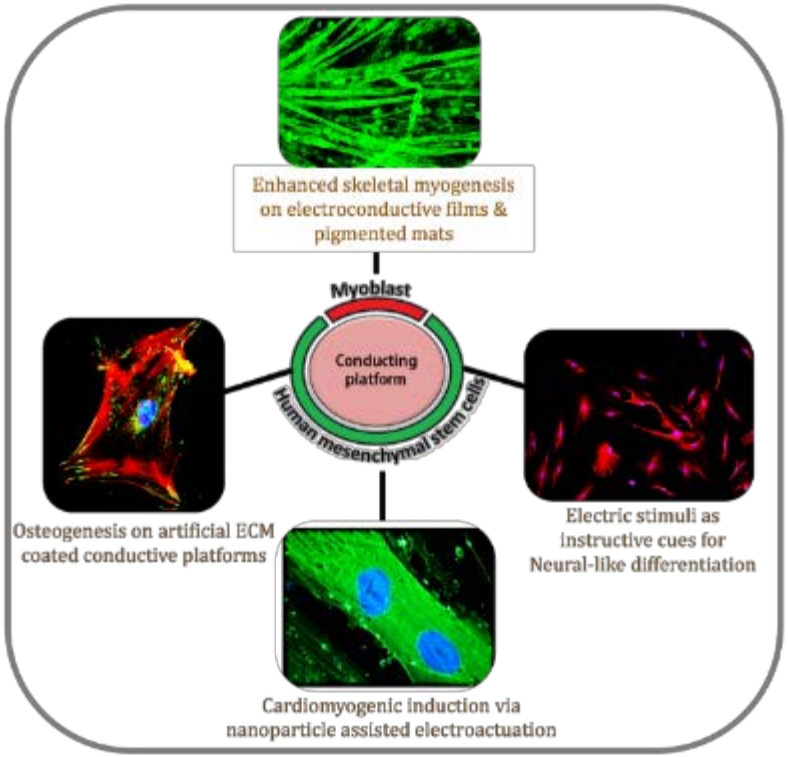
Assistant Professor, Biotechnology

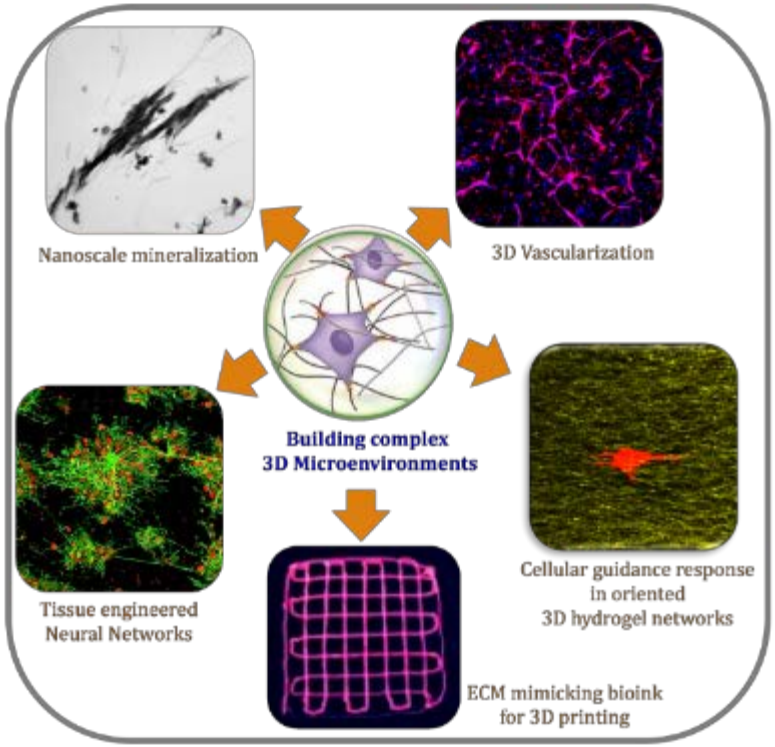
+91-8825581831; greeshma@iitm.ac.in

Stem cell based Regenerative Medicine

Engineered 3D tissue/organ equivalents

Extracellular Matrix manipulation for tissue morphogenesis &disease modeling





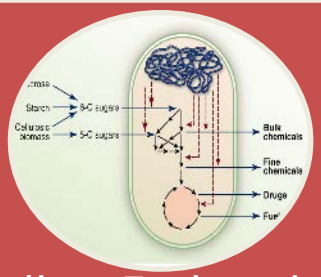
Dr. Guhan Jayaraman

PhD, Rensselaer Polytechnic Institute, USA

Professor, Biotechnology

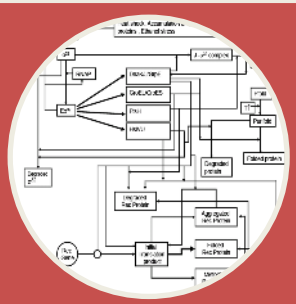
044-2257-4108; guhanj@iitm.ac.in

- Metabolic Engineering for Biopolymers and Biofuels production
- Bacterial Systems Biology – Analysis of Metabolic and Gene Regulatory Networks
- On-line Monitoring of Bioprocesses using Spectroscopic Techniques
- Process Chromatography for Protein Purification

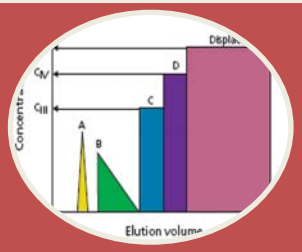


Metabolic Engineering of Lactic Acid Bacteria

High Molecular Weight Hyaluronan



Analysis of Bacterial Stress Response Networks



Displacement Chromatography

Simulated Moving Bed Chromatography

Dr. Hamsa Priya Mohana Sundaram

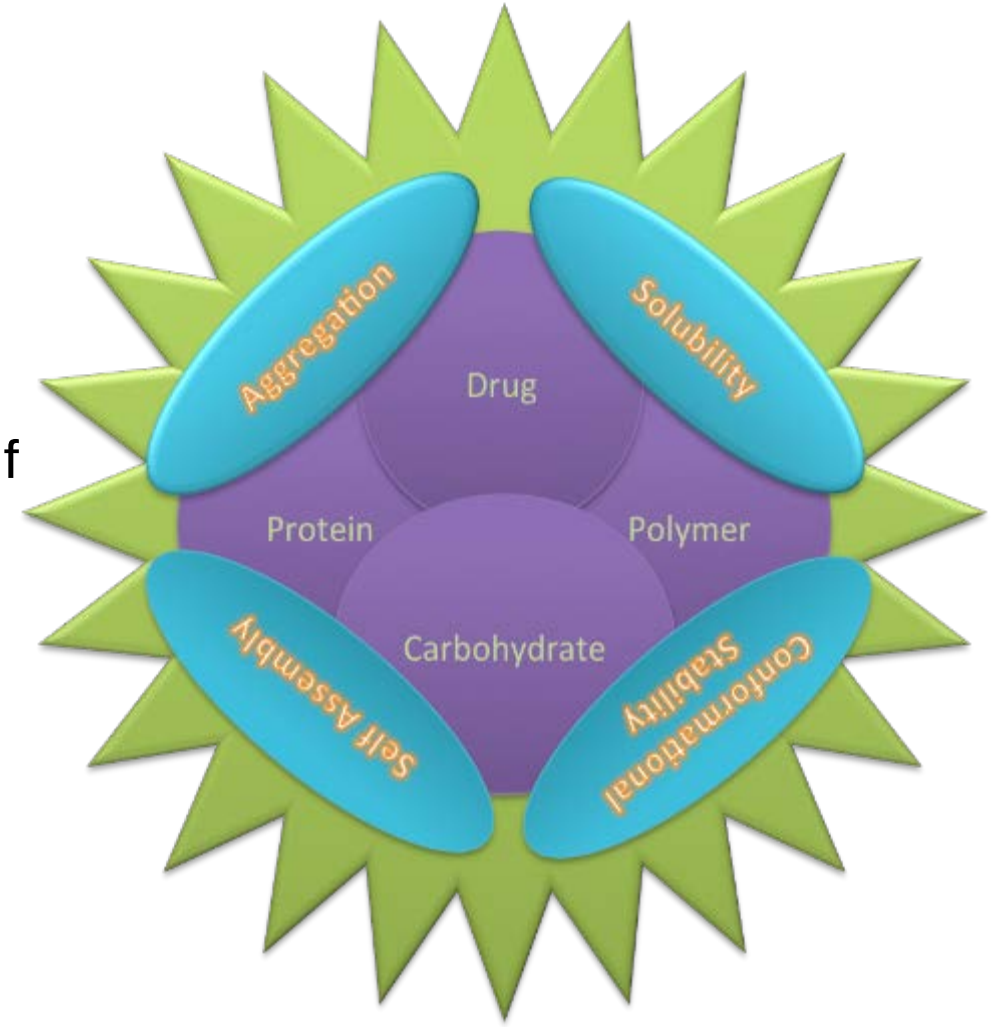
PhD, The Ohio State University, USA

Associate Professor, Biotechnology

044-2257-4132; hamsa@iitm.ac.in

Major Areas of Research

- ComputaNonal biophysics
- Protein aggregaNon
- Protein solubility and stability
- ComputaNonal characterizaNon of materials for therapeuNcs
- Self assembly of nano drug delivery carriers
- Drug-polymer conjugates
- Bio-molecular simulaNons
- MulN-scale modeling



Dr. Himanshu Sinha

PhD, Cambridge University, UK

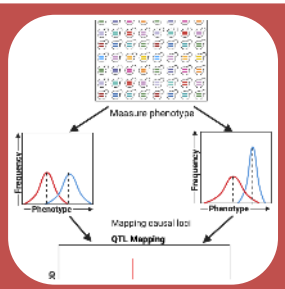
Professor, Biotechnology

044-2257-4120; sinha@iitm.ac.in

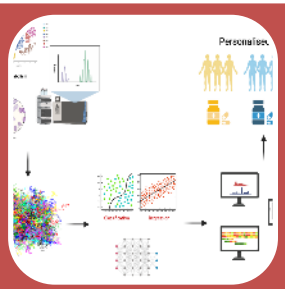
https://www.iitm.ac.in/sinha

- How the information flow from genotype to phenotype gets dynamically modulated by genetics, environment and evolution – using yeast model and human data
- Analyse complex relationships in clinical and genomics datasets to build models resulting in better clinical outcomes for improving public health

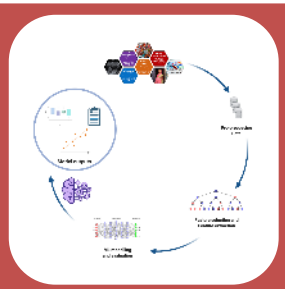
RBCDSAI IITM



Population and Natural Variation



Systems Medicine



Clinical Data Analytics

SYSTEMS GENETICS AND INDIGENOUS HEALTHCARE MODELS

Dr. V Kesavan

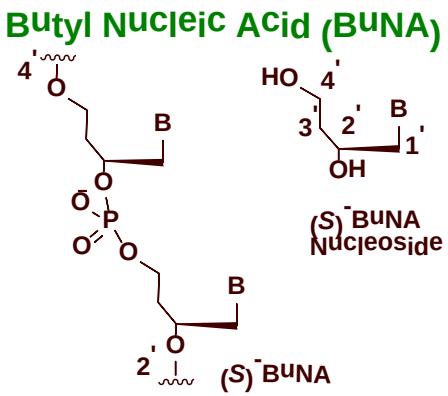
Ph.D, Indian Institute of Science

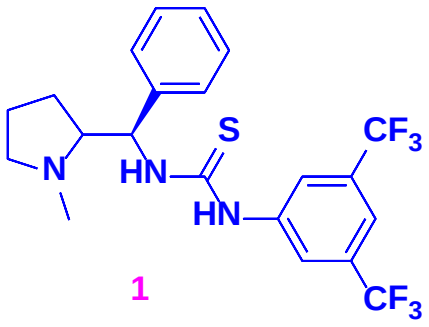
Professor, Biotechnology

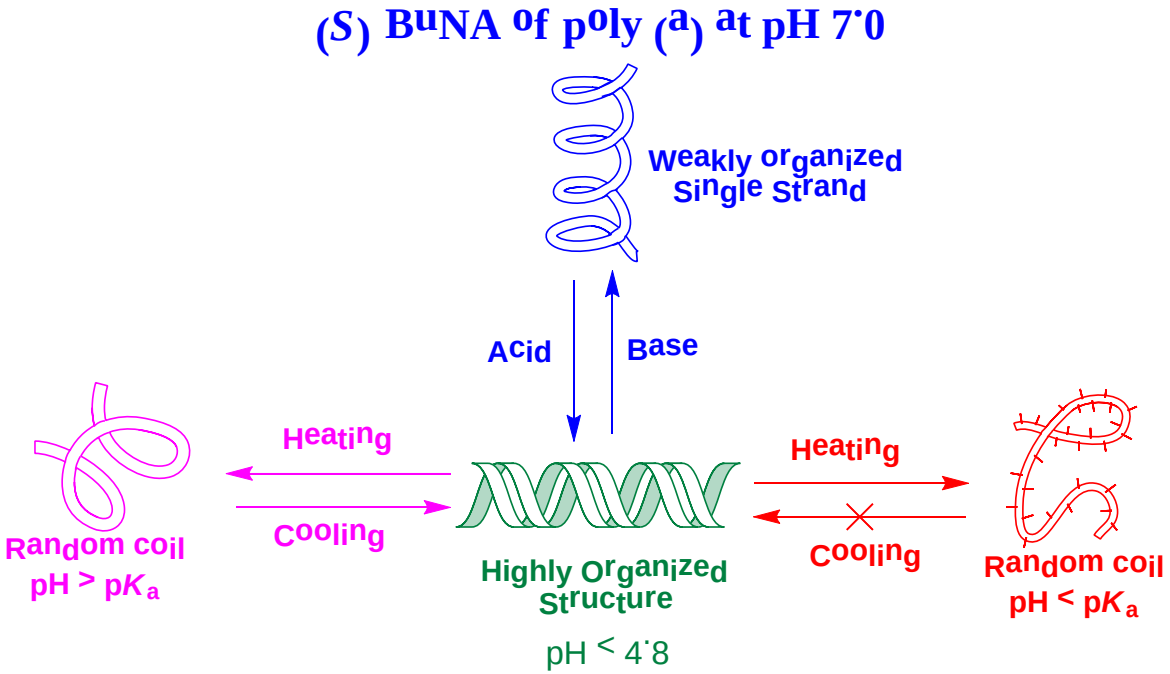
044-2257-4124; vkesavan@iitm.ac.in

http://www.biotech.iitm.ac.in/Kesavan

- Development of acyclic nucleic acid and molecular devices
- Development of organo catalysts from proline
- Exploration of covalent inhibition of cysteine kinases using NCEs







Vipin Kumar *et al*. *Org. Biomol. Chem.* **2013**, 000, and *RSC Adv.* **2013**

Thayagam *et al*. *Org. RSC Adv.* ***Under revision***

Dr. Krithika Ravi

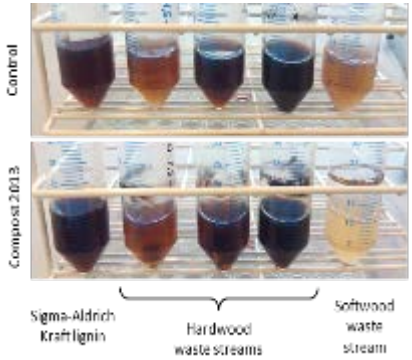
PhD, Lund University, Sweden

Assistant Professor, Biotechnology

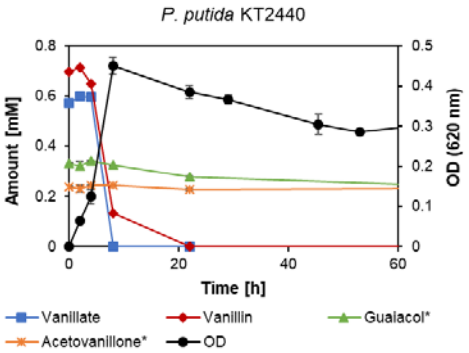
044 2257 4146, krithikaravi@iitm.ac.in

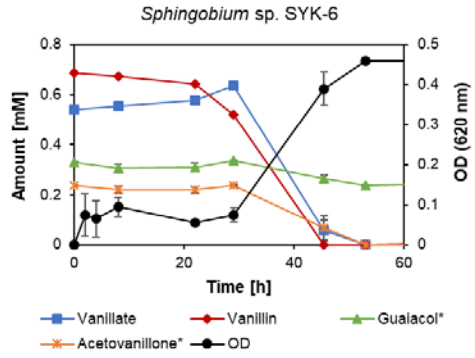
- Microbial conversion of lignin
- Bacterial aromatic metabolism
- Biomass utilization

Components of biomass

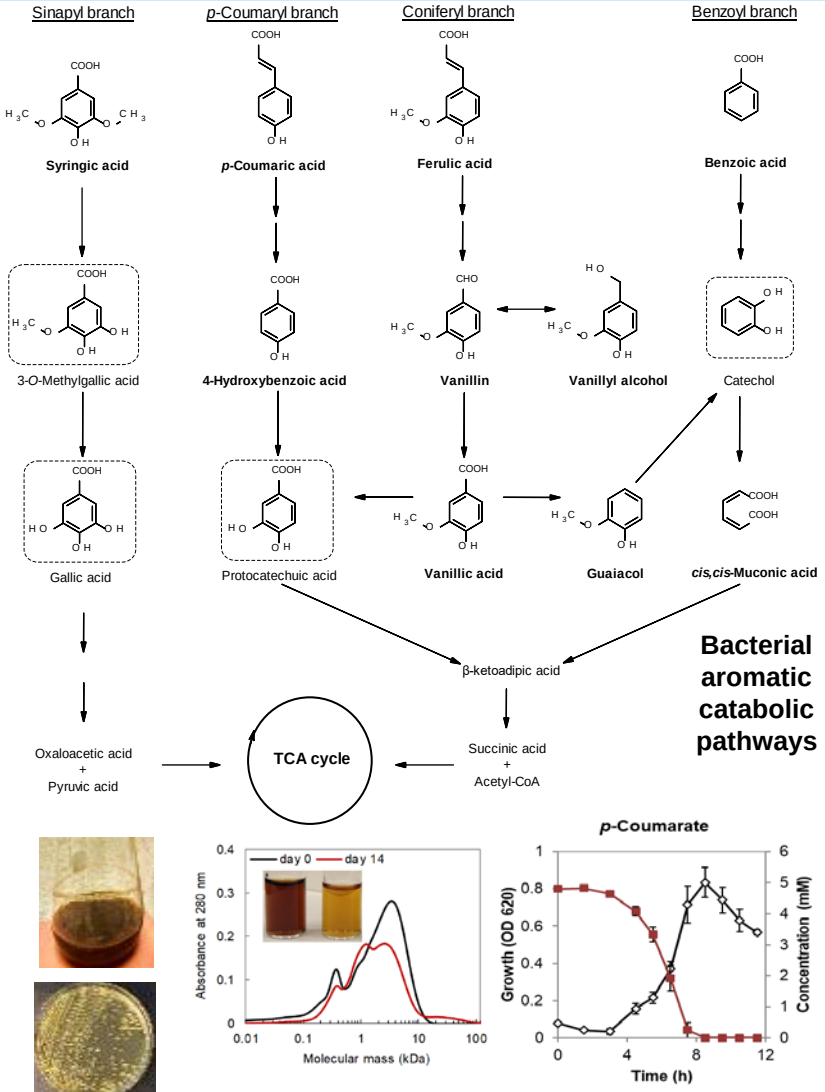


Screening and isolation of bacteria from lignin-rich environment





Growth of bacteria on depolymerized lignin



Bacterial aromatic catabolic pathways

Growth of *Pseudomonas* on lignin compounds

Dr. Madhulika Dixit

PhD, IIT Bombay, India

Professor, Biotechnology

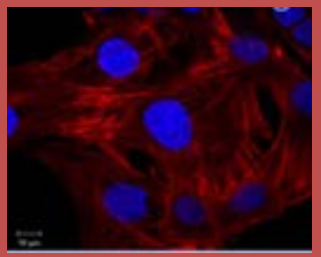
044-2257-4131; mdixit@iitm.ac.in

http://www.biotech.iitm.ac.in/faculty/mdixit/

- Endothelial Progenitors and Glucose Metabolism
- Endothelial Dysfunction and Shear Stress
- Atherosclerosis
- Research Area/Focus 3

Therapeutic Neo-vascularization

Functional Food



Vascular Grafts

Cardio-Vascular Dysfunction in Diabetes and Metabolic Syndrome

Dr. Mamata Bhaskara Bangera

PhD, Indian Institute of Science, India

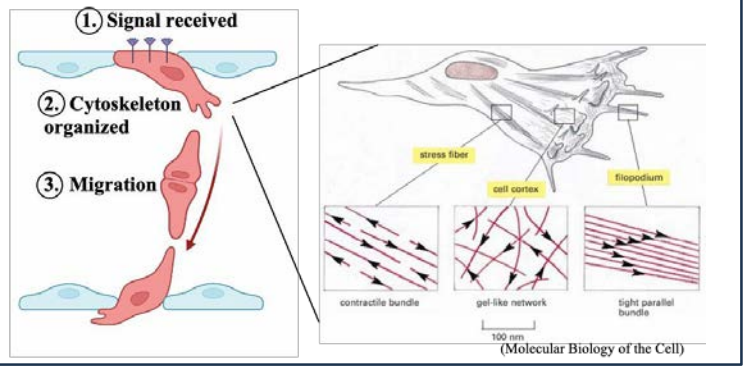
Assistant Professor, Biotechnology

044 2257 4106; m.bangera@iitm.ac.in

- Basis of cellular movement and growth
- Communication between environment and intracellular organisation
- Implications in wound healing and metastasis

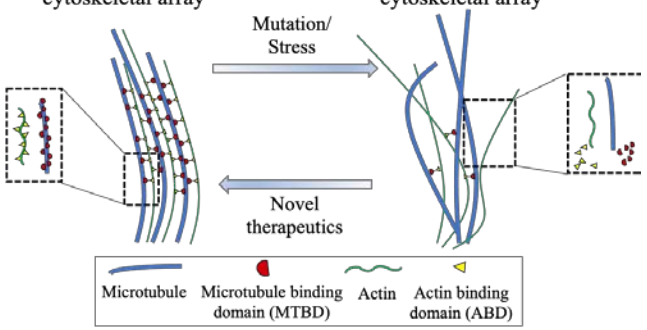
1.

How does a cell organize its framework for movement?



2.

What happens to cellular organization in disease?



Can we devise strategies to reverse the adverse effects?

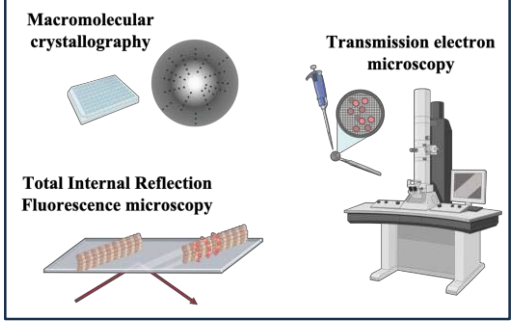
Short term goals : Characterization of proteins crosslinking filaments

Long term goals:

- Reconstitution of filament network *in vitro*
- Design of tissue-specific drugs

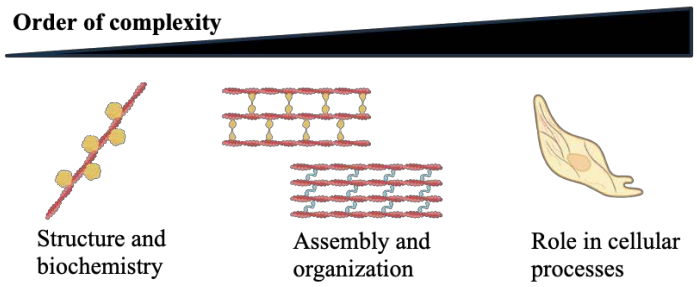
3.

Research expertise



Using a combination of approaches available at IIT M, I aim to address the above questions at different scales.

Advanced filament organization model



Dr. S Mahalingam

Professor, Biotechnology

044-2257-4130; mahalingam@iitm.ac.in

http://www.biotech.iitm.ac.in/Mahalingam

Tumor Biology

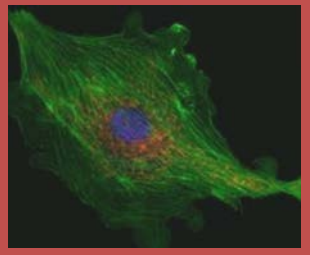
- Cross-talk between tumor suppresser genes and oncogenes
- Nucleolar GTPases and ribosome biogenesis
- Functional characterization of Ras effectors

Molecular pathogenesis of HIV

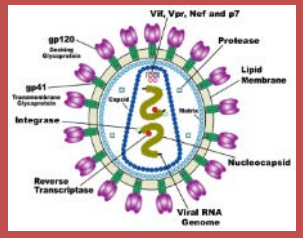
- Host-virus interaction, Neutralizing antibodies

Tumor Bio-Bank

Tumor Biology



Molecular pathogenesis of HIV



Laboratory of Molecular Cell Biology

Dr. **N Manoj**

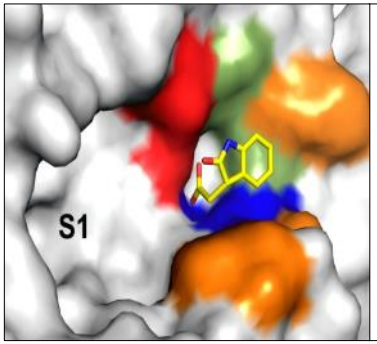
PhD, Indian Institute of Science

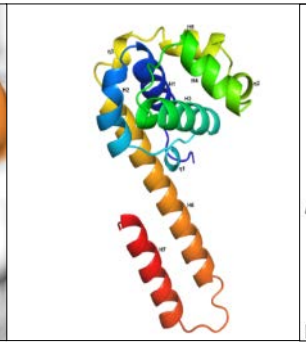
Professor, Biotechnology

nmanoj@iitm.ac.in

➢ Protein Structure and Function

Structural biochemistry of enzymes for biotechnology applications





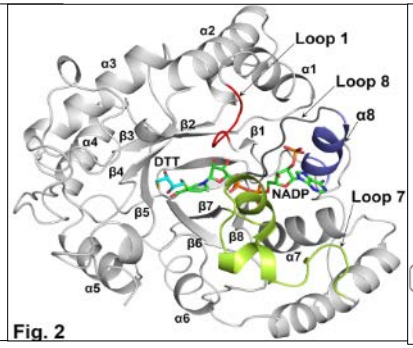


Fig. 2

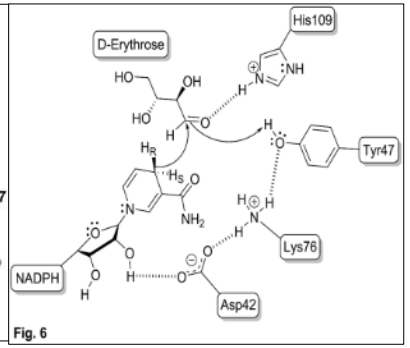
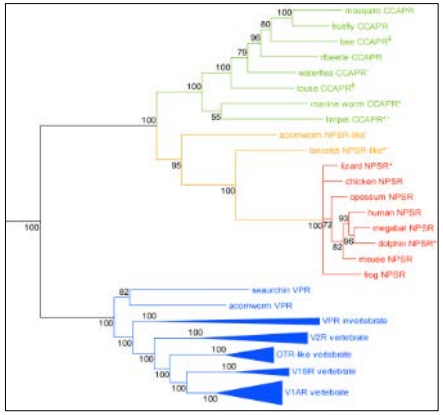
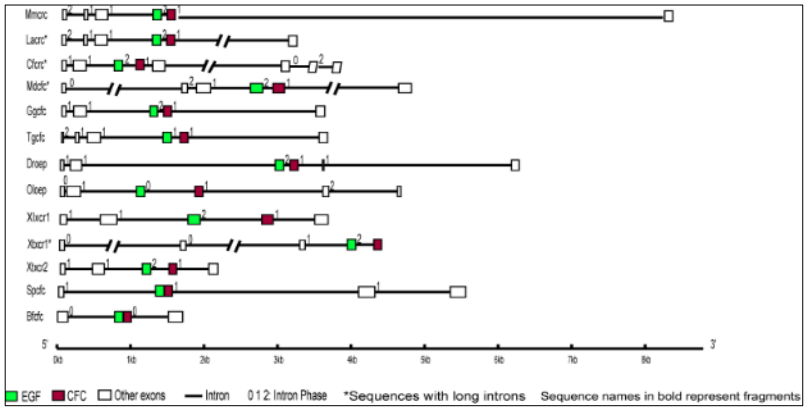


Fig. 6

➢ Molecular Evolution

Comparative genomics of membrane bound proteins





Dr. Meiyappan Lakshmanan
PhD, National University of Singapore
Assistant Professor, Biotechnology

meiyappan@iitm.ac.in; Lab website: https://sites.google.com/view/sbcelabiitm

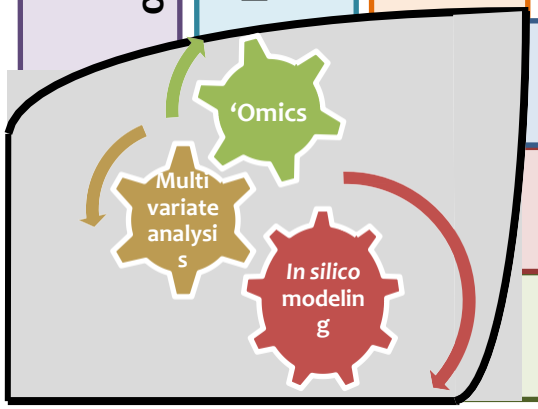
- Systematic process development for biopharmaceutical & cultivated meat manufacturing
- Data-driven cell line development for biopharmaceutical manufacturing
- Next-generation probiotics design through data-driven approaches
- Computational systems biology for clinical marker identifications
- Multi-omics data integration and constraint-based modelling algorithm development

Others: Cell therapy, cultured meat

Microbiota related human wellness

Biopharmaceutical manufacturing

Research areas overview

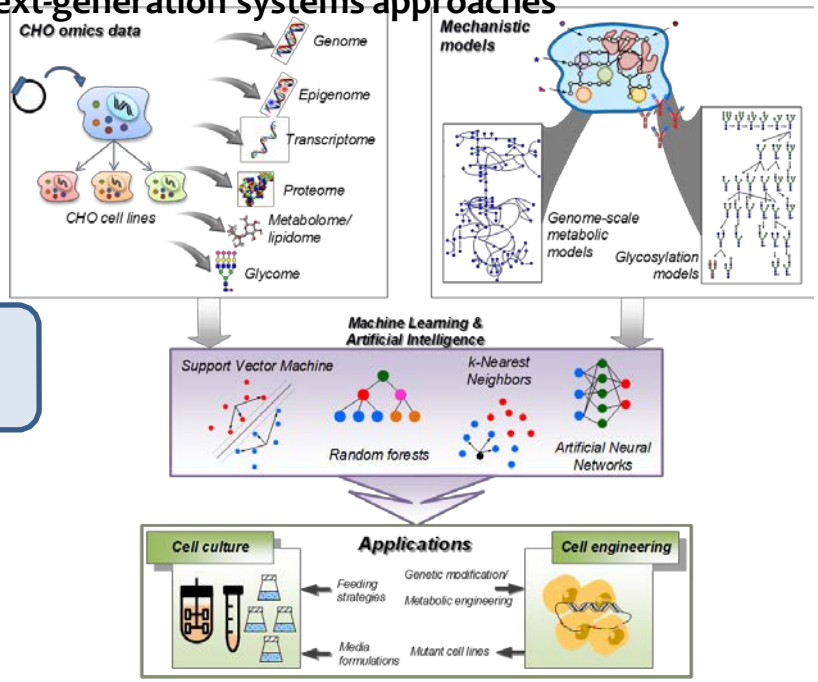


Mechanistic modeling of cellular processes

Multi-variate statistics /machine learning

Others: Genomics, regulatory networks

Advancing mammalian cell-based bioprocessing using next-generation systems approaches



Dr. M Michael Gromiha

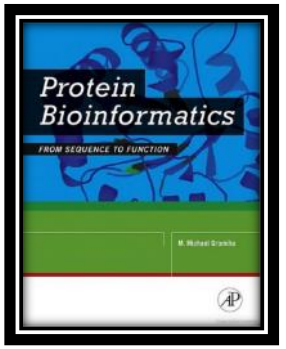
Professor, Biotechnology

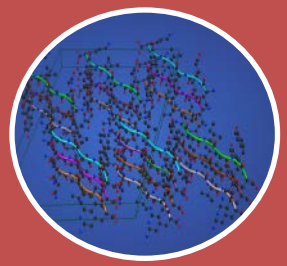
044-2257-4138; gromiha@iitm.ac.in

https://www.iitm.ac.in/bioinfo/Gromiha/

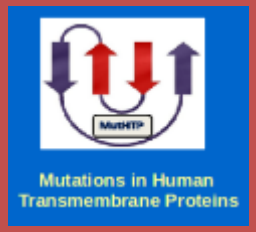
- Protein structure and function: binding affinity and aggregation rate
- Disease causing mutations in transmembrane proteins
- Deep learning and next generation sequence analysis: cancer, Alzheimer and Parkinson diseases

Protein Folding, Stability, Aggregation Interactions





1. Mutational effects on binding affinity of protein complexes.
2. Prediction of aggregation prone regions and aggregation rates



1. Disease causing mutations in membrane proteins
2. Sequence and structural parameters for membrane proteins
3. Developing databases and tools

1. Identify cancer mutations using deep learning
2. NGSanalysis: Neurodegenerative disorders
3. Structure based drug design

Structure-Function Relationship in Proteins and their Complexes: Applications to Drug Design

Dr. Nathiya Muthalagu

PhD, University of Glasgow, UK

Assistant Professor, Biotechnology

+91-8489123018; nathiya@iitm.ac.in

Area of Research

Cancer Biology

Sub-Domain

Pancreatic Cancer

Work Flow

Pancreatic neuroendocrine tumours (PNET)

New therapeutic target identification
(Model system: Mouse PNET cell line)

Candidate based approach
(Meta analysis of
PNET expression profile)

Unbiased synthetic lethal screening (Men1 KO PNET cells)

Target verification
Cell line derived Xenograft mouse model

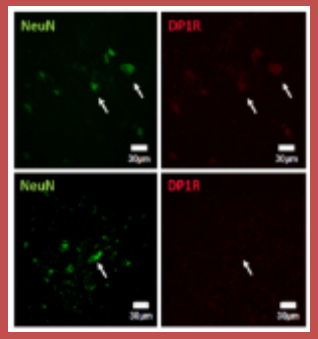
Dr. Ninitha AJ

PhD, Michigan State University, USA

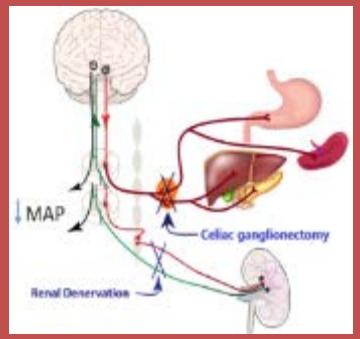
Assistant Professor, Biotechnology

044-2257-4135; ninitha@iitm.ac.in

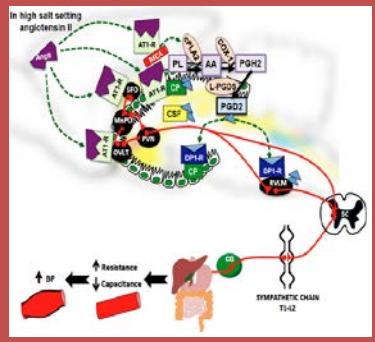
- Cardio metabolic diseases: novel pathways and drug discovery
- Peripheral neuromodulator for device development and therapy
- Role of PARPs in hypertension, diabetes, and heart failure



Cell Signaling



Peripheral neuromodulator



Long-term control of Blood pressure

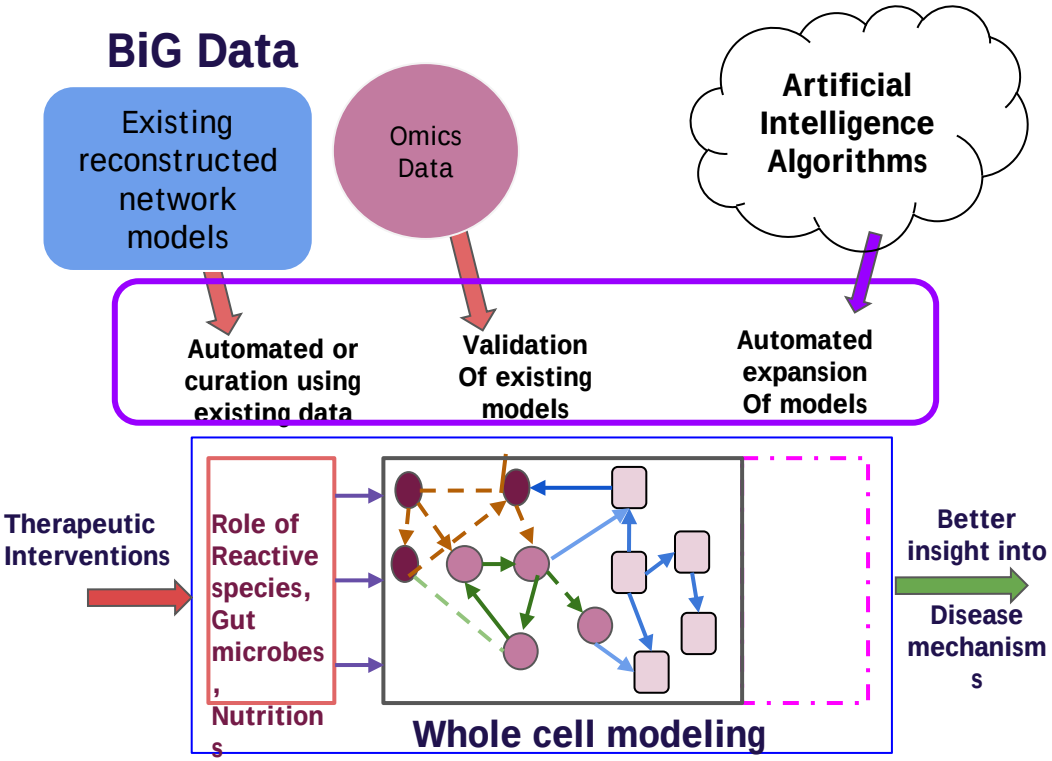
Neuromodulator and Cardio metabolic Research Lab

Dr. Nirav Pravinbhai Bhatt

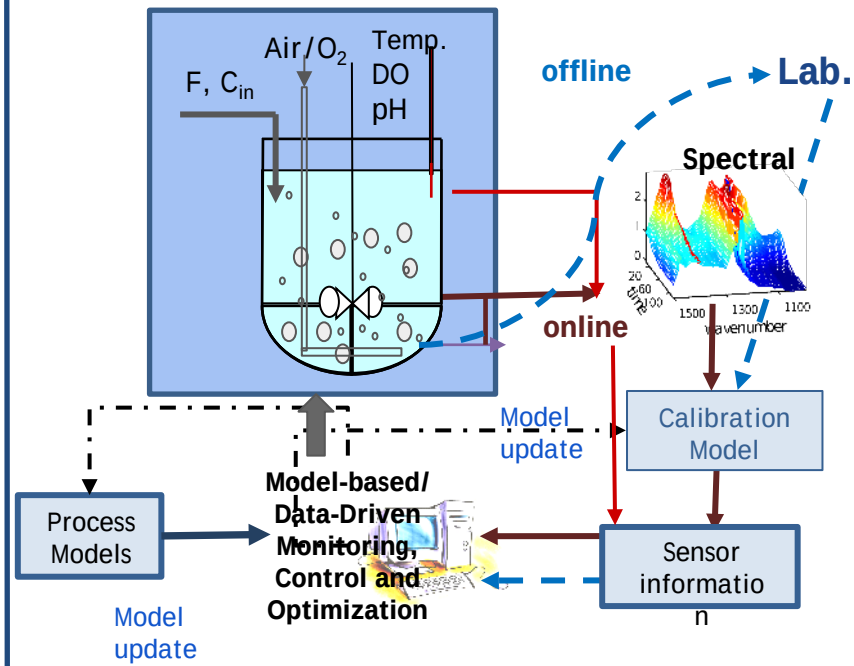
PhD, École polytechnique fédérale de Lausanne (EPFL), Switzerland
Associate Professor, Biotechnology
044-2257-4129; niravbhatt@iitm.ac.in

- **Process Analytical Controlled Technology for (Bio-)processes**
- **Physically Interpretable ML/AI for Biological and Engineering Applications**
- **Network Control and Learning Theory for Understanding Diseases and Therapeutics**

Therapeutic Strategies for Diseases



Process Analytical Controlled Technology



Dr. Nitish R Mahapatra

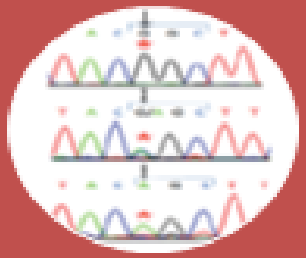
PhD, Indian Institute of Chemical Biology, Kolkata

Professor, Biotechnology

044-2257-4128; nmahapatra@iitm.ac.in

https://biotech.iitm.ac.in/faculty/nitish-r-mahapatra/

- Functional Genomics and Biomarker Discovery
- Transcriptional and Post-transcriptional Gene Regulation
- Molecular Medicine



Discovery of genetic variations

Structure-function analysis

Molecular signal transduction

MOLECULAR BASES OF CARDIOVASCULAR AND METABOLIC DISORDERS

Back to Top

Dr. Rajamanickam Murugan

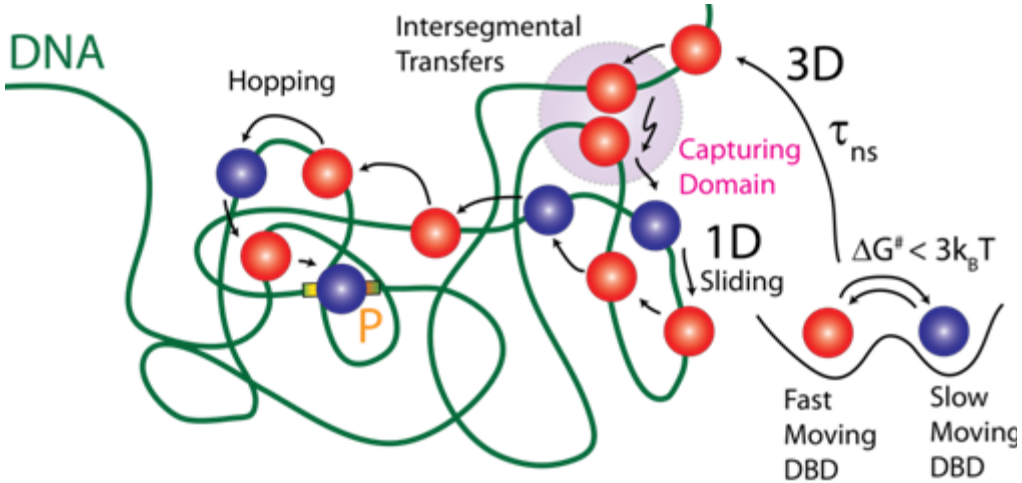
PhD, T.I.F.R Mumbai, India

Associate Professor, Biotechnology

044-2257-4116; rmurugan@iitm.ac.in

http://www.biotech.iitm.ac.in/Murugan

- Theoretical Biology and Biophysics
- Computational/Systems Biology
- Rate Processes in Biology



$$\tau_s = (N/L)\,(L^2/6x_d + \tau_{ns})$$

Understanding the dynamics of transcription factors helps to further our unravel the design principles connected with the existence of life.

Dr. Rayala Suresh Kumar

PhD, Cancer Institute, Chennai, INDIA

Professor, Biotechnology

044-2257-4137; rayala@iitm.ac.in

http://www.biotech.iitm.ac.in/Rayala_research

- Cancer Biology
- Small molecule inhibitors and drug resistance
- Indigenous antibodies for diagnostic applications

Cancer Biology

Drug resistance

Diagnostic antibodies

Aiming novel diagnostic and therapeutic reagents for Cancer

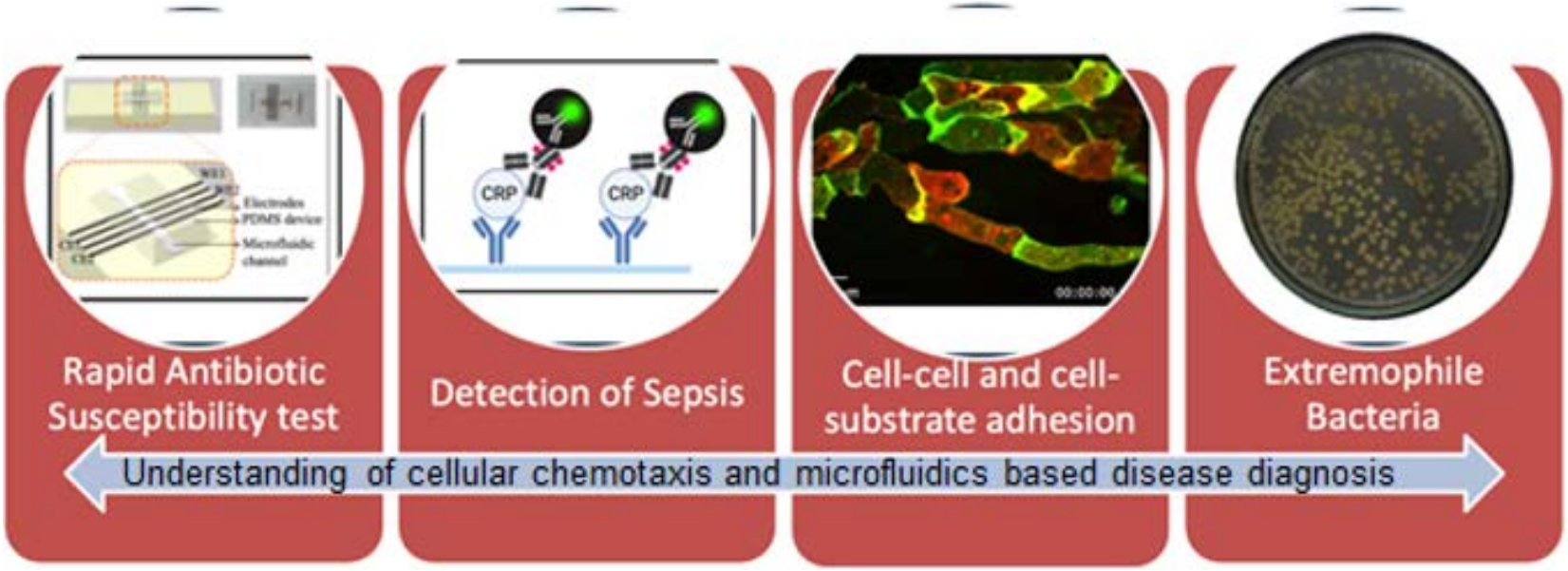
Dr. Richa Karmakar

PhD, Indian Institute of Technology Bombay

Assistant Professor, Biotechnology

044 2257-4145; rkarmakar@iitm.ac.in

- Development of microfluidic device for disease diagnosis
- The interplay of cell- cell and cell substrate adhesion in eukaryotic chemotaxis
- CO2 sequestration and molecular mechanisms of extremophile bacteria



Dr. Sanjib Senapati

PhD, IIT Kanpur, India

Professor, Biotechnology

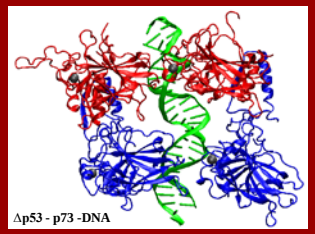
044-2257-4122; sanjibs@iitm.ac.in

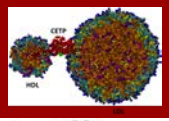
https://biotech.iitm.ac.in/Faculty/Sanjib_lab/index.html

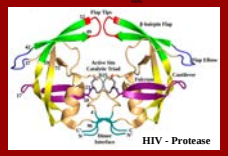
- Exploring Protein Dynamics and Mechanism through Advanced Computer Simulations and *In-vitro* assay for Innovative Drug Discovery
- Harnessing Ionic Liquids in Biomolecular Preservation, Drug Reformulation, and Biomaterials design
- Protein Folding and enhanced sampling with Quantum Computing

Mechanistic Insights into Protein-drug interactions

- HIV Protease - AIDS
- CETP – Cardiovascular Diseases
- TCR-MHC Complex - Immune response
- p53 - Cancer

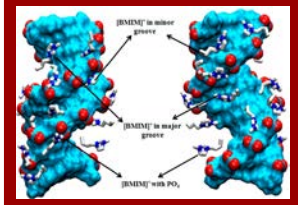


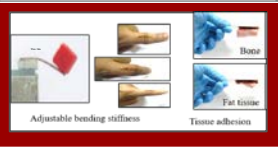




Multi tasking with Ionic Liquids

- DNA/RNA Storage at Room Temperature
- Reformulation of APIs for Improved Solubility and Rapid Onset of Action
- Bio-Ionic Liquid Based Thin Films for Therapeutic Applications

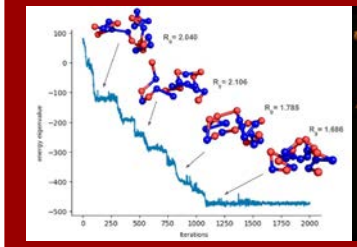


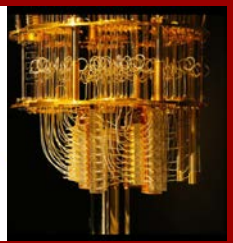


Protein structure prediction using quantum computers

Develop quantum algorithm for enhanced sampling

Solving protein folding in quantum computers





Dr. Santhosh Sethuramanujam

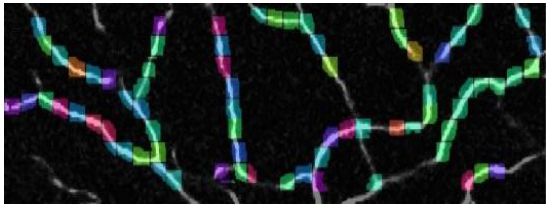
PhD, State University of New York at Buffalo, USA

Assistant Professor, Biotechnology

santhoshs@iitm.ac.in

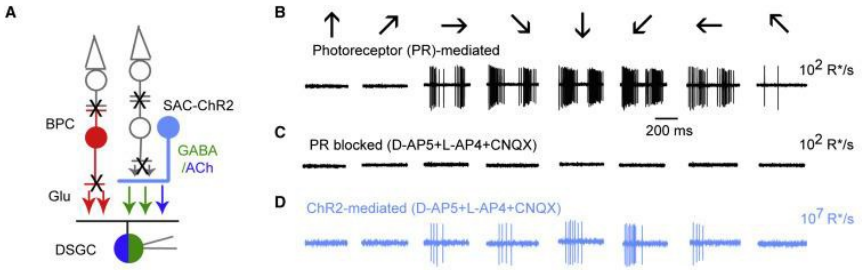
- Vision, Neuronal circuits, dendritic computations, synaptic transmission
- Neuropeptides
- Neuronal degeneration and Vision restoration strategies

Dendritic computations



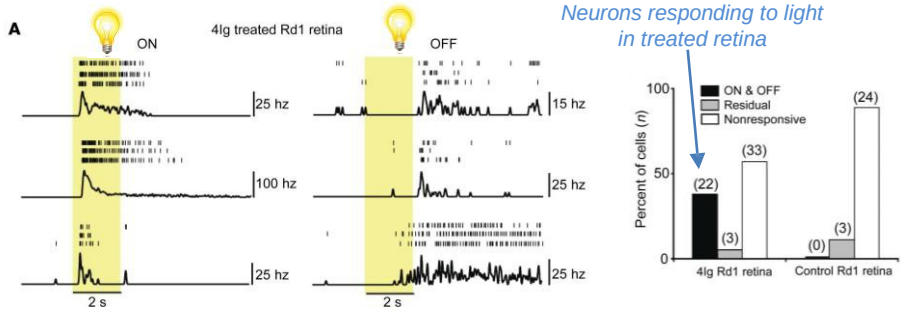
Monitoring dendritic activity with calcium indicators reveal that each dendritic segment performs a distinct computation (shown by differences in color).

Neuronal circuit function



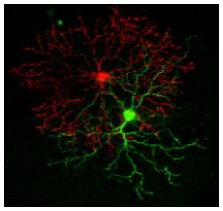
Direction selective mechanisms probed using optogenetic and knockout strategies

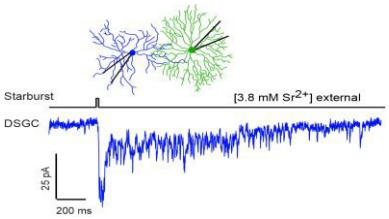
Vision Restoration



Light evoked spike activity of retinal neurons is restored upon treatment with peptides

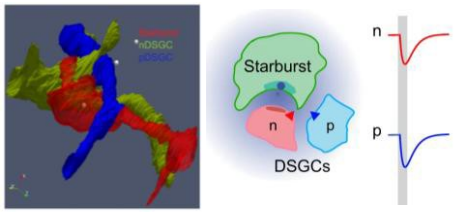
Neuronal connectivity





Employ anatomical and physiological methods to determine connectivity between two neurons

Multi-directed neurotransmission



New mode of neuronal communication, where one synaptic vesicle triggers activity in multiple downstream neurons

Dr. Sathyanarayana N Gummadi

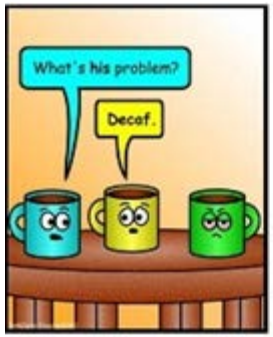
PhD. IIT Madras, INDIA

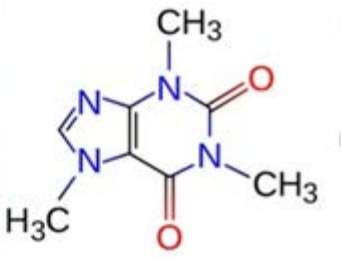
Professor, Biotechnology

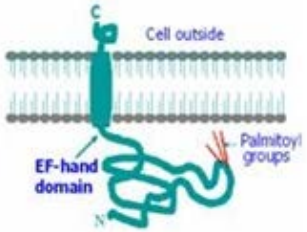
044-2257-4114; gummadi@iitm.ac.in

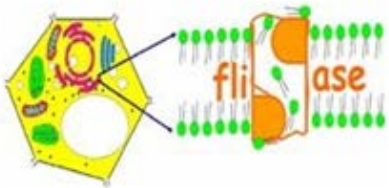
http://www.biotech.iitm.ac.in/faculty/sng/index.html

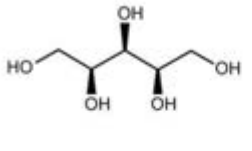
- Microbial and Enzymatic Process for Caffeine Degradation
- Bioprocess Development for Production of Biopolymers, Xylitol, Enzymes
- Biochemistry of Flippases and Scramblases

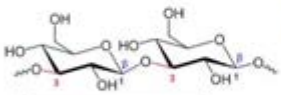












Fundamental biosciences to industrial applications

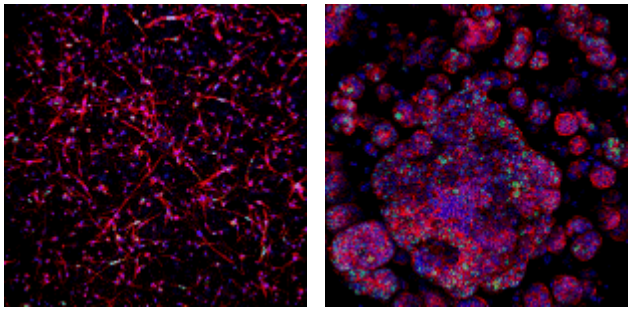
Dr. Shantanu Pradhan

PhD, Auburn University, USA

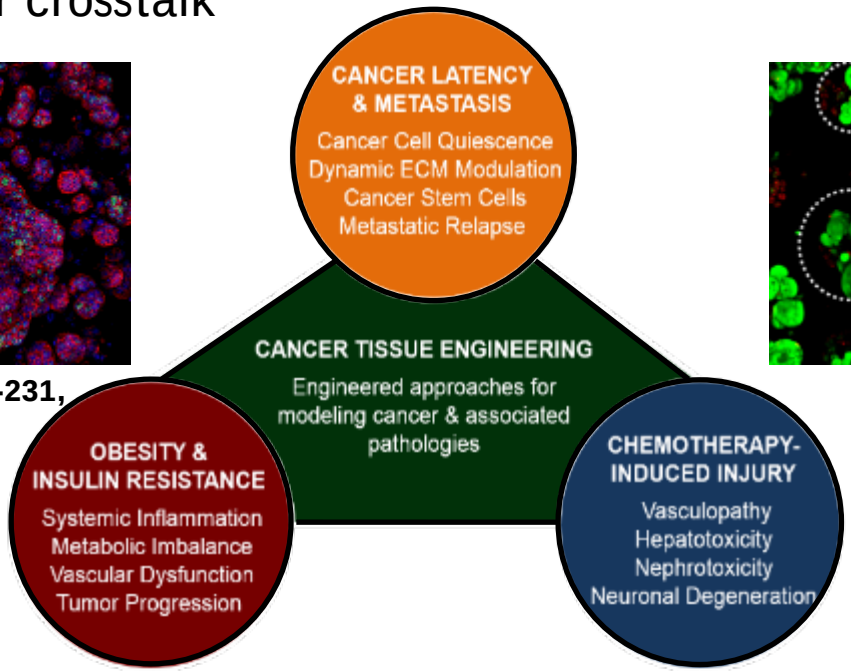
Assistant Professor, Biotechnology

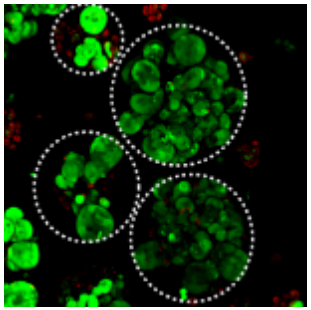
+9193303513448; spradhan@iitm.ac.in

- Biomaterials: Natural and synthetic hydrogels for mammalian cell culture and in vitro disease modeling
- Cancer: Mechanisms of tumorigenesis, metastasis and tumor dormancy
- Microfluidics: In vitro models of vascularized tissue microenvironments for drug delivery and cellular crosstalk

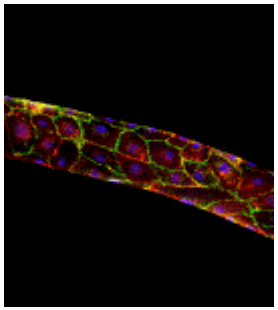


Breast cancer cells (left: MDA-MB-231, metastatic and right: MCF7, non-metastatic) cultured within PEG-fibrinogen hydrogels





Cancer cells encapsulated in hydrogel microspheres



Endothelial cells in microfluidic channels

Dr. Smita Srivastava

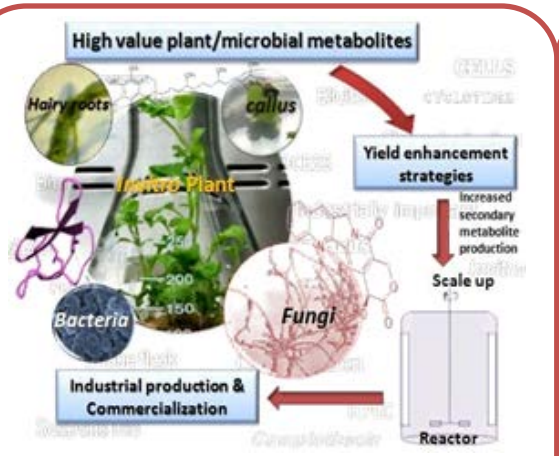
PhD, IIT DELHI, INDIA

Professor, Biotechnology

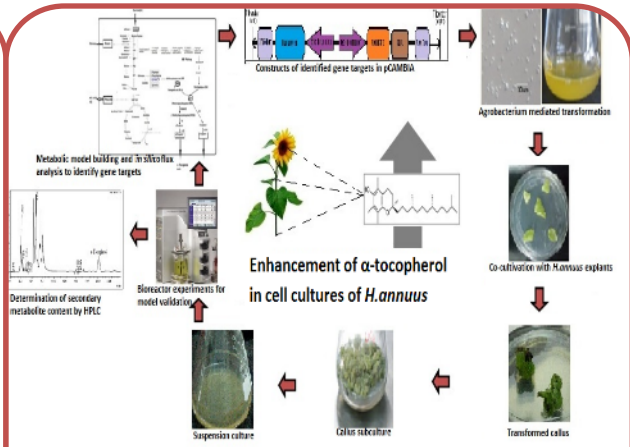
044-2257-4127; smita@iitm.ac.in

http://www.biotech.iitm.ac.in/faculty/smita/

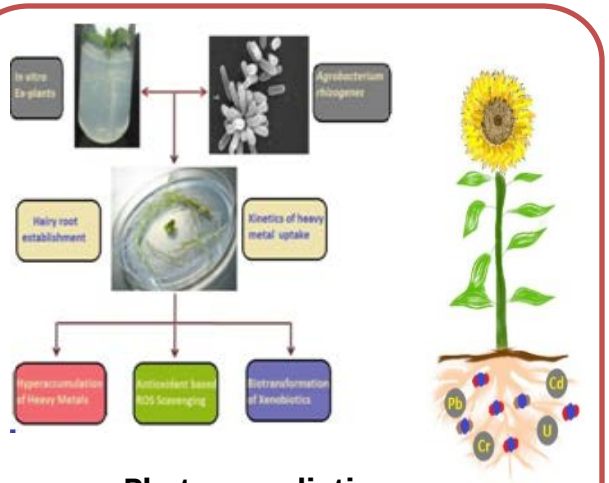
- Plant cell technology
- Microbial technology



***In vitro* production of high value plant/microbial metabolites**



Plant Metabolic engineering



Phytoremediation

Applied/Industrial Biotechnology

Dr. K Subramaniam

PhD, Indian Institute of Science

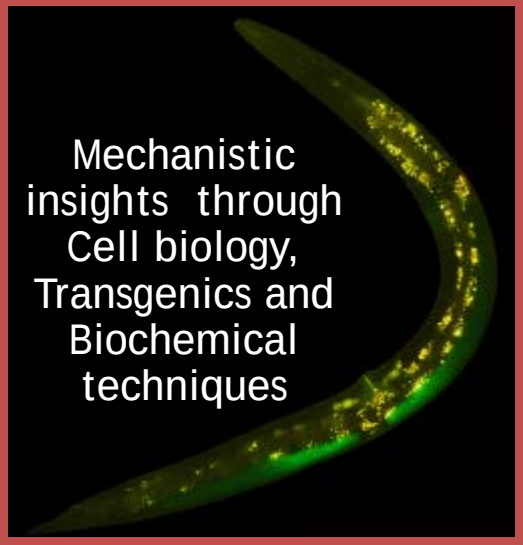
Professor, Biotechnology

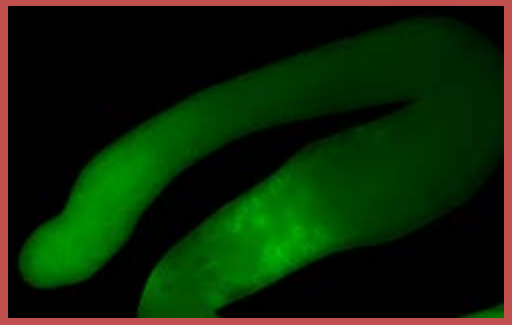
044-2257-4119; subbu@iitm.ac.in

Major Areas of Research

- Control of self-renewal and differentiation decisions in adult stem cells
- Developmental biology of germ cells
- Translational control of germ cell decisions

Forward and reverse genetic approaches using the free-living nematode *Caenorhabditis elegans* as a model organism





PUF proteins and translational control of gene expression in the germ line

Dr. G. K. Suraishkumar

Ph.D., Drexel University, Philadelphia, USA

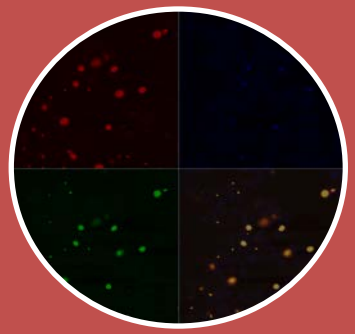
Professor, Dept. of Biotechnology

044-2257-4105; gk@iitm.ac.in

https://biotech.iitm.ac.in/faculty/g-k-suraishkumar/

- Improved reactive species (RS)-based bioprocess strategies under microgravity in space
- Improved treatment strategy through RS phenomena
- Interesting cell phenomena (RS-based)

Bioprocess improvements especially in space (microgravity)



Interesting cell phenomena (RS-based)

Improved treatment

Quantitative Understanding and Manipulation of Biological Systems (RS-based)

Dr. Vani Janakiraman

PhD, UPMC, Paris, France

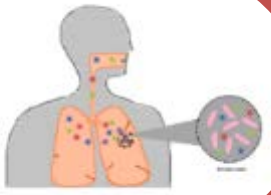
Associate Professor, Biotechnology

044-2257-4141; vani@iitm.ac.in

https://biotech.iitm.ac.in/research/faculty/vani-janakiraman/

Major areas of research

- Understanding immune evasion and delineating factors that tilt the inflammatory balance
- Understanding the role of novel immune receptors and pleiotropic cytokines in modulating immune responses
- Understanding bacterial communication



Immune evasion

Immune receptors/cytokines

Bacterial communication

Understanding host-pathogen interaction in tuberculosis - The immunological aspects

Dr. Vignesh Muthuvijayan

PhD, Oklahoma State University, USA

Professor, Biotechnology

044-2257-4123; vigneshm@iitm.ac.in

https://biotech.iitm.ac.in/faculty/vignesh-muthuvijayan/

- Tissue engineering and regenerative medicine
- Controlled drug delivery
- Surface engineering of polymeric implants

INDIVIDUAL FACULTY PROFILE

DEPARTMENT OF CHEMICAL ENGINEERING

LIST OF FACULTY

- Abhijit P. Deshpande
- Abhinav Sankara Raman
- Aravind Kumar Chandiran
- Basavaraja Madivala Gurapa
- Ethayaraja Mani
- Himanshu Goyal
- Jitendra Shital Sangwai
- Jithin John Varghese
- Kannan A
- Khushboo Suman
- Niket S Kaisare
- Nitin Muralidharan
- Parul Verma
- Preeti Aghalayam
- Pushpavanam S
- Raghunathan Rengasamy
- Raghuram Chetty
- Rajagopalan Srinivasan
- Rajnish Kumar
- Ramanathan S
- Ramnarayanan R
- Rashmi Prava Mohanty
- Ravi R
- Ravi Krishna R
- Renganathan T
- Sagar Sourav
- Sankha Karmakar
- Sreenivas Jayanti
- Sumesh P Thampi
- Susy Varughese
- Swapna Singha Rabha
- Tanmay Basak
- Tarak Kumar Patra
- Upendra Natarajan
- Vinu R

Dr. Abhijit P Deshpande

Professor, Chemical Engineering

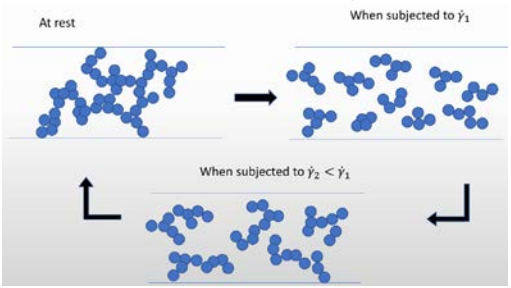
044-2257-4169; abhijit@iitm.ac.in

http://www.iitm.ac.in/~abhijit

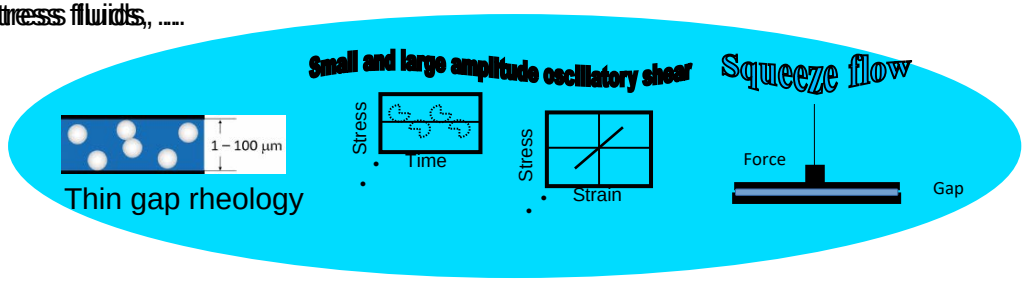
Polymeric systems: aggregation, gelation, rheology

Applications: Electrolyte, Electroactive devices, Biomaterials, Rheological modifiers, ...

Microstructure in filled melt system



Rheological fingerprinting of hydrogels, supramolecular gels, waxy gels, thixotropic // yield stress fluids, ...



Recent publications

- K Bhaskaran, P Saveri, AP Deshpande, S Varughese, Role of microstructure of cellulosic mucilage in seed anchorage: A mechanical interpretation of antitelechory in plants, Plant and Soil, 1-16, 2025
- R Miriyala, AP Deshpande, P Ravindran, Rheology of thixotropic food systems: mayonnaise, Journal of Food Engineering, 2025
- Meghana Mekala, Jan Vermant, Madivala G. Basavaraj, Abhijit P. Deshpande, Influence of Particle Surface Charge and Shape on the Rheology and Microstructure of Worm-like Micellar Solutions, Langmuir, 2025
- S Lalitha, V Srivastava, LE Schmidt, AP Deshpande, S Varughese, Multiscale Approach to Studying Biomolecular Interactions in Cellulose–Casein Adhesion, Langmuir 38 (49), 15077-15087, 2022
- J John, D Ray, VK Aswal, AP Deshpande, S Varughese, Pectin self-assembly and its disruption by water: insights into plant cell wall mechanics, Physical Chemistry Chemical Physics 24 (37), 22691-22698, 2022
- M Hisham, GS Kumar, AP Deshpande, Process optimization and optimal tolerancing to improve dimensional accuracy of vat-photopolymerized functionally graded hydrogels, Results in Engineering 14, 100442, 2022

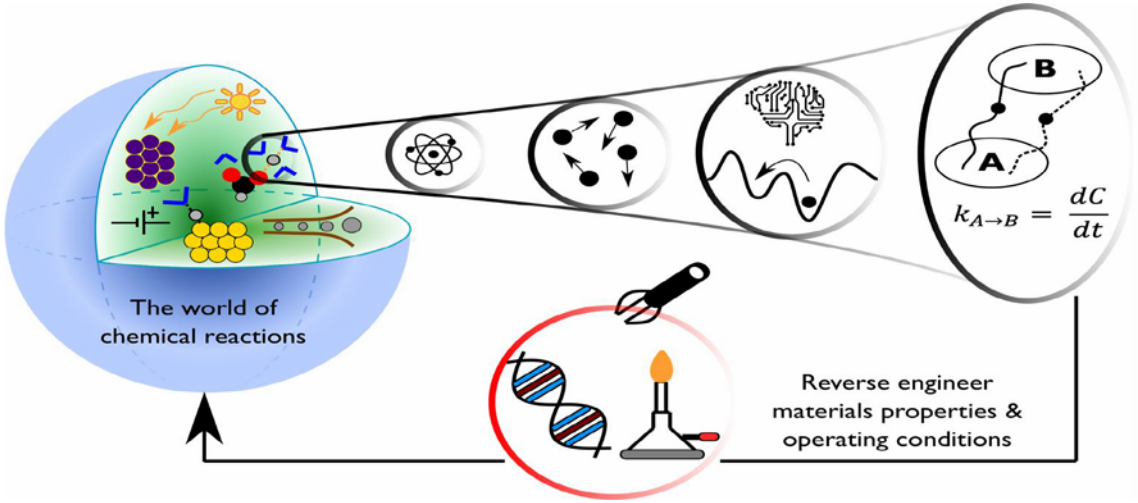
Dr. Abhinav S. Raman

PhD, University of Pennsylvania, USA

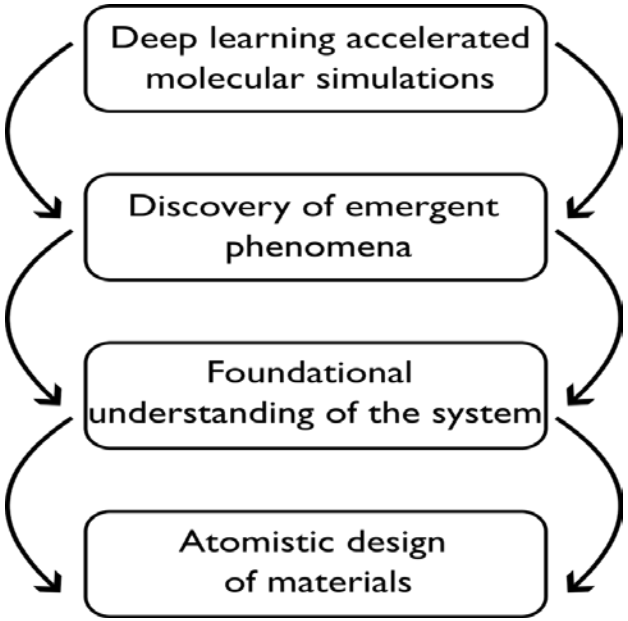
Assistant Professor, Chemical Engineering

044-2257-4150; asraman@iitm.ac.in

- Machine learning enabled physical chemistry
- Catalysis, Surface and Interface science
- Decarbonization and Sustainability



Multiscale modeling of reactive systems



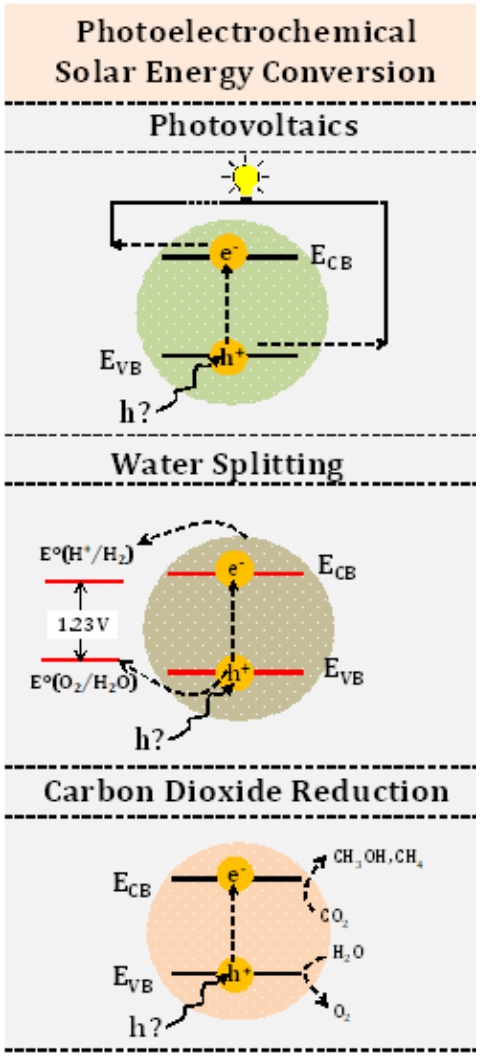
Dr. Aravind Kumar Chandiran

PhD, Gratzel's Group, Swiss Federal Institute of Technology

Associate Professor, Chemical Engineering

+91 80563 80100; aravindkumar@iitm.ac.in

http://scholar.google.com/citations?user=D18I3fcAAAAJ



Dr. Basavaraj M Gurappa

PhD, KU Leuven, Belgium

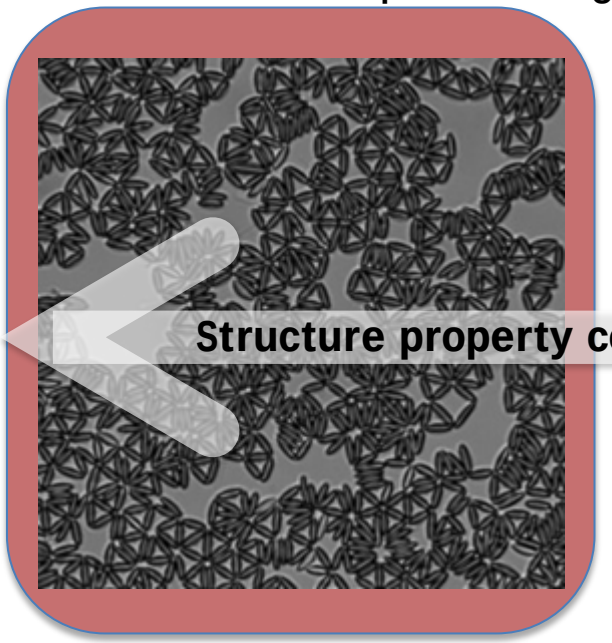
Professor, Chemical Engineering

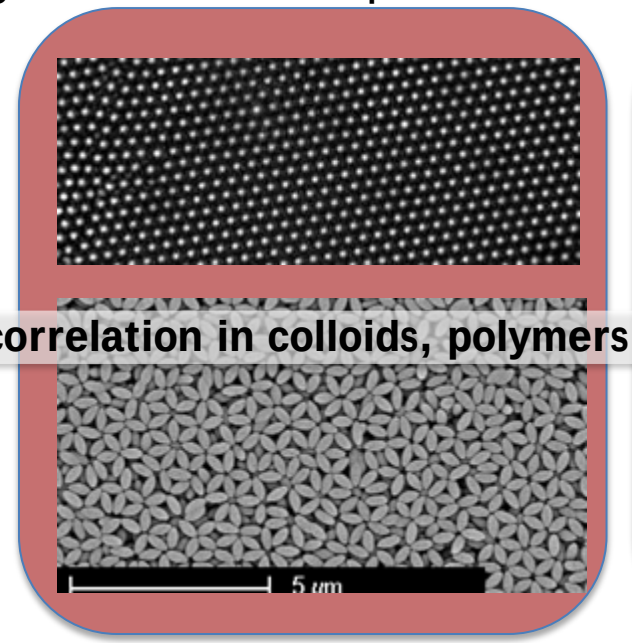
044-2257-4164; basa@iitm.ac.in

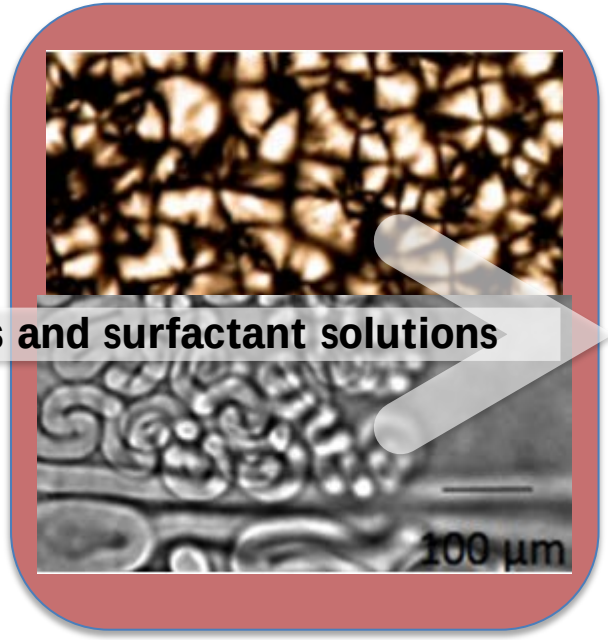
http://www.che.iitm.ac.in/~basa

Research Area: Colloids and Interface Science

- Self-assembly of colloids and nanoparticles
- Rheology and microstructure of suspensions
- Structure and surface rheology of complex fluid interfaces, Emulsions, Foams
- Surfactant in aqueous, organic and ionic liquids







Structure property correlation in colloids, polymers and surfactant solutions

Dr. Ethayaraja Mani

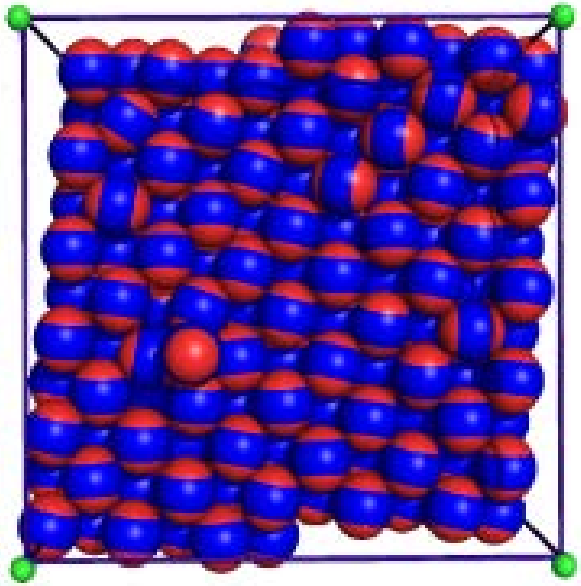
PhD, IIT Bombay, India

Professor, Chemical Engineering

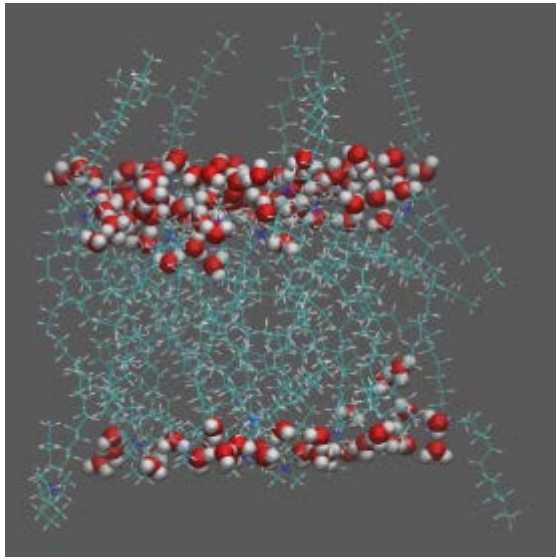
044-2257-4157; ethaya@iitm.ac.in

http://www.che.iitm.ac.in/~ethaya/ethaya/Home.html

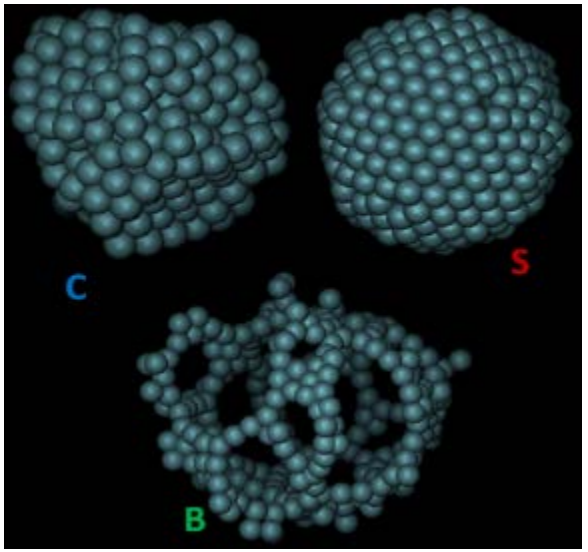
- Self-assembly of patchy colloids
- Molecular simulation of softmatter
- Stochastic simulation of formation of nanostructures



Crystal of Patchy Colloids



Surfactant Bilayer



Soft-colloid Stabilized Emulsions

Dr. Himanshu Goyal

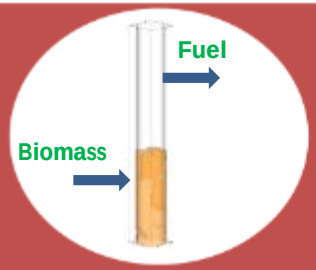
PHD, Cornell University, USA

Assistant Professor, Chemical Engineering

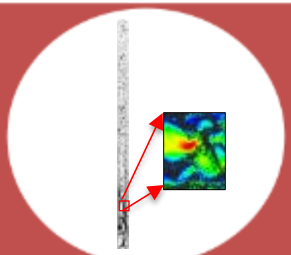
044-2257-4183; goyal@iitm.ac.in

https://che.iitm.ac.in/?page_id=3419

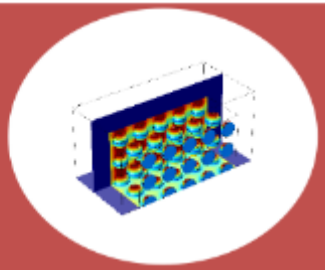
- Research Area/Focus 1: Multiscale modeling of reactive multiphase flows
- Research Area/Focus 2: Process intensification using microwaves
- Research Area/Focus 3: Uncertainty quantification in simulation predictions



Biomass into biofuels and chemicals



Chemical-looping combustion



Process intensification

Develop a computational platform to create design tools for clean energy systems

Dr. Jitendra S Sangwai

PhD, IIT Kanpur, India

Professor, Chemical Engineering

044-2257-4825; jitendrasangwai@iitm.ac.in

http://www.iitm.ac.in/oedept

- Enhanced Oil Recovery
- Gas Hydrates
- Flow Assurance

Phase Equilibrium Studies

Gas Hydrates for Storage and Transportation

Semiclathrate Hydrates

CO_2 sequestration

Emulsions and Polymer Flooding

Ionic Liquids for EOR

Wax and Asphaltene Dissolution

Microbial Degradation of Waxes

Nanofluids for Flow Assurnace

Dr. Jithin John Varghese

PhD, Nanyang Technological University, Singapore

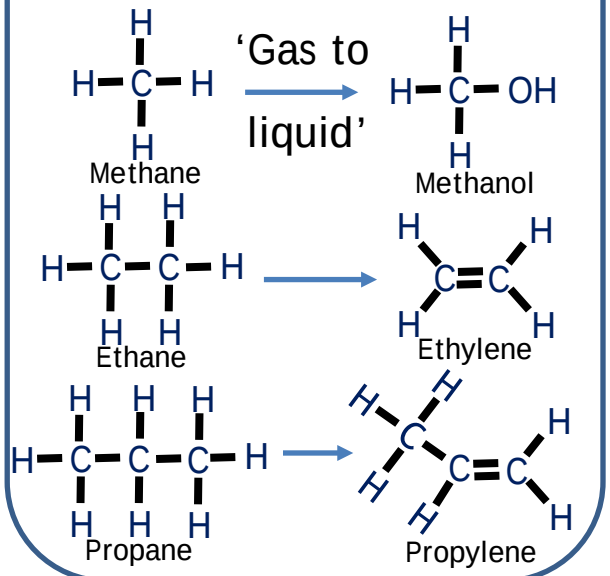
Associate Professor, Chemical Engineering

044-2257-4182; jithinjv@iitm.ac.in

- Natural gas to alcohols/ olefins
- Carbon dioxide to liquids
- Biomass derivatives to chemicals

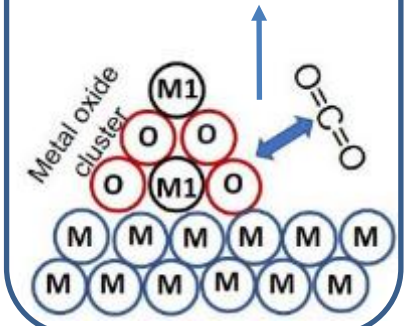
Computational catalyst design, multiscale modelling, bottom up catalytic reaction engineering

Oxidative upgradation of light alkanes



Catalytic reduction of CO_2

'Gas to liquid'
'Waste to liquid'



Hydrodeoxygenation of biomass derivatives/ biowaste

'Waste to wealth'

'Lignin derivatives'

Computational Catalysis: Towards Sustainable Chemical Reaction Engineering

Dr. Kannan A

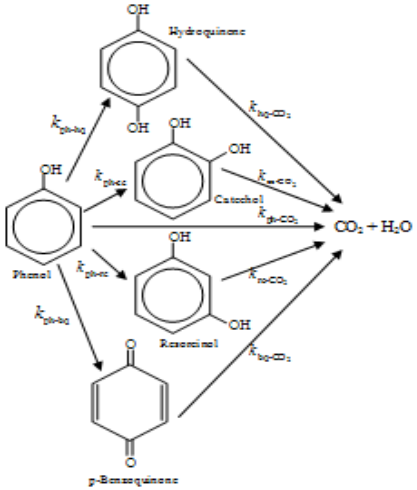
PhD, McMASTER University, Canada

Professor, Chemical Engineering

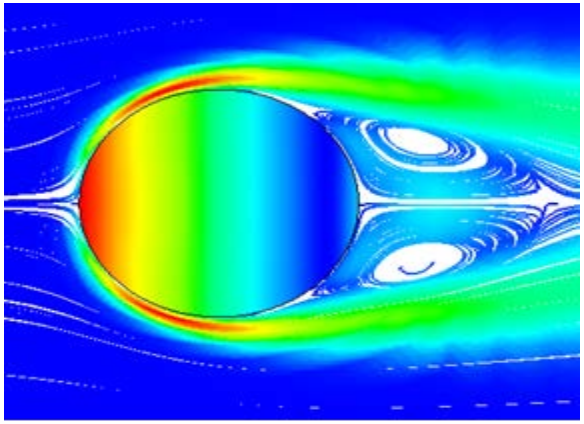
044-2257-4170; kannan@iitm.ac.in

http://www.che.iitm.ac.in/~kannan/

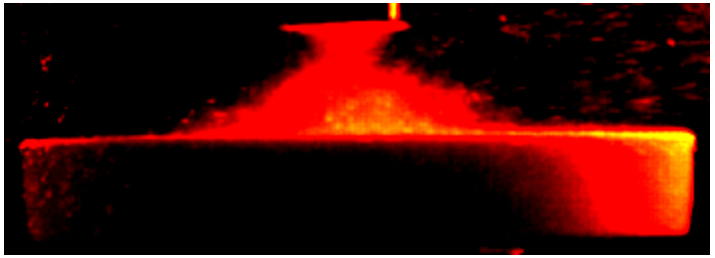
- Intensification of Transport and Reaction Rates in Environmental Pollution Control, Separation Processes and Thermal Food Processing
- Innovative Process Equipments for Environmental Pollution Control
- Modelling and Simulation of Chemical and Environmental Processes



Reaction pathway in a photocatalytic reactor



CFD based fluid flow patterns and convective heat fluxes around a food particle



Ultrasound jet impinging on a spinning disk to enhance mass transfer

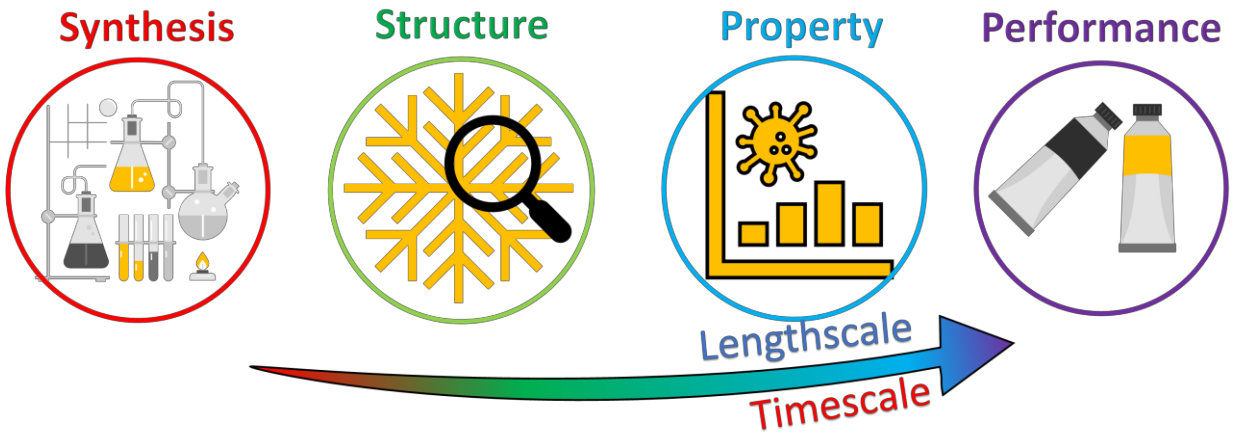
Dr. Khushboo Suman
PhD: IIT Kanpur,
Assistant Professor, Chemical Engineering
044 2257 4193; ksuman@iitm.ac.in

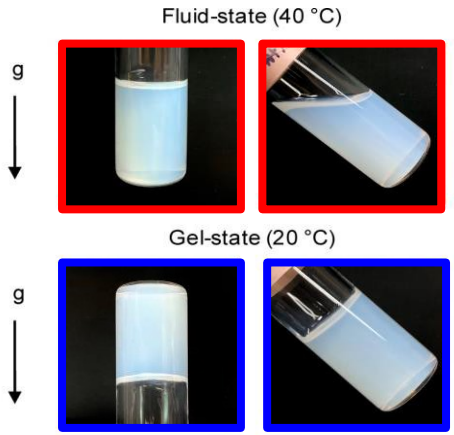
Research Areas:

- Soft Matter
- Structure and dynamics of colloidal glasses and gels
- Self assembly in physically and chemically crosslinking systems
- Structure property relationships
- Synthesis of nanoparticles

Rheometer
(to characterize the bulk property of the gels)

Research Theme: to synthesize and understand self assembly in colloidal dispersions





Thermoresponsive gels

Dr. Niket Kaisare

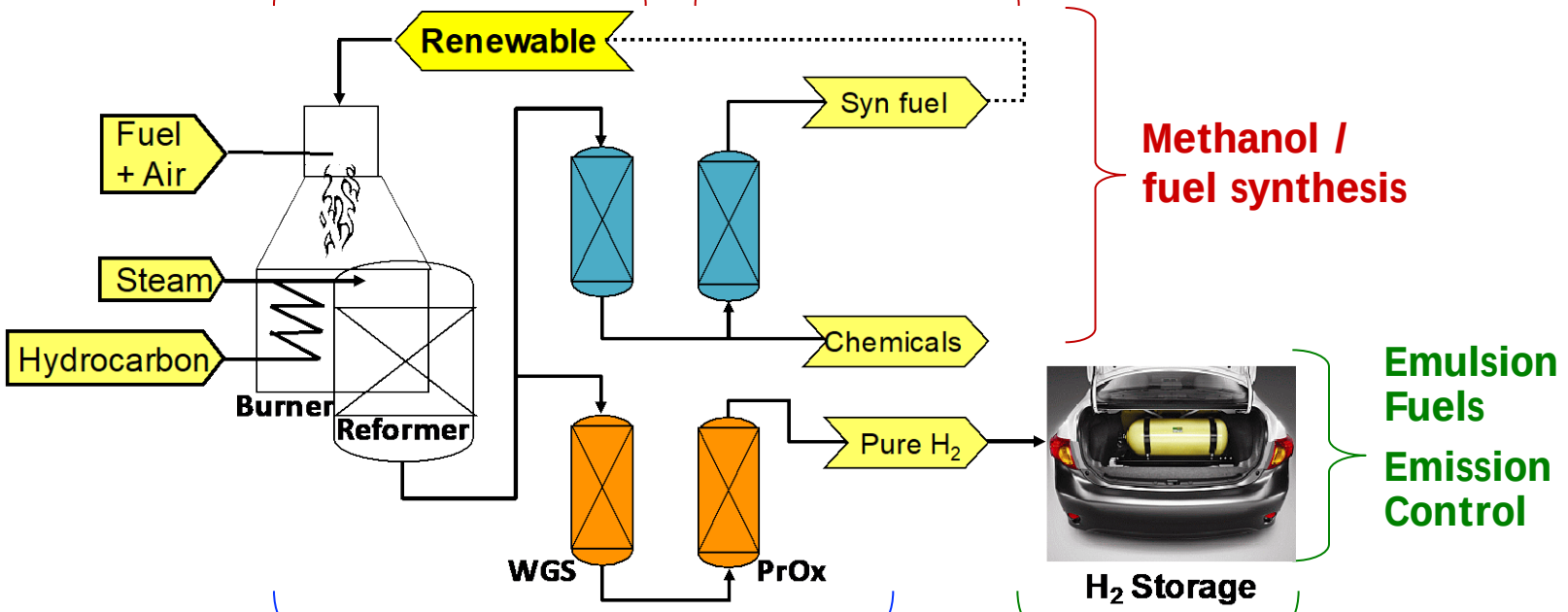
Professor, Chemical Engineering

+91 44 22574176; nkaisare@iitm.ac.in

http://www.che.iitm.ac.in/~nkaisare/

Micro-Combustion

H_2 generation in microreactors



Methanol / fuel synthesis

Emulsion Fuels

Emission Control

Model Predictive Control;

Plant-wide Control

Cryo-Adsorption

Research in Energy: Catalysis, Combustion and Control

Dr. Nitin Muralidharan

PhD, Vanderbilt University, USA

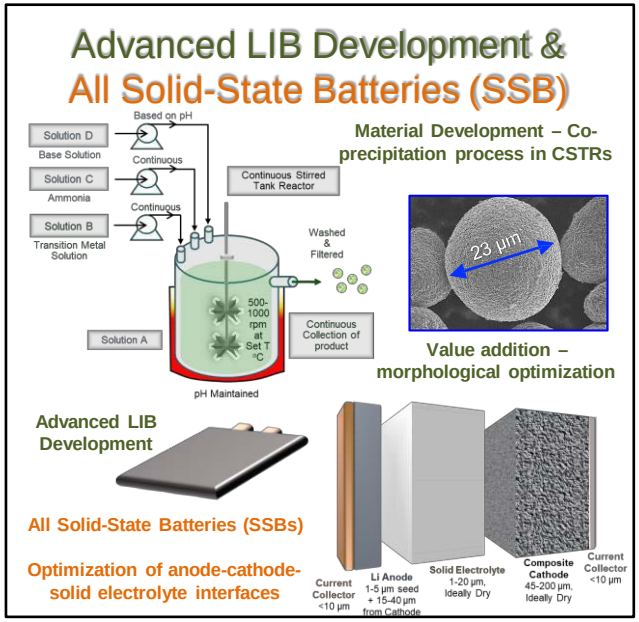
Assistant Professor, Chemical Engineering

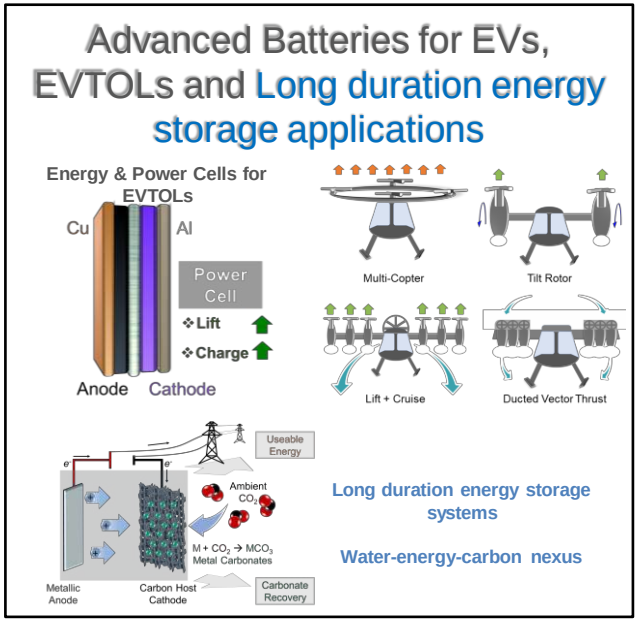
044-2257-4189; muralidharan@iitm.ac.in

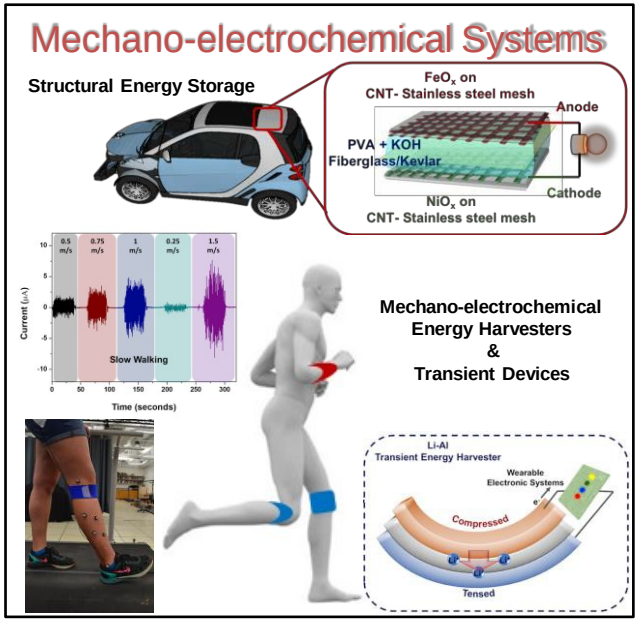
Advanced Battery Research and Development, Interdisciplinary Materials Science and Chemical Engineering

Research Portfolio

- Lithium-ion Battery (LIB) material and device R&D for Electric Vehicle (EV) and Electric Vertical and Take-off and Landing (EVTOL) applications
- Beyond Li and Alternative-ion chemistries and devices for long duration energy storage applications
- Mechano-electrochemistry, electrochemical energy harvesters and interplay of carbon-water-energy nexus

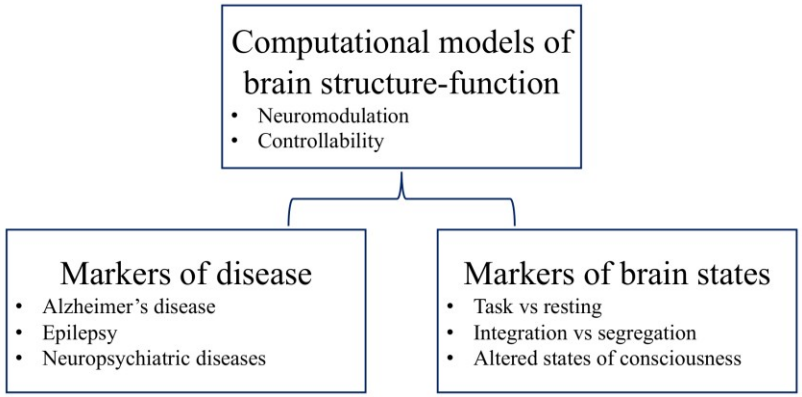


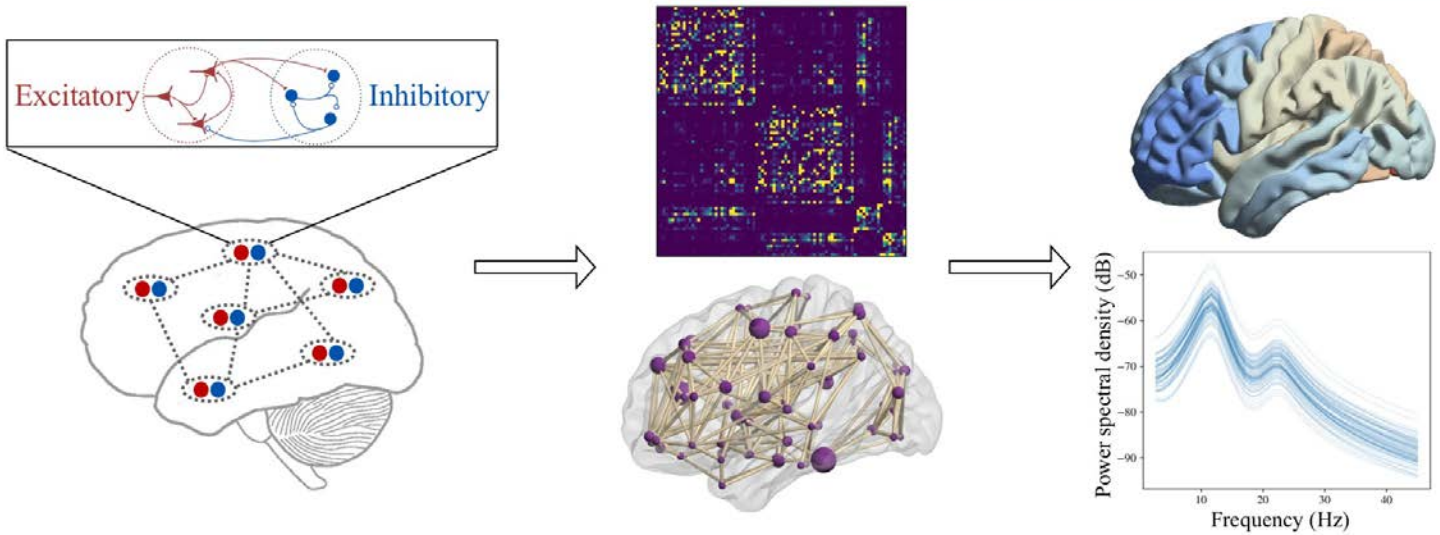




Dr. Parul Verma
PhD, Purdue University, USA
Assistant Professor, Chemical Engineering
044-2257-4195; parulv@iitm.ac.in

- Computational neuroscience
- Neurological diseases and brain states
- Mathematical modeling and data science





Model for excitatory and inhibitory neuronal population signals for different brain regions

Neuronal populations are connected to each other via an anatomical structural connectivity (top) that can be represented as a graph (bottom)

Model simulation gives functional spatial (top) and spectral (activity) which can be compared to empirical data

Dr. Preeti Aghalayam

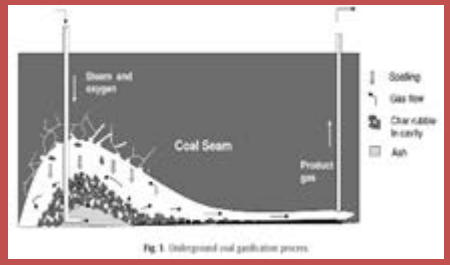
PhD, Univ. of Massachusetts Amherst, USA

Professor, Chemical Engineering

044-2257-4185; preeti@iitm.ac.in

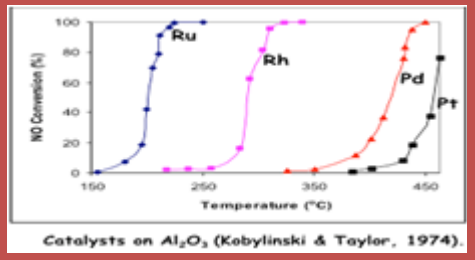
http://www.aghalayam.com

- **Coal Gasification:** *In-situ utilisation of deep coals; Kinetic Experiments; Modeling*
- **Catalytic Converters:** *Detailed chemistry for catalytic reduction of NO*
- **Reaction Mechanisms:** *Reduction of detailed reaction mechanisms*



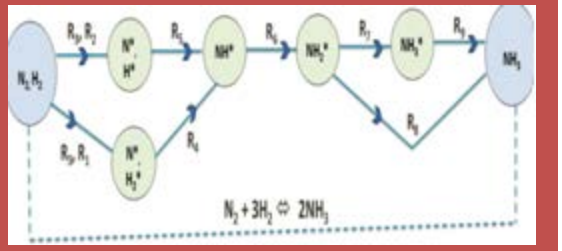
Underground Coal Gasification:

Cavity studies & Process models



Automotive Catalytic Converters:

Surface reaction mechanisms & Catalyst Selection



Detailed Reaction Mechanisms:

Analysis, Reduction Methodologies

MICROKINETIC MODELING; LAB-SCALE EXPERIMENTS; FUNDAMENTAL STUDIES

Dr. S Pushpavanam

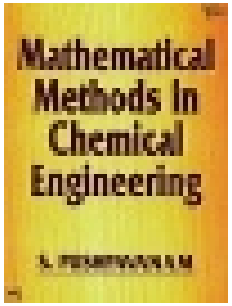
PhD, University of Florida, USA

Professor, Chemical Engineering

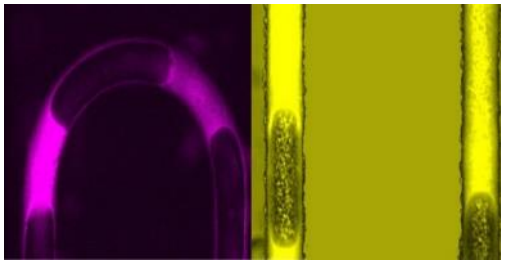
044-2257-4161; spush@iitm.ac.in

http://www.che.iitm.ac.in/~spush/

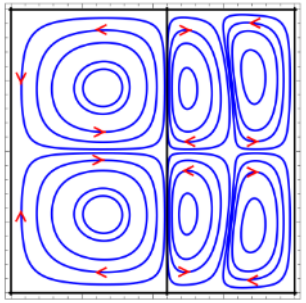
- Two phase flows and interfacial transport
- Micro flows: Hydrodynamics and Mass Transport
- Mathematical Modeling and Nonlinear Dynamics



Molten Flows



Microfluidics



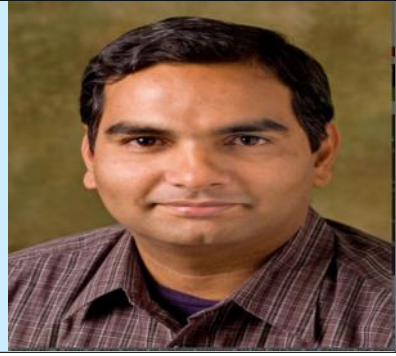
Fundamentals

Mathematics + Physics ---> Smarter Engineering

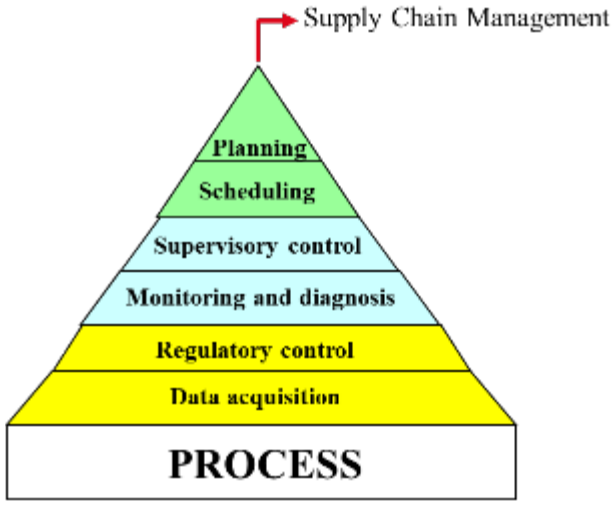
Dr. Raghunathan Rengaswamy

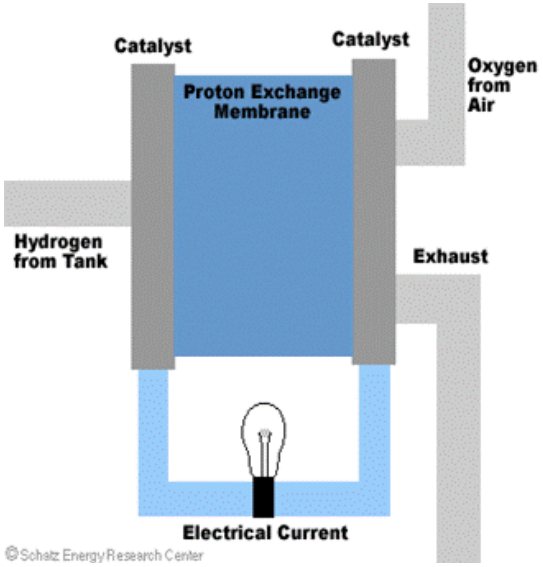
Professor, Chemical Engineering

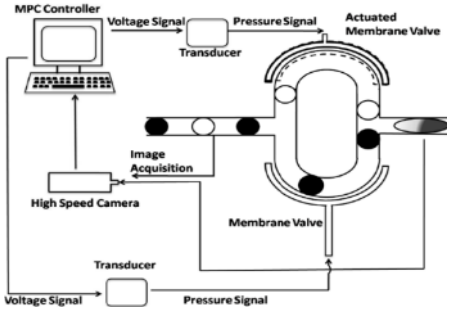
044-2257-4159; raghur@iitm.ac.in

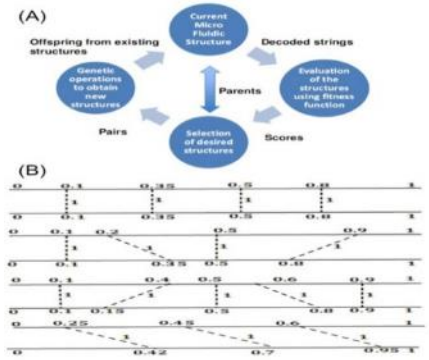


- Process Systems Engineering
- Fuel Cell Research
- Computational Droplet-based Microfluidics Research









Dr. Raghuram Chetty

PhD, Newcastle University, UK

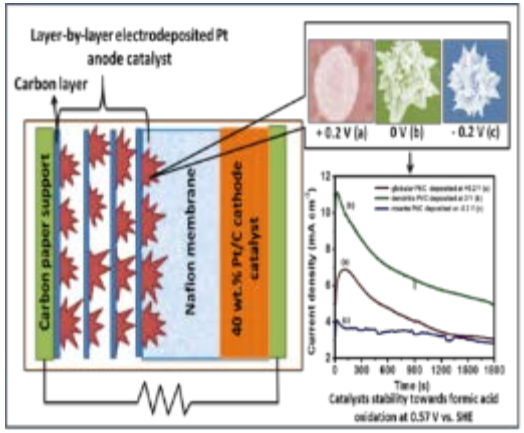
Professor, Chemical Engineering

044-2257-4178; raghuc@iitm.ac.in

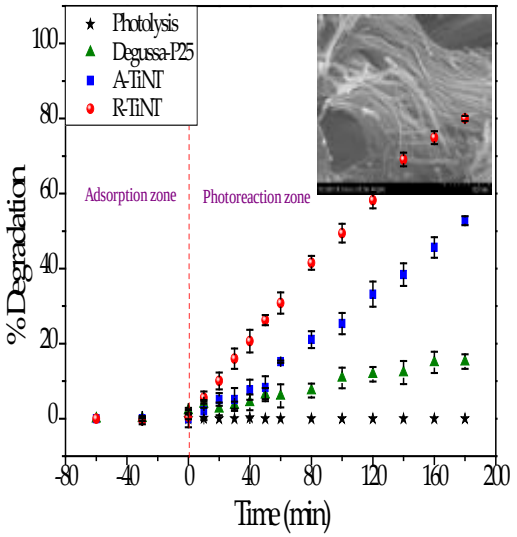
http://www.che.iitm.ac.in/~raghuc/

Research Interest

- Fuel Cells (Electrocatalyst, Bipolar Plates)
- Redox Flow Batteries (Vanadium Flow Battery)
- Conversion of CO2 into Chemicals
- Electrochemical & Photochemical Wastewater Treatment
  - Electrochemical Reduction of Nitrate
  - Heavy Metal (Chromium) Removal
  - Photocatalytic Degradation (Dyes, Pharmaceuticals)
  - Water Desalination (Anti Fouling RO Membranes)



Different morphologies of Pt catalysts synthesized by electrochemical deposition by varying the potential.



Photodegradation of Rhodamine-B with different crystalline TiO_2 nanotubes (TiNT) phase as compared to commercial P25 nanoparticles.

Dr. Rajagopalan Srinivasan

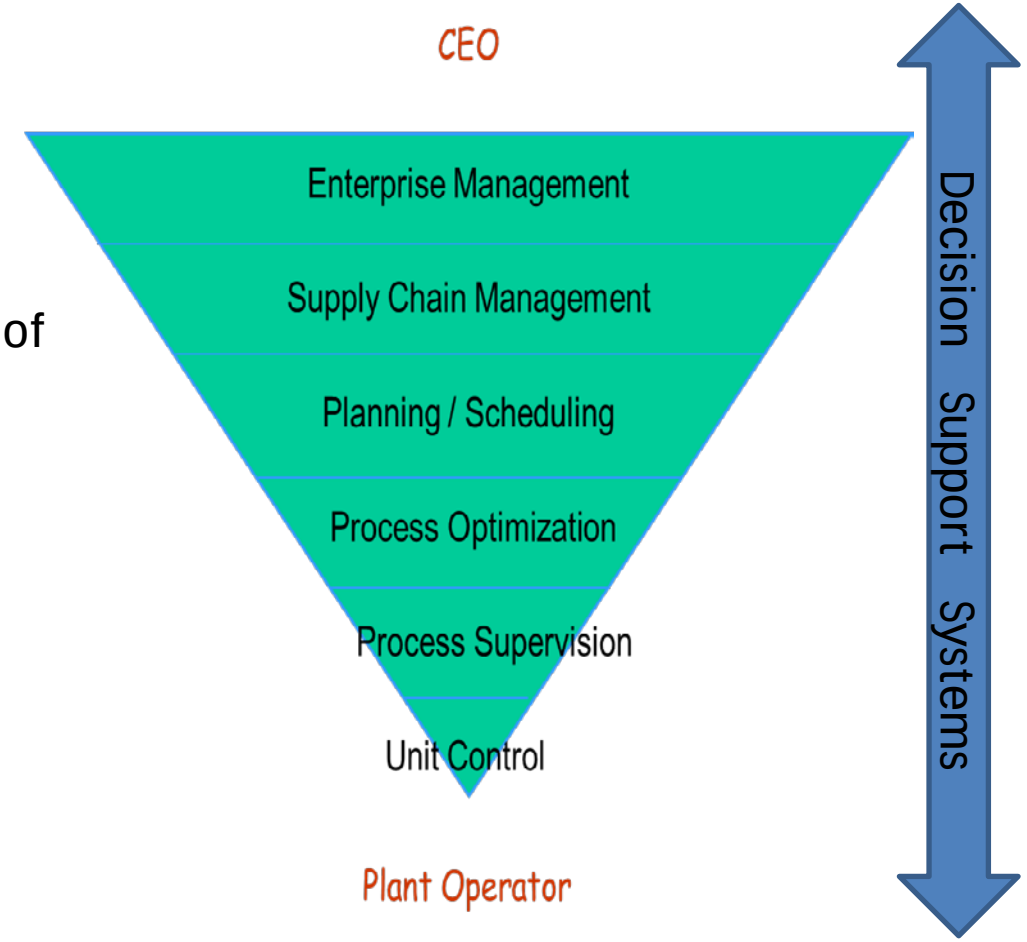
Professor, Chemical Engineering

+91 44-2257-4190; raj@iitm.ac.in

https://che.iitm.ac.in/?page_id=457

Major Research Areas

- Safety, Sustainability & Resilience of complex systems
- Cognitive Engineering
- Supply Chain Management & Enterprise Optimization



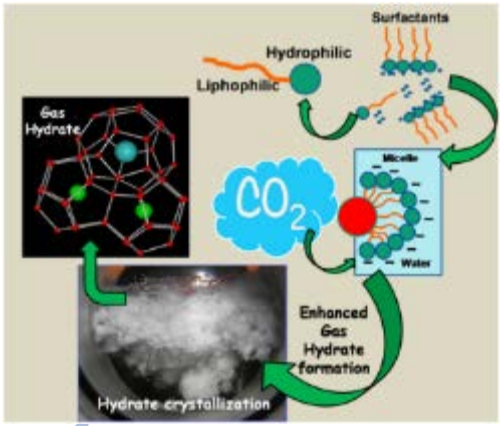
Dr. Rajnish Kumar

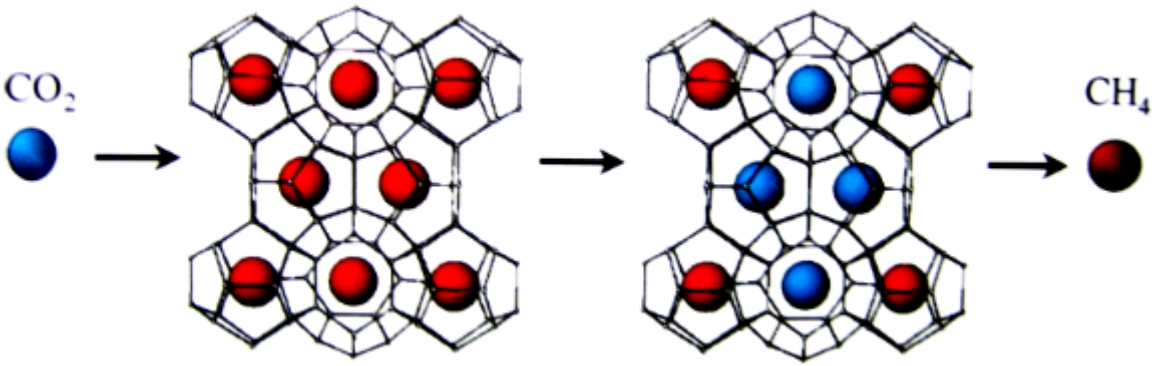
Professor, Chemical Engineering

Ph: 8805340709; rajnish@iitm.ac.in

Major Areas of Research

- Methane recovery from natural gas hydrate; methane storage and transportation
- Gas separation through molecular selection and enclathration; CO_2 capture
- Process development and scale up; biomass upgradation through HTL





Gas Hydrates: Opportunities for Innovative Energy Selection

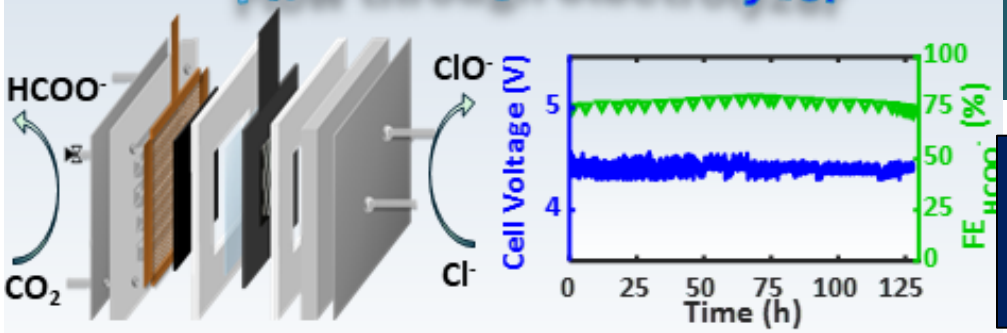
Dr. S Ramanathan

Professor, Chemical Engineering

+91 44-2257-4171; srinivar@iitm.ac.in

http://www.che.iitm.ac.in/~srinivar/

Flow through electrolyzer



Large current
High-formate FE

Profitable in a large scale
High single-pass conversion

Profitable CO_2 reduction to formic acid or Syngas

Long-life GDE for CO2RR. In-situ regeneration

Techno-economic Analysis - profitability of CO2RR

A

Electrochemical CO_2 reduction

Sea water batteries for power generation in deep ocean

B

Sea water batteries

C

Electrochemical Biosensors

Biosensor for CHIKV Detection

Dr. Ramnarayanan R

Assistant Professor, Chemical Engineering

044-2257-4174; ramna@iitm.ac.in

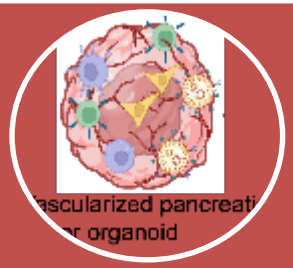
Dr. Rashmi P Mohanty

PHD, University of Texas at Austin, USA

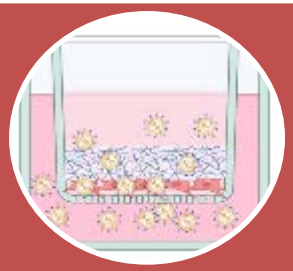
Assistant Professor, Chemical Engineering

044-2257-xxxx; rashmipm@iitm.ac.in

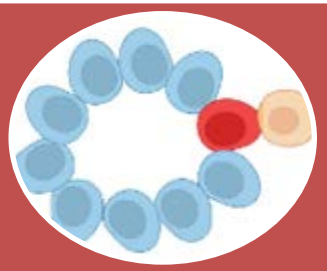
- Research Area/Focus 1: Disease-specific Extracellular Matrix (ECM)-secreting cell lines to study drug transport and drug delivery
- Research Area/Focus 2: Pancreatic organoid mimicking *in vivo* tumor development
- Research Area/Focus 3: Organoid recapitulating zonated human cartilage



ECM-rich disease modeling



Smart drug delivery vehicle screening



Understanding disease progression at the cellular level

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

Dr. R Ravi

PhD, Purdue University, USA

Professor, Chemical Engineering

044-2257-4167; rravi@iitm.ac.in

http://www.che.iitm.ac.in/~rravi/

- Thermodynamics
- Transport
- Statistical Mechanics

Phase equilibrium

Multicomponent mass transfer

Property Estimation

Mathematical modeling and theoretical analysis

Dr. R Ravikrishna

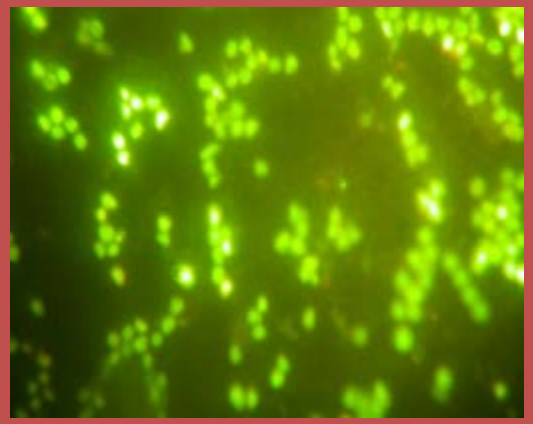
PhD, Louisiana State University, USA

Professor, Chemical Engineering

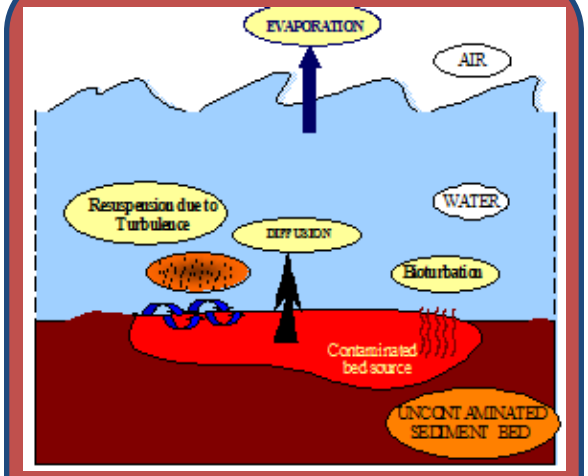
044-2257-4175; rrk@iitm.ac.in

http://www.che.iitm.ac.in/~rrk

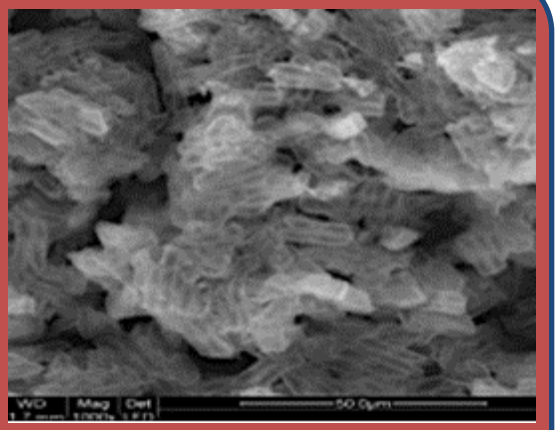
- Fate and Transport of Pollutants in the Environment
- Assessment and Remediation of Contaminated Sediments
- Development of Waste Treatment Technologies



Bioaerosol Release from solid waste surfaces



Chemical Release Rates from Sediments



Photocatalytic Degradation of Organic Chemicals

Dr. T Renganathan

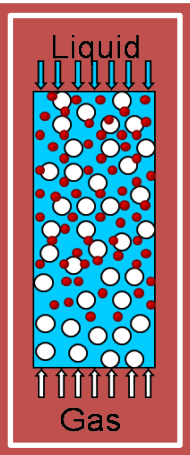
PhD, IIT Madras, India

Professor, Chemical Engineering

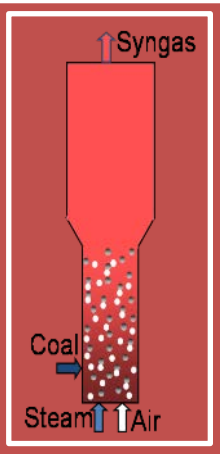
044-2257-4186; renga@iitm.ac.in

http://www.che.iitm.ac.in/faculty.php?fid=20

- Multiphase systems – Inverse fluidized bed
- Gasification – Fluidized bed gasifier



Hydrodynamics of inverse fluidized bed



Simulation of fluidized bed gasifier

Dr. Sagar Sourav

Assistant Professor, Department of Chemical Engineering

PhD: Lehigh University, USA; **Postdoc:** University of Delaware, USA

souravs@iitm.ac.in Phone (O): +91 44 2257 4194

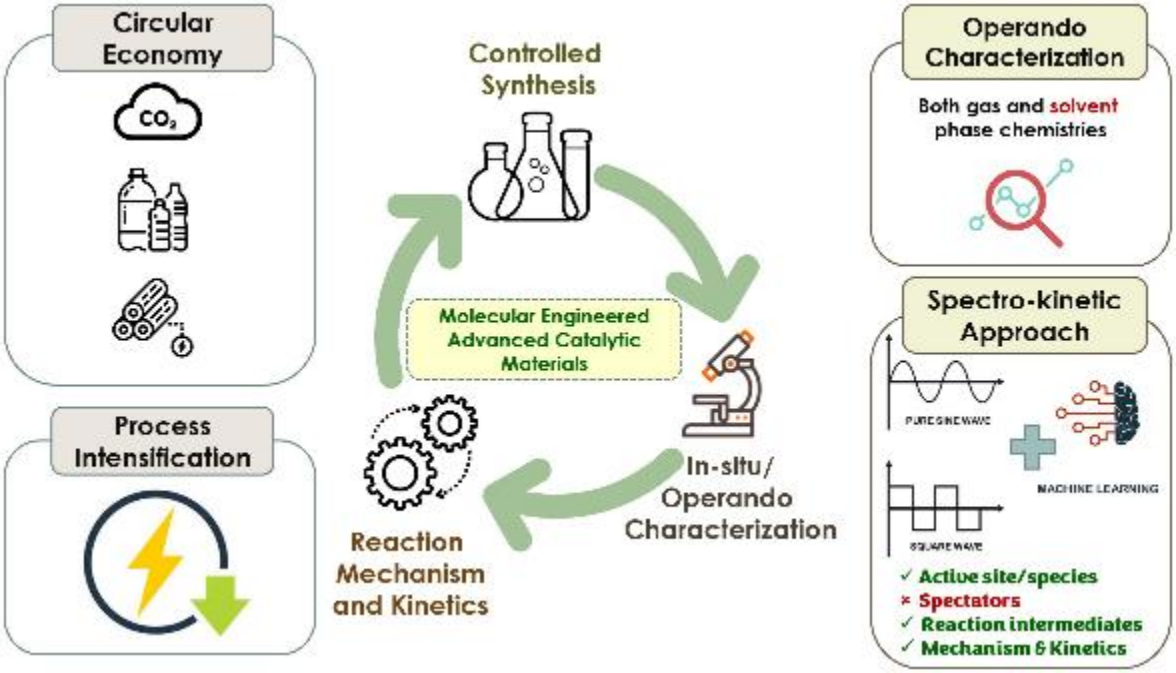
➢ Research Area:

- Heterogeneous Catalysis
- Spectroscopic characterization of catalysts during reaction
- Transient kinetics studies

➢ Key Application Areas:

- CO_2 conversion and utilization
- Light Alkane Valorization
- Sustainable Fuels & Chemical Production

➢ Research Theme:



➢ Research Overview:

Catalysis Research at a Molecular Level

Our Mission:

To decode the molecular intricacies of catalytic processes and leverage this knowledge for rational catalyst design and process optimization.

Our Approach:

- In-situ & operando spectroscopy for real-time catalyst characterization
- Transient kinetic studies to uncover structure–function relationships
- Mechanistic insights guiding innovation in catalysis

Group website

Dr. Sankha Karmakar

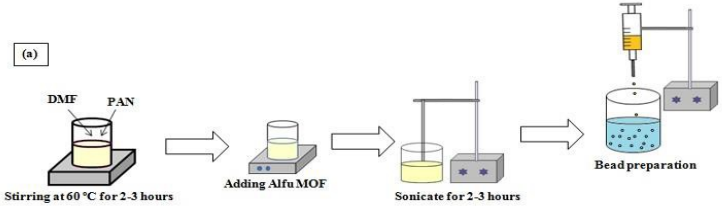
PhD, IIT Kharagpur

Assistant Professor, Chemical Engineering

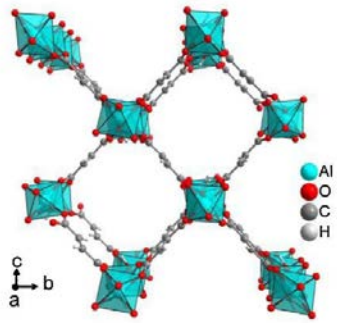
044-2257-4155; skarmakar@iitm.ac.in

Research Field:

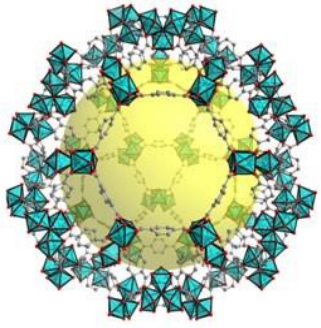
- Metal Organic Frameworks Membrane
- based Separation Processes Water
- Treatment
- Gas Separation and Storage
- Valorization of Industrial Waste
- Development of Novel Adsorbents (High Efficiency, low cost)
- Application of novel material in biotechnology, biomedicine and pharmaceuticals



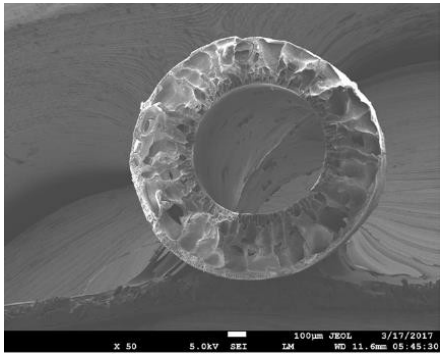
(a) Preparation of mixed matrix PolyMOF Beads; (b) Prepared PolyMOF Beads



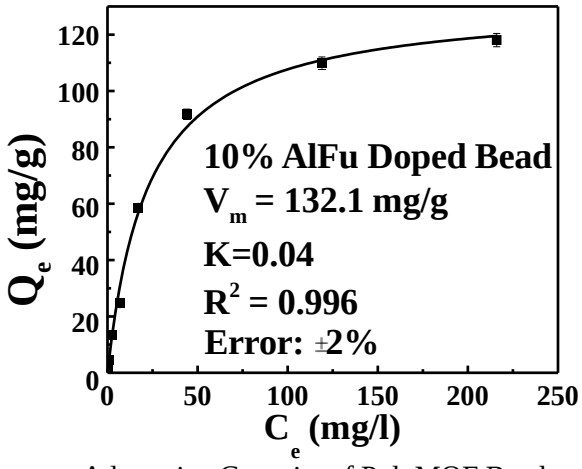
AlFu Framework



MIL-101-Cr Framework



Cross sectional image of hollow fibre mebrane



Adsorption Capacity of PolyMOF Beads

Dr. Sreenivas Jayanti

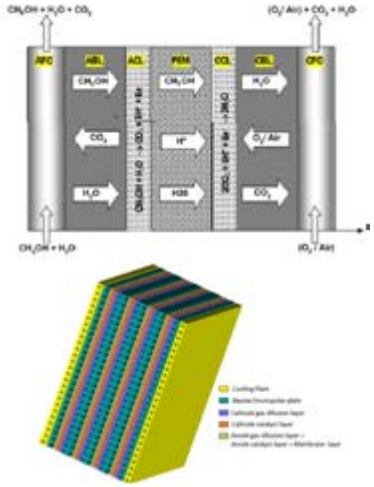
PhD, Imperial College, London, UK

Professor, Chemical Engineering

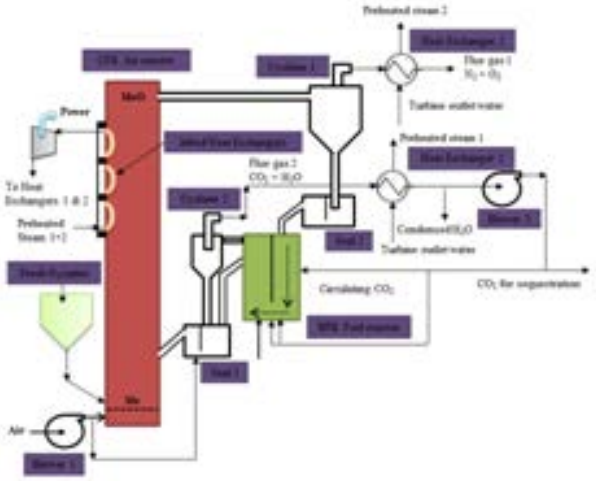
044-22574168; sjayanti@iitm.ac.in

http://www.che.iitm.ac.in/~sjayanti/

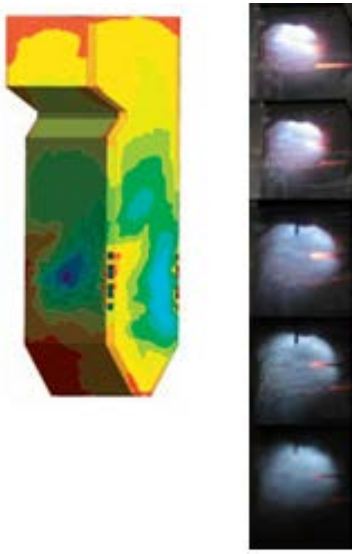
- Combustion: Oxy-fuel combustion; chemical looping combustion
- Electrochemical devices: Fuel cells; redox flow batteries
- Multiphase flow: computational fluid dynamics, heat transfer



Cell and stack level studies of fuel cells



System level studies of chemical looping combustion



Experimental and CFD studies of oxycoal combustion

Dr. Sumesh P Thampi

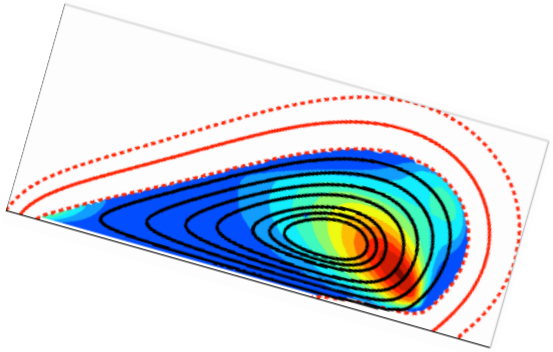
Associate Professor, Chemical Engineering

044-2257-4169; sumesh@iitm.ac.in

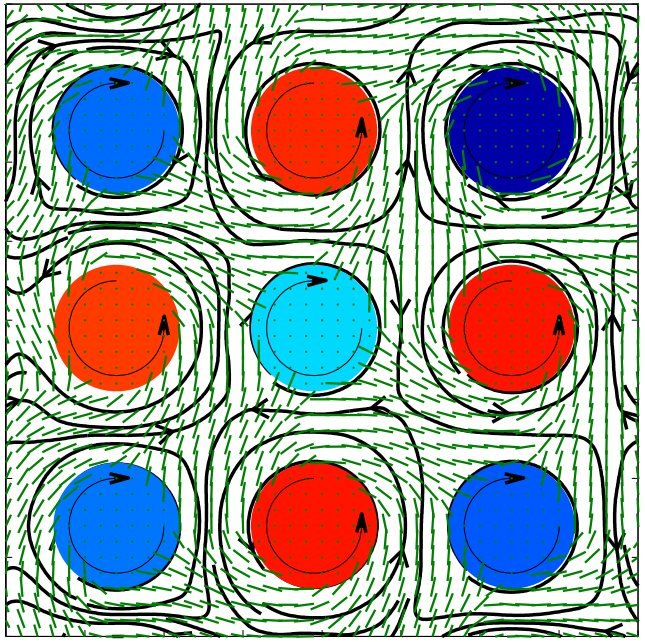
http://www.che.iitm.ac.in/~sumesh

Major Areas of Research

- Hydrodynamics of complex fluids
- Colldaection motion in active matter
- Interfacial fluid mechanics



Sliding–rolling motion of a drop on an inclined surface – streamlines and vorticity contours



Counter rotating colloidal discs to power micro-machines exploiting nemato-hydrodynamics of active turbulence

Application of fluid mechanics on soft and biological matter

Dr. Susy Varughese

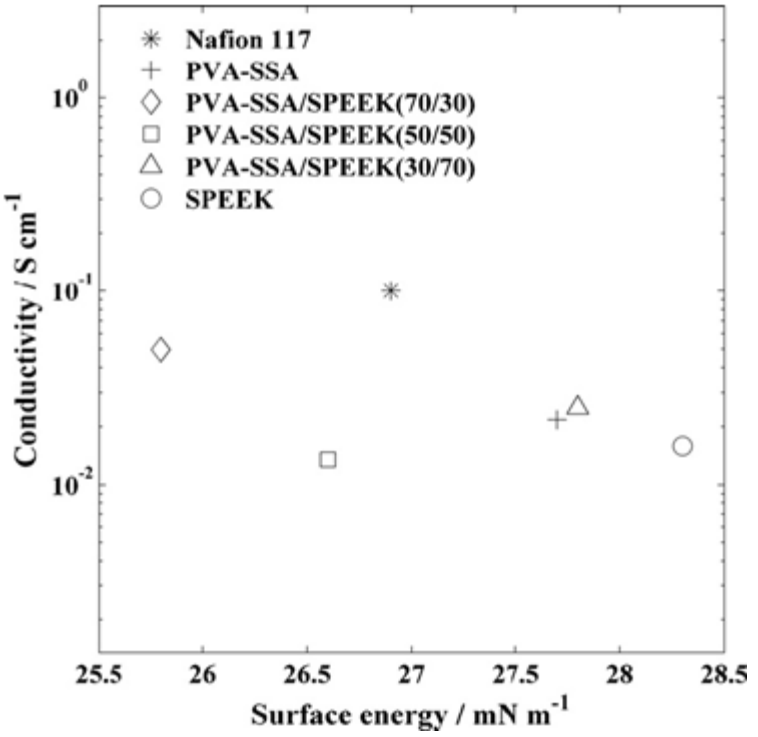
Professor, Chemical Engineering

+91 44 2257 4172 ; susy@iitm.ac.in

http://www.che.iitm.ac.in/~susy/

Major Areas of Research

- Physics and mechanics of polymeric materials
  - dynamic mechanical behavior of polymers
  - vibration damping and isolation using polymers
  - Filler-polymer interactions
- Conducting polymers
  - Processing aspects related to inkjet printing & drying of drops
  - Wetting and surface energy
  - Electromechanical behaviour of conducting polymer films
- Ionically conducting polymers
  - Fuel cell membrane materials
  - Diffusion through membranes
  - Structure and morphology
  - Shape memory behavior
- Recycling of polymers and composites



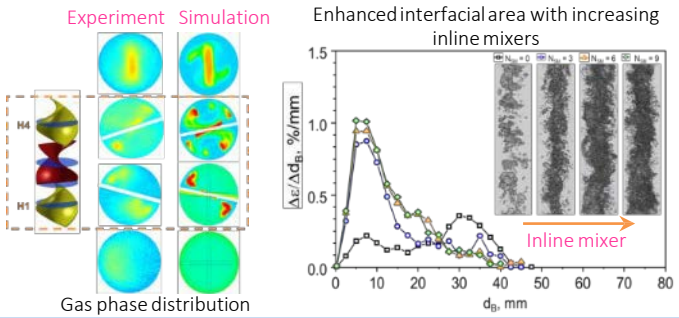
P. Kanakasabai et al., Journal of Power Sources 196 (2011) 946-955

Dr. Swapna Singha Rabha
PhD, Indian Institute of Technology Delhi
Assistant Professor, Chemical Engineering
044-2257-4191; srabha@iitm.ac.in

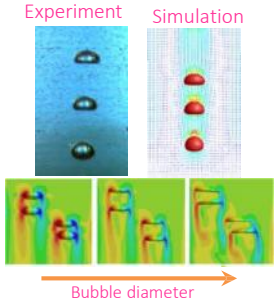
Research areas

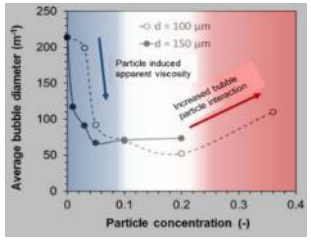
- Micro scopic gas-liquid flows
- Three phase suspension systems e.g. gas-liquid-solid flows
- Process intensifications
- Carbon capture
- Transport in porous media.

Energy efficient gas-liquid contacting device



Bubble dynamics in gas-liquid & gas-liquid-solid flows





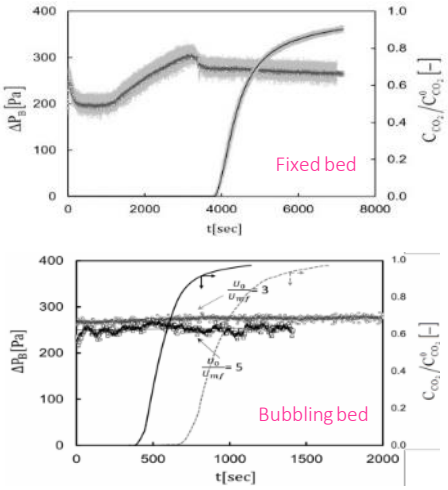
Dual effect of particles in slurry bubble columns in terms of flow stabilization and destabilization

Bubble size distribution
Gas holdup

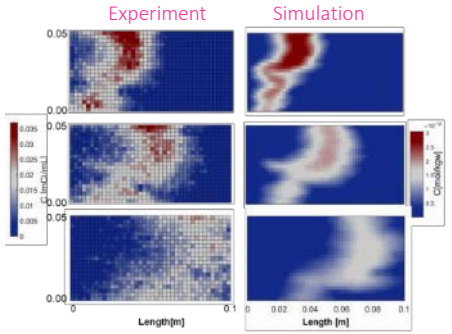
Gas flow structure via ultrafast X-ray tomography

Carbon capture and storage

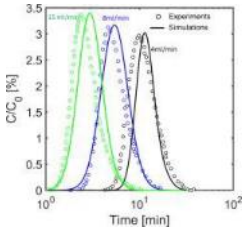
Sorbent-based CO_2 capture technology



Pressure drop, CO_2 breakthrough in amine-impregnated mesoporous sorbent bed



Solute transport in heterogeneous permeable media



Transport parameter like residence time distribution in a heterogeneous permeable media

Dr. Tanmay Basak

PhD, IISc, Bangalore

Professor, Chemical Engineering

044-2257-4173; tanmay@iitm.ac.in

http://www.che.iitm.ac.in/~tanmay/

- Microwave Assisted Material Processing
  - Computational Electromagnetics
  - Chemical Reacting Systems
  - Material Invariant Characteristics
  - Closed Form Analysis
  - Scattering Effect
- Computational Fluid Flow and Heat Transfer
  - Heat Flow visualization and Thermal Management
  - Thermodynamics and Irreversibility: Entropy Generation Minimization
- Finite Element Method and Modeling

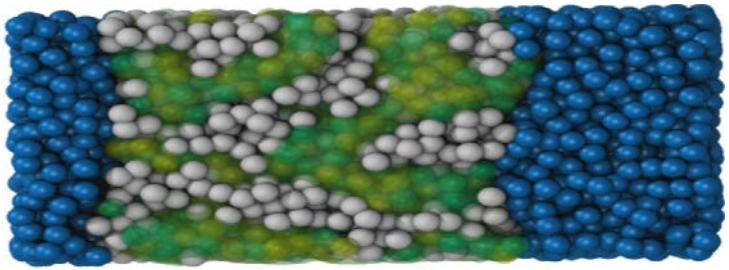
Dr. Tarak K Patra

PhD, IIT Kanpur, Post-Doc, Argonne National Laboratory

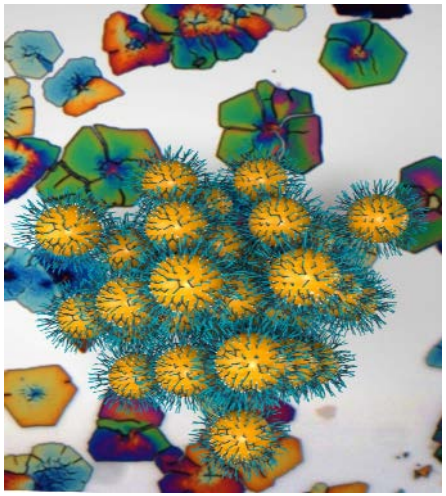
Associate Professor, Chemical Engineering

044 2257-4162; tpatra@iitm.ac.in

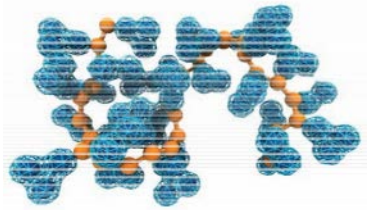
- High Throughput Materials Design
- Molecular Simulations and Machine Learning
- High Performance Computing and AI
- Polymeric Ionic Liquids
- Nanoparticle Supercrystals
- Glassy Materials



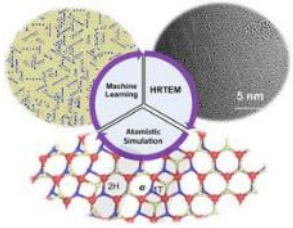
Engineering polymer architecture for high ion conductivity and mechanical properties



Computational design of highly stable nanoparticle supercrystals



Modeling Structure-property correlations in polymer glasses



Phase transition in 2D materials

Dr. Upendra Natarajan

PhD, Institute of Polymer Sci.& Polym. Eng,
University of Akron, USA
Professor, Chemical Engineering
044-2257-4184; unatarajan@iitm.ac.in
http://www.che.iitm.ac.in/~unatarajan/

- Molecular Theory, Simulation and Modeling
- Macromolecular Science and Engineering
- Hybrid Materials and Composites

FMCG – Shampoo, Conditioner, Detergents, Cosmetics, Superabsorbents, structured dispersions

Polymer-based Coatings, liquid dispersions

Advanced structural Materials

Dr. R Vinu

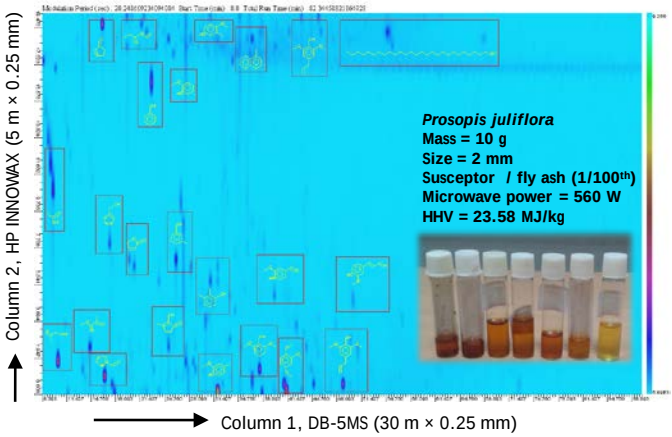
Professor, Chemical Engineering

044-2257-4187; vinu@iitm.ac.in

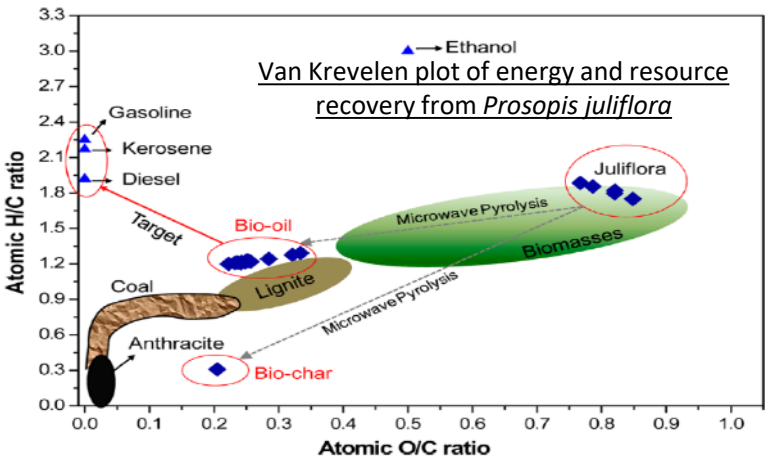
https://sites.google.com/site/vinuresearch/

Current Research Areas

- Catalytic fast pyrolysis of biomass, algae and polymers in micropyrolysis systems with online analysis using GC/MS and FT-IR
- Microwave assisted pyrolysis of renewable feedstocks (biomass, plastic wastes, MSW) for energy and resource recovery and nanomaterials
- Characterization of solid, liquid and gaseous fuels
- Deconstruction and pretreatment of biomasses using non-conventional techniques
- Characterization and degradation of engine oils
- Selective photocatalytic conversion of biomass constituents
- Microkinetic modeling using continuum and stochastic techniques



2D-GC/MS TIC of bio-oil from *Prosopis juliflora* biomass via microwave pyrolysis



INDIVIDUAL FACULTY PROFILE

DEPARTMENT OF CHEMISTRY

LIST OF FACULTY

Anbarasan P

Arnab Rit

Arti Dua

Baskaran S

Beeraiah Baire

Bhyrappa P

Desai Aamod Vikas

Debashis Chakraborty

Dhamodharan R

Dillip Kumar Chand

Edamana Prasad

Hema Chandra Kotamarthi

Indrapal Singh Aiden

Kartik Chandra Mondal

Kothandaraman R

Krishna Reddy Nandipati

Mahiuddin Baidya Md

Masilamani Jeganmohan

Muraleedharan K M

Narasimha Murthy N

Palaniselvam T

Pradeep Thalappil

Rajakumar B

Ramesh L Gardas

Ranga Rao G

Sanjay Kumar

Sanjib Panda

Sekar G

Siva Rama Krishna Chaitanya Sharma Yamijala

Sooraj K

Soumen Ghosh

Sudam Ganpat Dawande

Sundargopal Ghosh

Venkatakrishnan P

Yogesh Gangaram Shelke

Dr. Anbarasan P

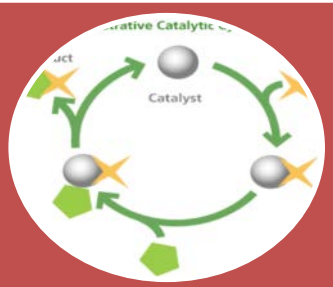
PHD, Indian Institute of Science, India

Professor, Chemistry

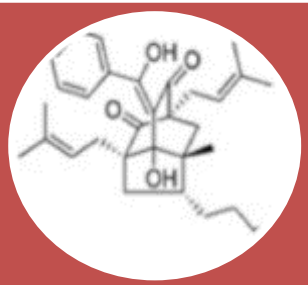
044-2257-4216; anbarasansp@iitm.ac.in

http://chem.iitm.ac.in/professordetails/profanbarasan/profanbu/

- Transition Metal Catalysis – Functionalization of Carbenes and Strong Bonds
- Organocatalysis – Development of New Brønsted Acid
- Conversion of sugar and carbon dioxide to valuable chemicals



Catalytic Process



Natural Products

Bio-Refinery

Synthesis (Application) Driven Catalysis

Dr. Arnab Rit

PHD, Banaras Hindu University, India

Associate Professor, Chemistry

044-2257-4205; arnabrit@iitm.ac.in

http://www.iitm.ac.in/info/dept/CY

Major Areas of Research

- Synthesis, Structure and Catalytic application of organometallic compounds
- Development of new ligand systems for Poly-nuclear complexes
- Novel Main-group compounds for small molecule activation
- Non-transition metal based hydrogen economy

Organometallic Synthesis

Catalysis

Main-group Chemistry

Organometallic and Main-group Chemistry

Dr. Arti Dua

PHD, IISc, Bangalore, India

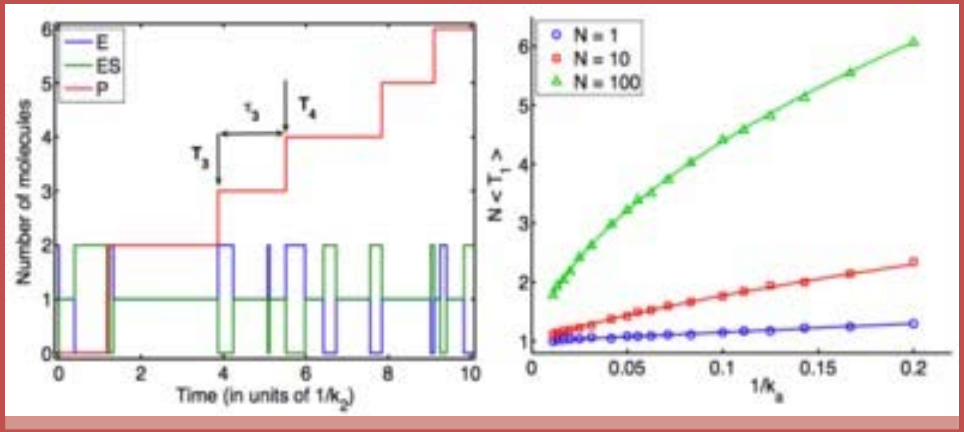
Professor, Chemistry

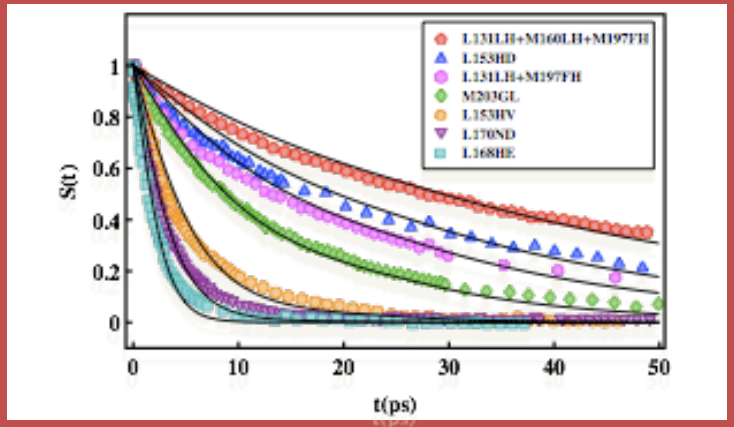
044-2257-4236; arti@iitm.ac.in

http://chem.iitm.ac.in/professordetails/profartidua/index.htm

- Stochastic Processes in Chemistry and Biology
- Statistical Mechanics of Polymers and Biopolymers
- Biophysical Chemistry

BROAD DESCRIPTION OF THE AREA OF RESEARCH





- Stochastic kinetics of chemical and biochemical reactions for small number of reactants
- Enzyme kinetics at cellular level
- Stochastic gene expression
- Single-enzyme catalysis

- Models of electron transfer reactions in protein matrix
- Non-Markovian models for protein conformational fluctuations
- Counterion condensation in polyelectrolytes

Dr. S Baskaran

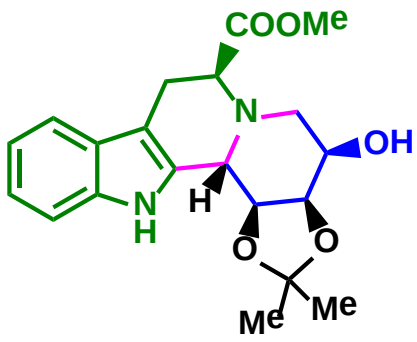
PHD, IIT Kanpur, India

Professor, Chemistry

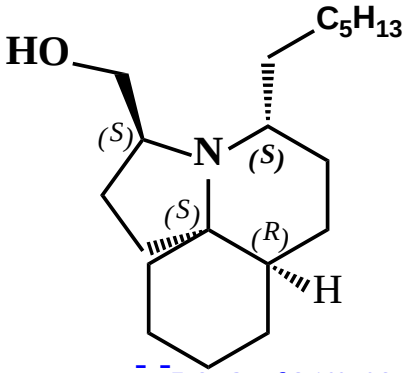
044-2257-4218; sbhaskar@iitm.ac.in

http://chem.iitm.ac.in/professordetails/profsundarbabubaskaran/index.htm

- Development of new strategies in Organic Synthesis
- Synthesis of Biologically active Natural Products
- Drug Design of Pharmaceutical Importance

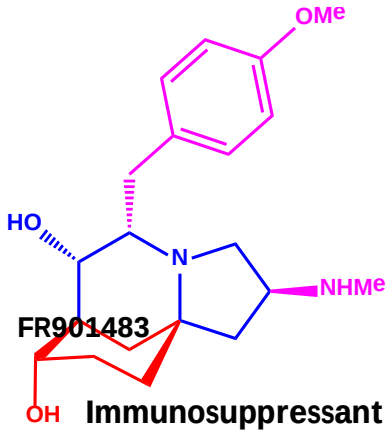


Antidiabetic agent



(-)-Lepadiformine A

Anticancer agent



Immunosuppressant

Stereoselective Synthesis of Biologically Active Molecules

Dr. Beeraiah Baire

PhD., IISc Bangalore, India

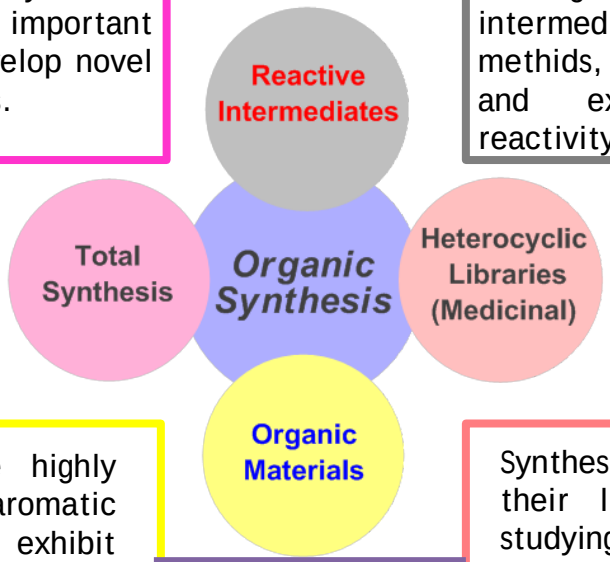
Professor, Chemistry

044-2257-4206; beerut@iitm.ac.in

http://chem.iitm.ac.in/professordetails/beeraiahbaire/

Motivated by the architecturally interesting, biologically and pharmaceutically important natural products to develop novel synthetic methodologies.

Novel synthetic strategies for the generation of reactive intermediates like quinone methids, ketenes and benzynes, and explore their novel reactivity for organic synthesis.



Design and synthesize highly conjugated, rigid aromatic systems which will exhibit interesting materials properties e.g. photochromic.

Synthesis of drug molecules and their libraries. Interested in studying the bioactivity of the newly synthesized libraries for drug leads in collaboration.

Dr. Bhyrappa, P

PhD., IISc., Bangalore

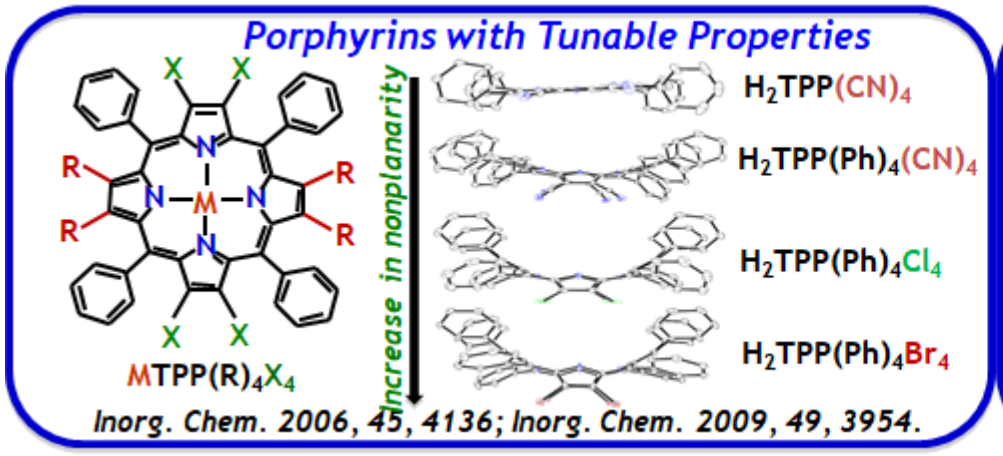
Professor, Chemistry

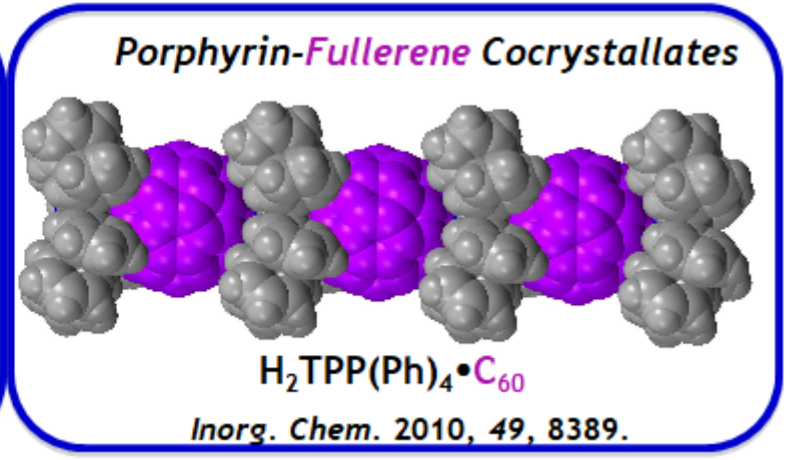
+91 44 2257 4222; byra@iitm.ac.in

http://chem.iitm.ac.in/faculty/bhyrappa/

Major Areas of Research

- *Biomimetic Models*
- *Porphyrin Synthesis*
- *Tunable Macrocycle Properties*
- *Supramolecular Chemistry*
- *Materials Chemistry (DSSCs)*
- *Catalysis*





Dr. Debashis Chakraborty (Dr.rer.nat.)

PhD, University of Göttingen, Germany

Professor, Chemistry

044-2257-4223; dchakraborty@iitm.ac.in

- **Organometallic Synthesis/Catalysts for Biodegradable Polymers and Copolymers**
- **Organometallic Synthesis/Catalysts for CO_2 Utilization and Sequestering**
- **Organic Synthesis/Metal Mediated Catalysis for Organic Reactions**
- **Organometrallic Catalysts for Olefin Polymereization**

Polymer from Corn

Polymerization using CO_2

Green Catalytic Systems for Organic Synthesis

FROM LABORATORY TO INDUSTRY

Dr. Desai Aamod

PhD, IISER Pune, India

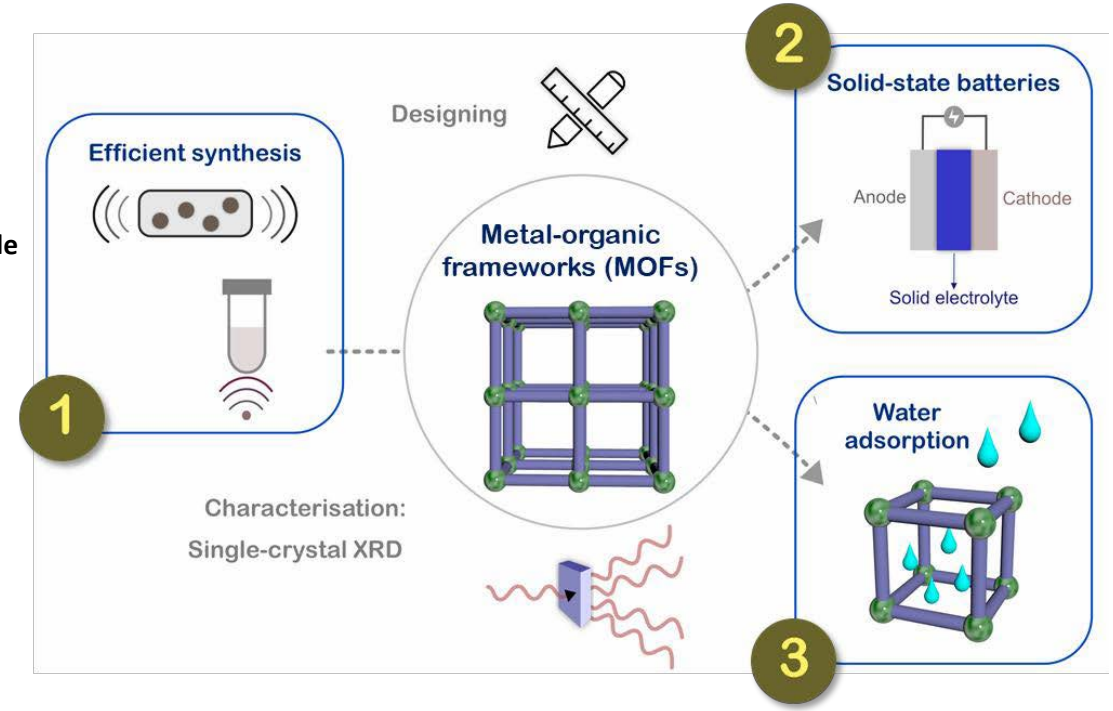
Assistant Professor, Dept. of Chemistry

044-2257-11758; avdesai@iitm.ac.in

- Developing functional crystalline, porous solids, such as MOFs
- Using MOFs for water harvesting and in energy storage devices
- Applying principles of sustainable and green chemistry

Schematic diagram showing main research areas in short and long term

Greener, sustainable methods



Using MOFs for energy storage devices, such as batteries

Towards water conservation

Dr. R Dhamodharan

PhD, University of Massachusetts, USA

Professor, Chemistry

044-2257-4204; damo@iitm.ac.in

http://www.iitm.ac.in/http://chem.iitm.ac.in/

https://sites.google.com/site/welcometoprofdhamodharangroup/

- Controlled Radical Polymerization – Block Copolymers of Complex Architectures
- New Applications Using Biopolymers (Chitin, Cellulose, Rubber, Natural Gums)
- Polymer Light Emitting Diodes (PLED) and Electroluminescent (EL) Materials – Synthesis and Applications in Solar Energy Harvesting

Controlled Release of Nutrients Minerals and Water to Soil from Biodegradable Polymer Matrices (Sea Shell)

Environmental Remediation (Oil Spill, Metal ion Removal, Waste and Dye Water Treatment)

PLED and EL Materials

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

Dr. Dillip Kumar Chand

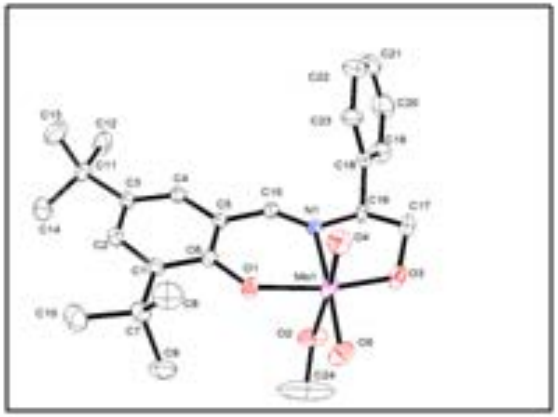
PhD, IIT Kanpur, INDIA

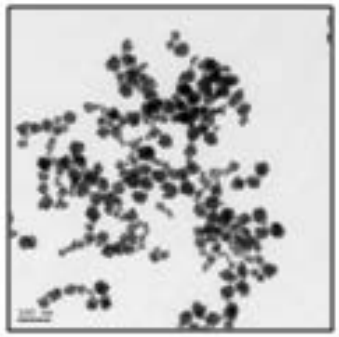
Professor, Chemistry

044-2257-4224; dillip@iitm.ac.in

http://chem.iitm.ac.in/professordetails/profdillip/index.htm

- Supramolecular Chemistry: Self-assembled coordination cages from palladium(II) and organic ligands.
- Homogeneous catalysis: Molybdenum containing catalysts for organic transformation reactions.
- Nanoscience: Synthesis and functional (e.g. catalysis) aspects of metal nanoparticles.





Dr. Edamana Prasad

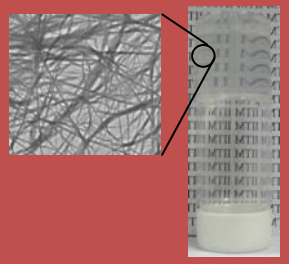
PHD, Kerala University, IN

Professor, Chemistry

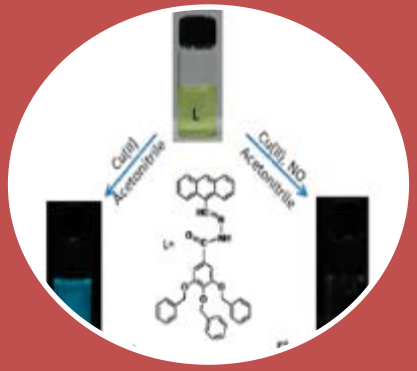
044-2257-4232; pre@iitm.ac.in

http://www.chem.iitm.ac.in

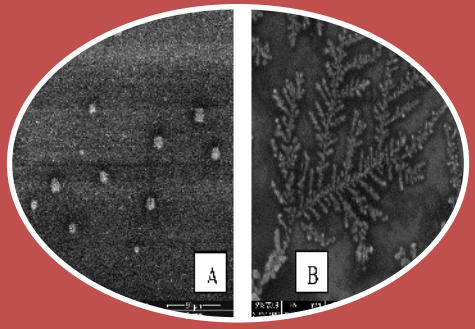
- Self Assembly of Macromolecules
- Photophysics of the Self Assembled Systems



Developing Novel Gel Systems



Developing Sensors for Anions, Toxic Metal Ions



Develop Fundamental Knowledge about the Mechanism of Self Assembly in Macromolecules

Dr. Hema Chandra Kotamarthi

PhD, Tata Institute of Fundamental Research

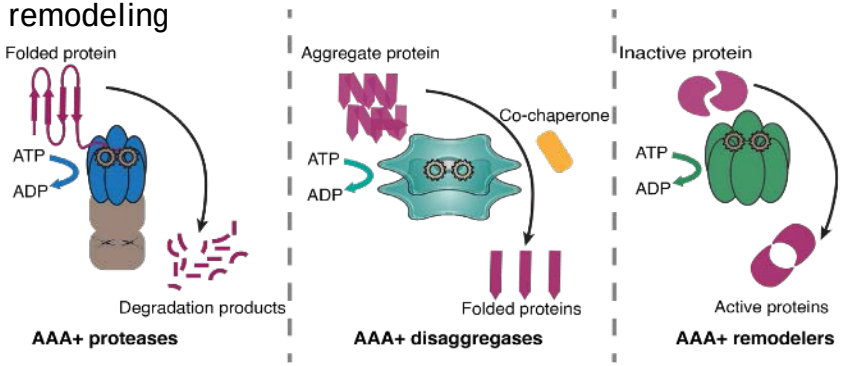
Professor, Chemistry

044-2257-4213; hemachandra@iitm.ac.in

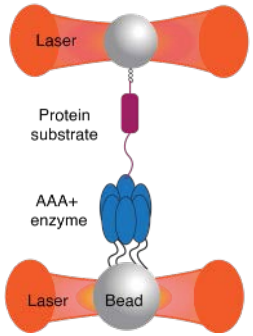
http://chem.iitm.ac.in/faculty/hemachandra/

- Experimental Biophysical Chemistry/ Single-molecule biophysics
- ATP-dependent bio-molecular motors
- Protein folding/unfolding, degradation and disaggregation

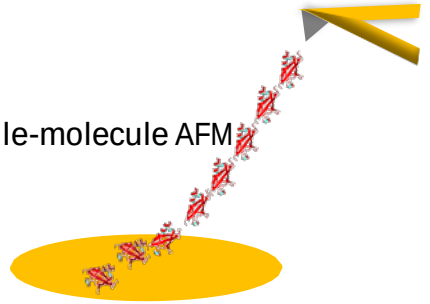
ATP-dependent molecular motors involved in protein remodeling



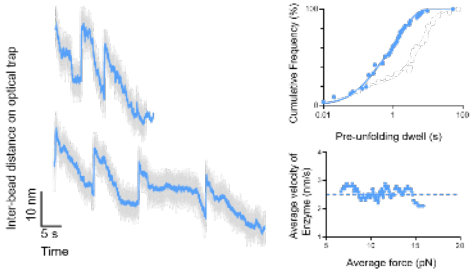
Tools for single-molecule force-spectroscopy



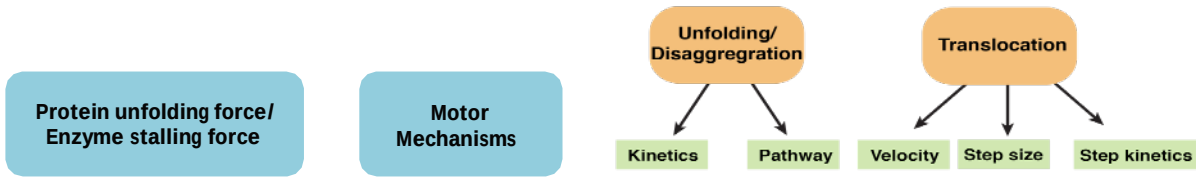
Single-molecule AFM



Representative data traces



Enzyme properties measured using single-molecule force spectroscopy



Dr. Indrapal Singh Aidhen

PhD, University of Pune, India

Professor, Chemistry

044-22574219; isingh@iitm.ac.in

http://chem.iitm.ac.in/professordetails/profsingh/index.htm

- Synthetic Organic/Carbohydrate Chemistry
- Synthesis of Biologically important Molecules
- Developing Methodologies/Building blocks for Target Driven Synthetic Endeavours

Major research interests have been in three directions. The first direction aims at developing ***novel*** Synthetic equivalents based on Weinreb amide (WA) functionality and their applications in synthesis of important molecules. The second direction aims at the synthesis of important and challenging targets from the realm of carbohydrate chemistry. The chosen targets belong to the class of *C*-glycosides and *Aza*-analogues. The third direction aims at developing new synthetic strategies and building blocks for biologically/medicinally important molecules.

Dr. Kartik Chandra Mondal

PhD, Karlsruhe Institute of Technology Germany

Associate Professor, Chemistry

044-2257-4228; csdkartik@iitm.ac.in

http://chem.iitm.ac.in/faculty/kartik/

Major Areas of Research

- **Carbene stabilized main group element or transition metal atom**
- **Radical, diradical and radicaloid**
- **Organometallic single molecule/ion magnet**
- **Organic catalysis by above mentioned species**
- **Theoretical calculations on stability, bonding aspects of unusual exotic species**

Source: Faculty website

Dr. Kothandaraman Ramanujam

PhD, Karlsruhe Institute of Technology Germany

Professor, Chemistry

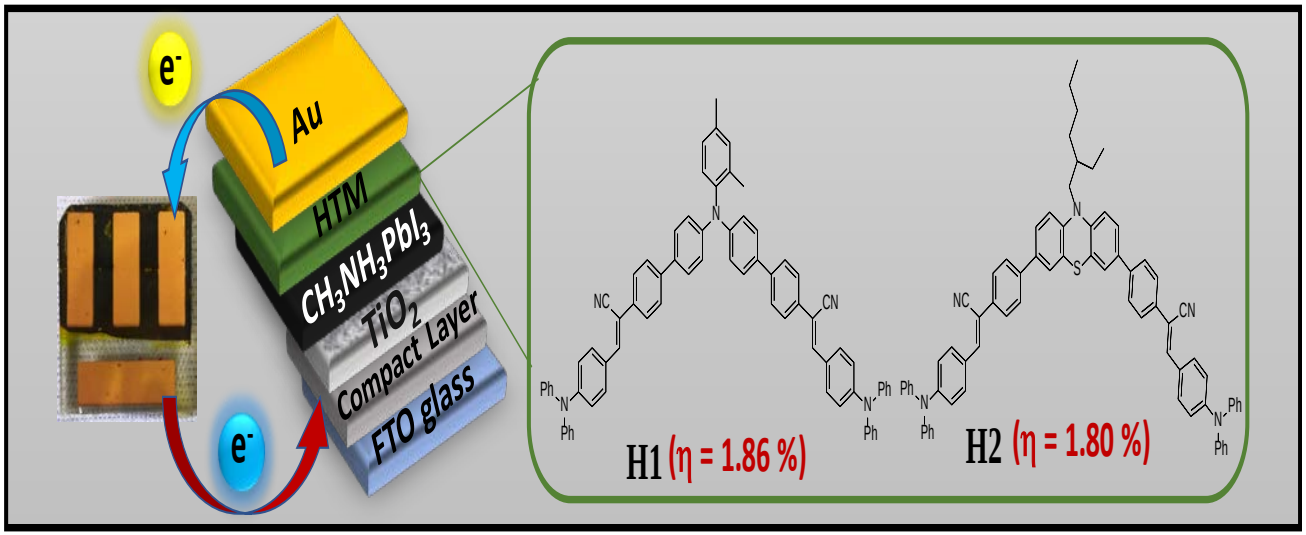
044-2257-4228; csdkartik@iitm.ac.in

http://chem.iitm.ac.in/faculty/kartik/

Areas of Interest:

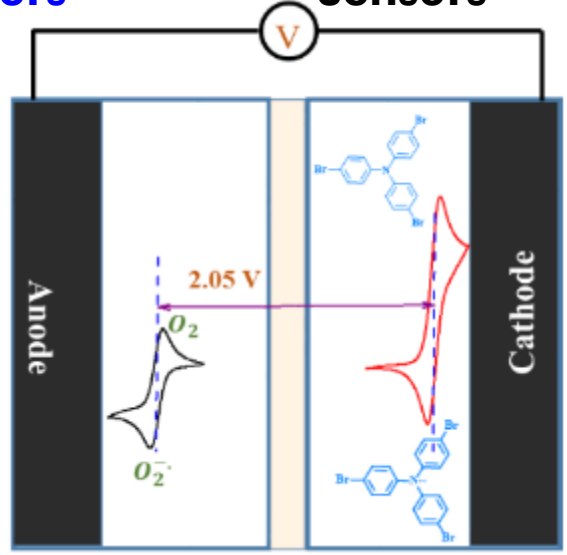
- Dye Sensitized Solar Cells **Perovskite Solar Cells**
- Redox Flow Battery (Vanadium and Organic)
- Organic electrode Materials for Li/Na ion Batteries

Flexible Battery



Molecularly Imprinted Polymers

Sensors



Dr. Krishna Reddy Nandipati

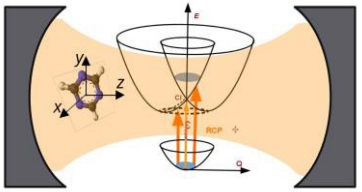
PhD, University of Hyderabad

Assistant Professor, Chemistry

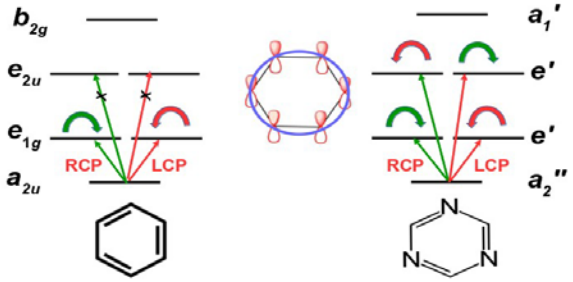
044 2257 4240; knandipati@iitm.ac.in

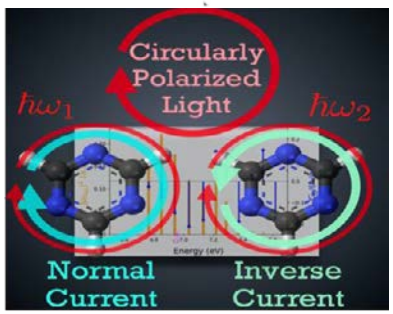
- Electronic ring currents in ring-shaped molecular systems
- Cavity control of molecular processes
- 2D electronic spectroscopy of nonadiabatic phenomena

Cavity control of ring currents in triazine



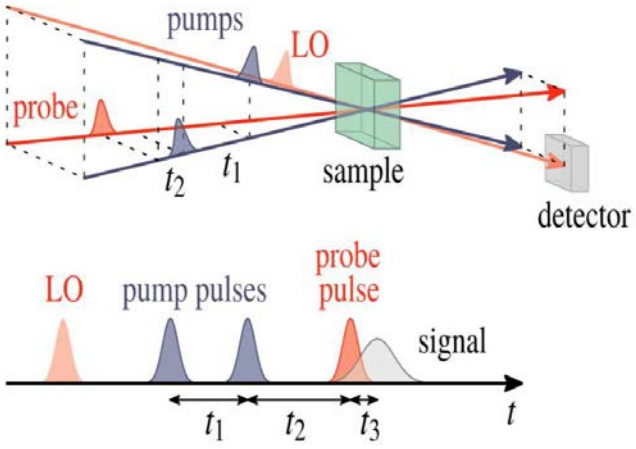
Electronic ring currents in ring-shaped molecules



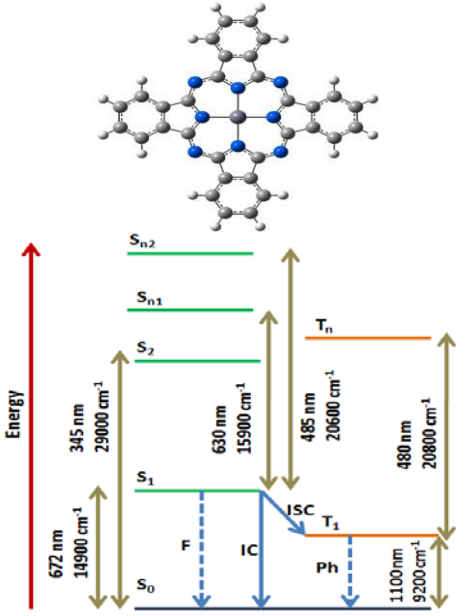


Previously predicted inverse ring currents

2D electronic spectroscopy of ZnPcs excited-state dynamics



Schematic of 2D electronic spectroscopy



ZnPc and its excited-state photophysics

Dr. MD Mahiuddin Baidya

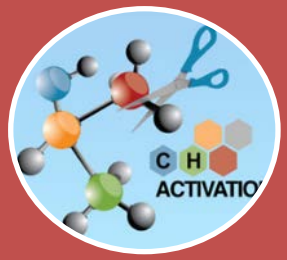
PhD, LMU Munich, Germany

Professor, Chemistry

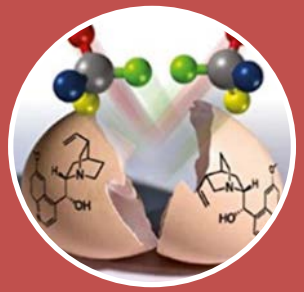
044-2257-4212; mbaidya@iitm.ac.in

http://chem.iitm.ac.in/faculty/baidya/

- Transition Metal Catalyzed C–H Bond Activation
- Asymmetric Synthesis with Nitroso Compounds
- Visible Light Photocatalysis for organic synthesis
- Synthesis of Natural Products and Bioactive Compounds



C–H bond activation



Chiral synthesis

Visible-light catalysis

Designer Catalysis and Organic Synthesis

Dr. Masilamani Jeganmohan

Professor, Chemistry

044-2257-4211; mjeganmohan@iitm.ac.in

http://www.iitm.ac.in/info/dept/CY

Major Areas of Research

- Transition metal complexes as catalysts in organic synthesis:
  - Metal-catalyzed C-H bond functionalization reactions
  - Metal-catalyzed cyclization and addition reactions
- Asymmetric synthesis by using chiral metal complexes as catalysts
- Natural products and biologically active molecules synthesis

Catalyst Design ⟹ **Synthetic Methodologies** ⟹ **Mechanistic Investigation**

⇩

- Natural Products
- Biologically active molecules
- Chiral Organic Molecules

Dr. Muraleedharan K M

PhD., NIIST Trivandrum (Kerala University), India

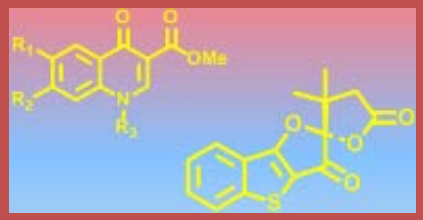
Professor, Chemistry

044-2257-4233; mkm@iitm.ac.in

http://www.chem.iitm.ac.in/professordetails/profmurali/page/index.html

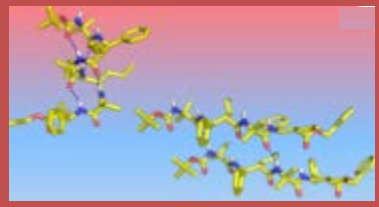
Research Areas:

- Synthesis of biologically active organic compounds
- Synthetic peptides for therapeutic applications
- Development of soft organic materials through controlled self-assembly



Organic Synthesis

Drug design



Synthetic mimics of Peptides and carbohydrates

Bio-Organic and Medicinal Chemistry

Dr. N Narasimha Murthy

PhD., IISc, Bangalore,

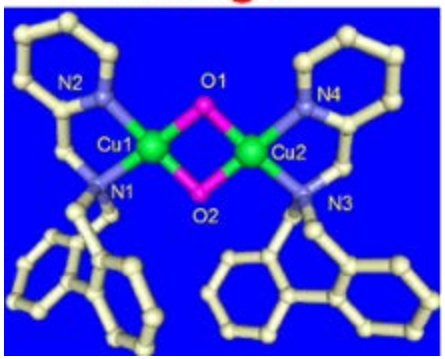
Professor, Chemistry

044-2257-4233; murthy@iitm.ac.in

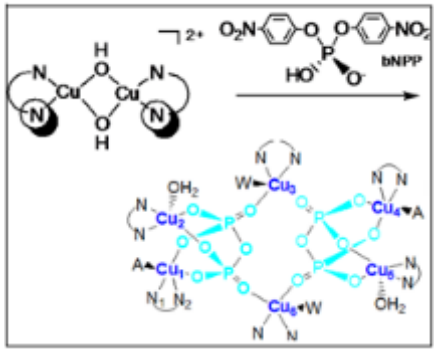
http://www.chem.iitm.ac.in/Faculty_murthy.html

- Bioinorganic chemistry of copper and iron
- Activation of O_2, stabilization of M-O_2 adducts, their spectroscopy and catalysis
- Design of binuclear DNA metallohydrolases model for cleavage of P-O bond
- Self-assembly of iron-oxo aggregates
- ^{1}H NMR and EPR spectroscopy of paramagnetic metal complexes

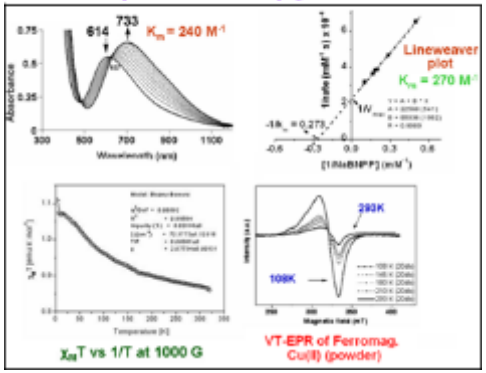
Design



Reactivity



Spectroscopy

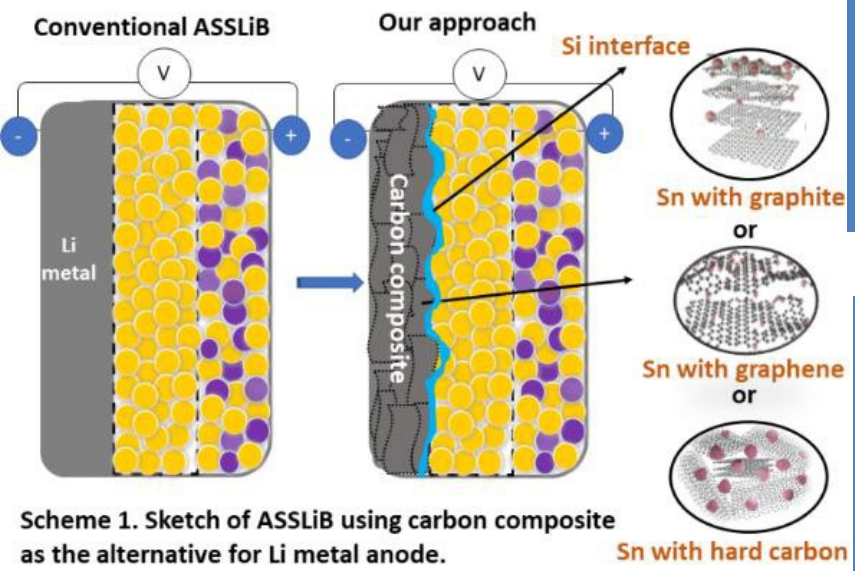


Dr. T. Palaniselvam

PhD, National Chemical Laboratory, India

Assistant Professor, Chemistry

044-2257-4215; palaniselvam@iitm.ac.in



Scheme 1. Sketch of ASSLiB using carbon composite as the alternative for Li metal anode.

Problem 1: Development of high-capacity materials

- Synthesis of electrode materials (anode and cathode)
- Physical characterization: SEM, XRD, TEM, XPS., etc.
- Study the electrochemical properties and phase changes with organic liquid electrolytes

Problem 2: Development of Solid Electrolytes (SE)

- Synthesis of sulfide-based & oxide-based SEs
- Structural characterization.
- Determination of ionic conductivity by EIS
- Study the compatibility of SE with electrode materials

Electrochemical studies

- Construction of solid-state battery cell
- Galvanostatic measurements
  (rate capability, cycle life, conductivity measurements)
- Identification of electrode-electrolyte interphases at the interface

Conventional battery

All-solid-state battery cell (homemade)

Dr. T. Pradeep

PhD. (Indian Institute of Science, India)

Professor, Chemistry

+91-44-2257-4208; pradeep@iitm.ac.in

http://www.iitm.ac.in/component/faculty/138/pradeep/

Most updated link: http://www.dstuns.iitm.ac.in/t-pradeep.php

- **Research Area/Focus 1:** Molecular and nanoscale materials
- **Research Area/Focus 2:** Drinking water purification
- **Research Area/Focus 3:** Ice chemistry

Advanced Sensors

Water Purification

Ice Chemistry

Diverse nanomaterials and their properties in the context of affordable clean water; with emphasis on understanding phenomena

Dr. Rajakumar Balla

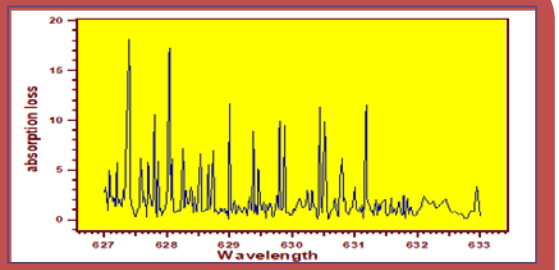
Phd, Indian Institute of Science, Bangalore

Professor, Chemistry

+91-44-2257-4231; rajakumar@iitm.ac.in

- Atmospheric lifetimes of VOCs, CFC/HFC alternatives, biogenically and anthropogenically emitted compounds. Absorption cross-sections and quantum yields of trace and transient species in the Earth's atmosphere; Global Warming Potentials; Ozone depletion and production potentials
- Cavity Ring Down Spectroscopy; Pulsed Laser Photolysis – Laser Induced Fluorescence
- Single Pulse Shock Tube studies on combustion of fuels/bio-fuels – Atomic Resonance Absorption Spectroscopic (ARAS) techniques
- Computational studies and kinetic simulations

Cavity Ring Down Spectrometer



Absorption spectrum of molecular oxygen

Single Pulse Shock Tube (For combustion studies)

Laboratory of Atmospheric and Combustion Processes

All the above are fabricated / developed at IITM

Dr. Ramesh Gardas

PhD, South Gujarat University, India

Professor, Chemistry

044-2257-4248; gardas@iitm.ac.in

http://www.iitm.ac.in/component/faculty/138/gardas

- Ionic Liquids
- Solution Thermodynamics
- QSPR and Group Contribution Methods

Green Solvents

Phase Equilibria

Process & Product Design

Experimental and Predictive Thermodynamic Data

Dr. G Ranga Rao

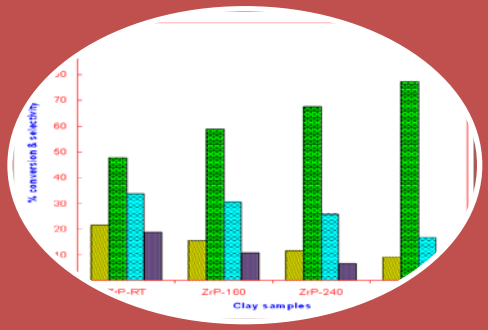
PhD, Indian Institute of Science, India

Professor, Chemistry

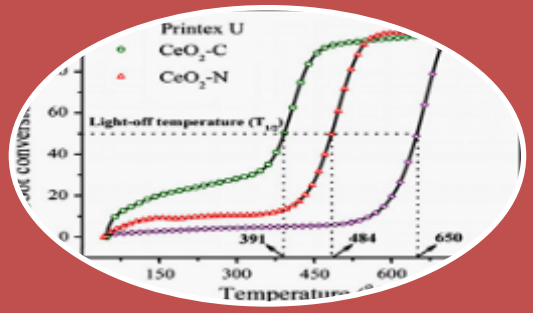
044-2257-4226; grrao@iitm.ac.in

http://chem.iitm.ac.in/department.html

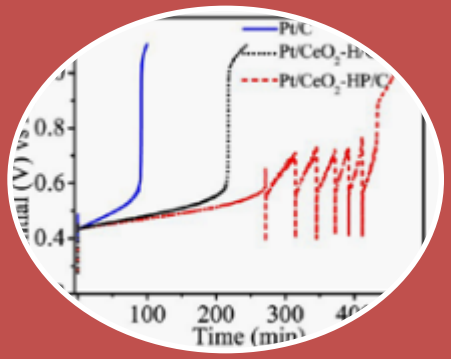
- Surface and nanomolecular catalysis: rare earth oxides, transition metal oxides and polyoxometalate compounds
- Solid state electrochemistry : electrocatalysis and supercapacitors
- Materials chemistry : porous materials, hybrid and functional materials



Pillared catalysts



Soot combustion activity



Eliminating CO poison on Pt

Materials chemistry : synthesis, catalysis, electrocatalysis, solid state electrochemistry

Dr. Sanjay Kumar

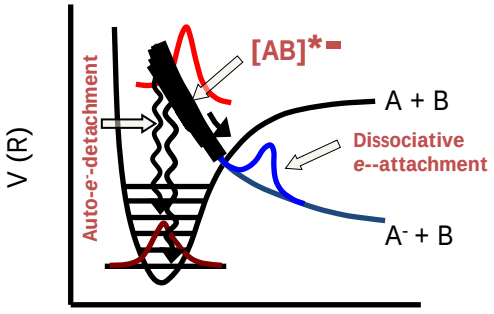
Professor, Chemistry

044-2257-4227; sanjay@iitm.ac.in

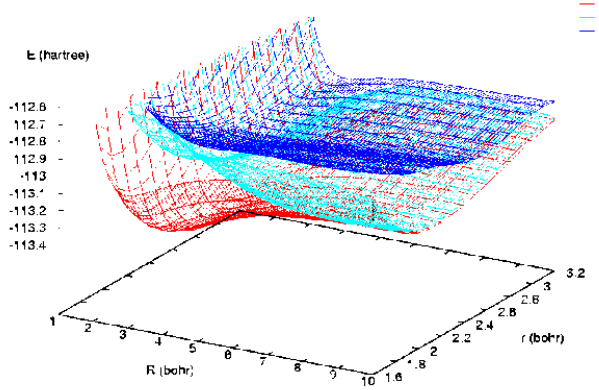
http://www.iitm.ac.in/info/fac/sanjay

Major Areas of Research

- Theoretical Chemistry, Quantum Molecular Reaction Dynamics
- High level *ab initio* bound-state quantum calculations and quantum dynamics of fundamental elementary chemical reactions
- Ion-molecule and low-energy resonant electron-molecule collisions, nonadiabatic (beyond the Born-Oppenheimer approximation) dynamics
- Computational modeling of chemical (organic) reactions & their mechanistic pathways



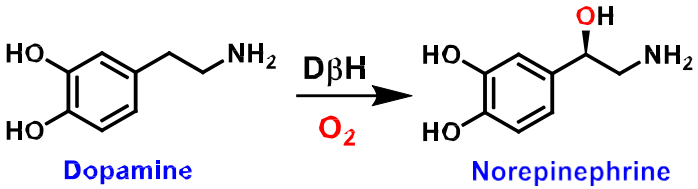
Formation of transient negative ions and their decay pathways in resonant e^--molecule collisions



Dr. Sanjib Panda
PhD, IIT Bombay
Assistant Professor, Chemistry, IIT Madras
044-2257-4235; sanjibp@iitm.ac.in

Understanding the coupled-binuclear mechani**sm of DβH enzyme**

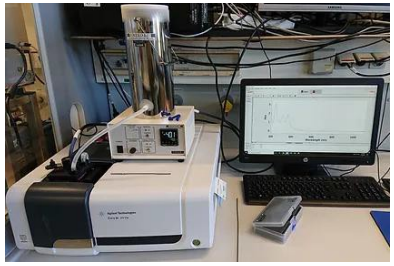
- Synthesis of suitably designed model comple xes and trapping of (μ-hydroxo)(μ-oxyl)dicopper(II) core (**A**) at -100 °C;
- Nature of H-atom transfer, radical trapping, pr oduct stereospecificity;
- Analysis by structural, spectroscopic and DFT studies.



Schlenk Techniques: For synthesis of our air-sensitive complexes

Closed active site of DβH at resting state

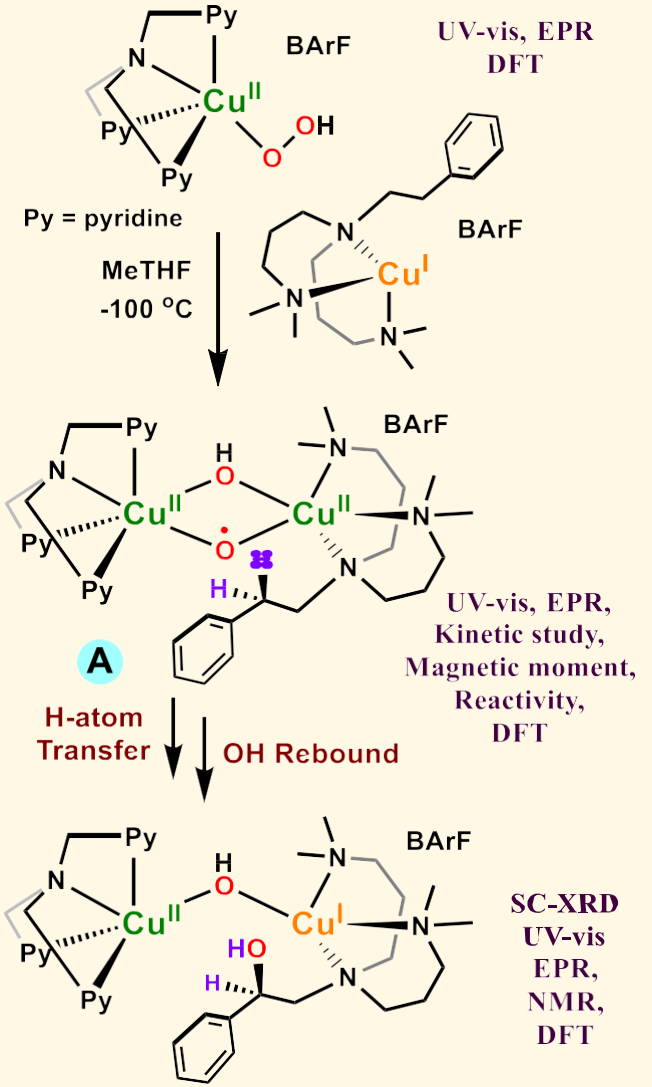
Handing air-sensitive samples



Low-temp UV-vis study

Cryo-cuvette

A Proposed model system



Dr. G Sekar

PhD. (IIT Kanpur, India)

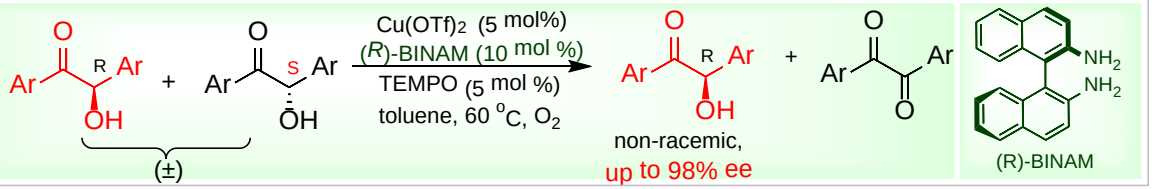
Professor, Chemistry

044-2257-4229; gsekar@iitm.ac.in

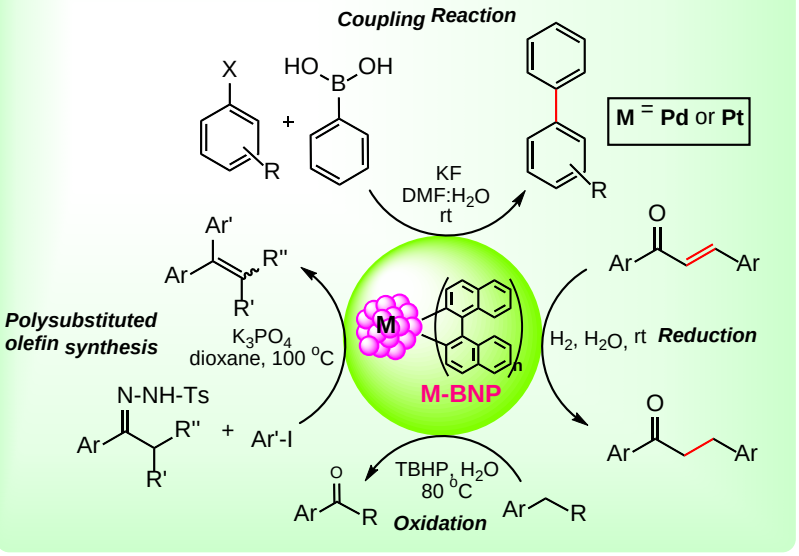
http://chem.iitm.ac.in/faculty/sekar/

- Asymmetric synthesis
- Metal nanocatalysts
- Halogen bonding catalysts

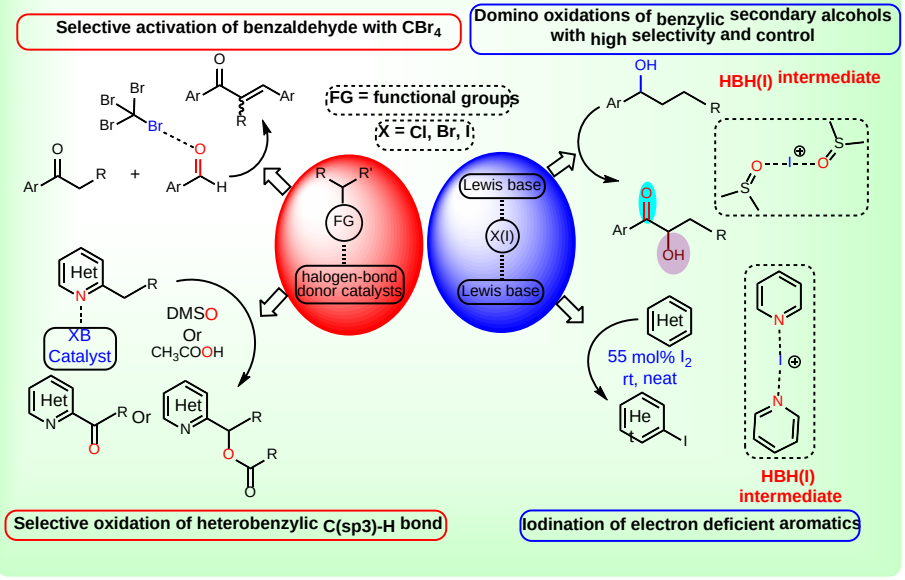
Enzyme Model: **Biomimetic, Enantiomer Differentiating, Oxidation of Alcohols by Chiral Copper Complex**



Metal nanocatalysts (covalent bond stablization)



Halogen bonding catalysts



Dr. S R K C Sharma Yamijala

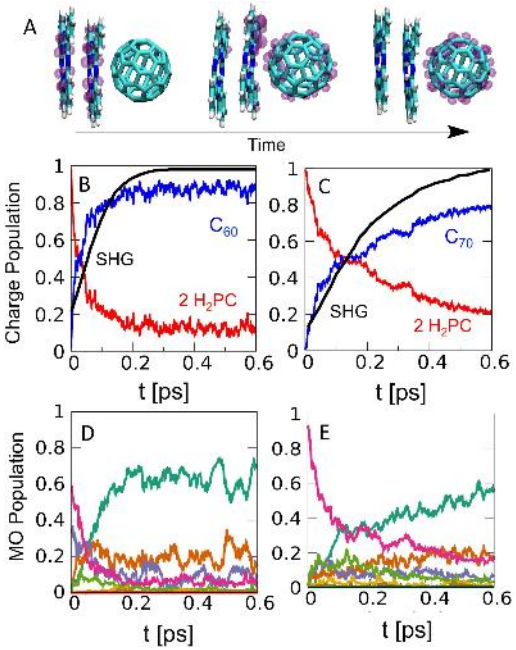
PhD, Jawaharlal Nehru Centre for Advanced Scientific Research

Assistant Professor, Chemistry

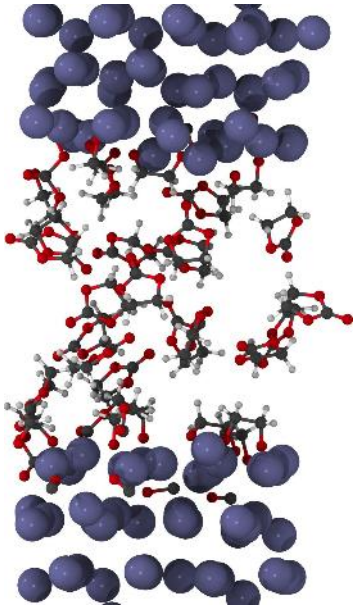
044-2257-4xxx; chaitanya@iitm.ac.in

http://chem.iitm.ac.in/faculty/chaitanya/

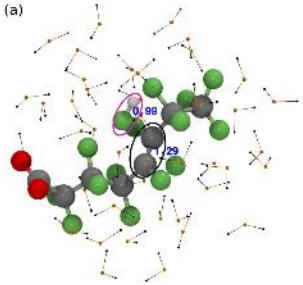
- Development, implementation, and application of nonadiabatic molecular dynamics methods
- Understanding the microscopic mechanism of batteries, and water-pollutants degradation
- External-energy assisted catalysis



Implementation and application of FSSH method



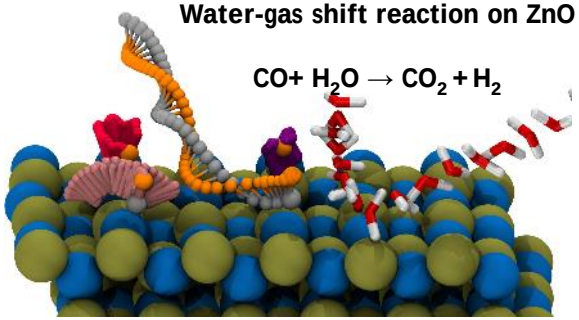
Solvent degradation mechanism in a Calcium-battery

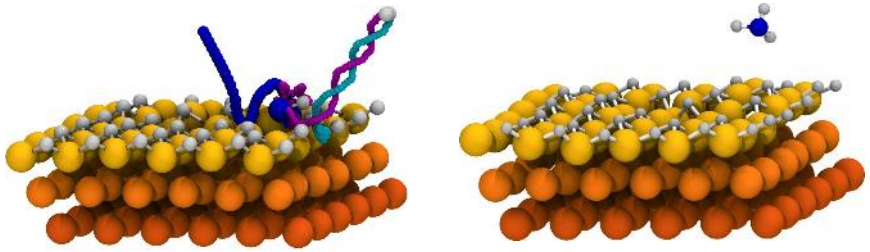


Perfluorooctanoic acid degradation

Water-gas shift reaction on ZnO

$CO + H_2O \rightarrow CO_2 + H_2$





Formation mechanisms of ammonia on a Cu-surface in a N_2/H_2 plasma environment.

Dr. Sooraj K

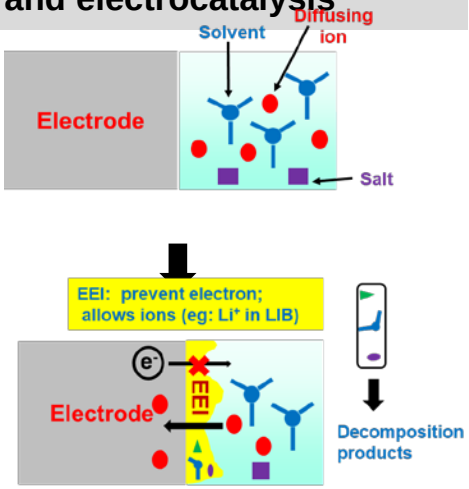
PhD Indian Institute of Technology Kanpur

Assistant Professor, Chemistry

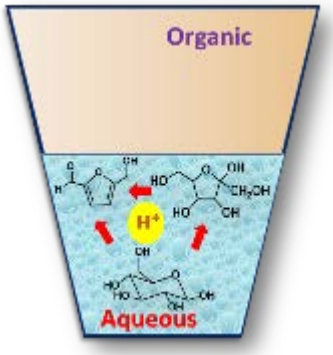
044 2257 4245, sooraj@iitm.ac.in

- Reactions at the interface with applications to energy storage, renewable energy production, catalysis, and synthetic chemistry
- Machine learning-based catalyst and material design
- Mechanism of formation and structure of polymers with diverse applications
- Development of electrodes and electrolytes for Li and post-Li ion batteries
- Homogenous and heterogeneous catalysis

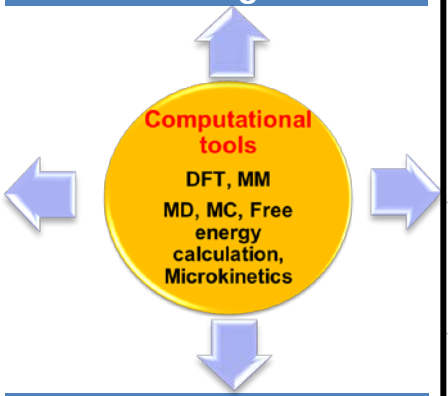
Reactions at the solid-liquid interface with applications in batteries and electrocatalysis



Chemical reactions at the liquid-liquid interface with applications to biofuel production

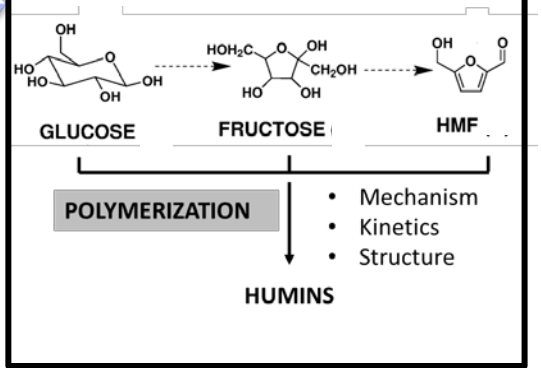


Electronic structure of materials for energy storage



Catalysis: acid/base, zeolite-based catalysis & electrocatalysis for renewable energy

Mechanism and kinetics of formation and structure of polymers with applications to energy storage and renewable energy



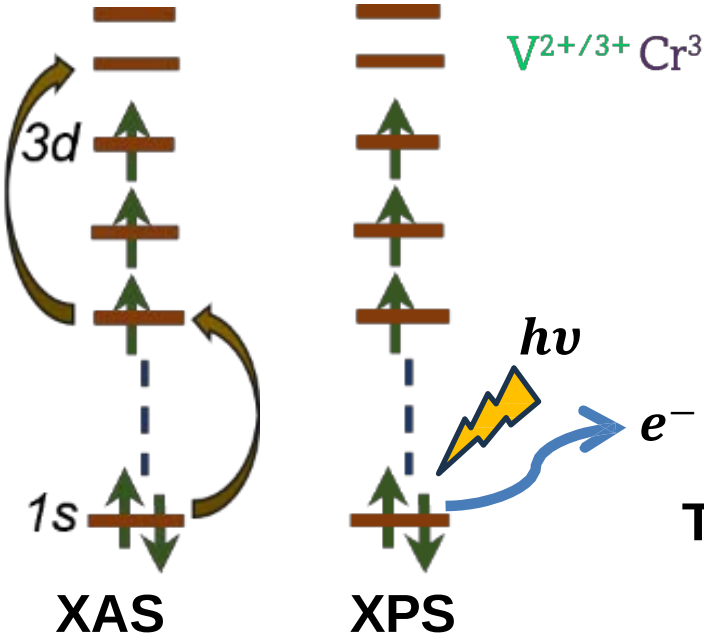
Dr. Soumen Ghosh

PhD, University of Minnesota, USA

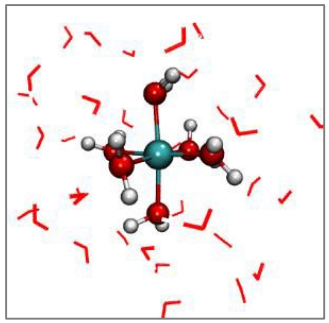
Assistant Professor, Chemistry

chemsghosh@iitm.ac.in

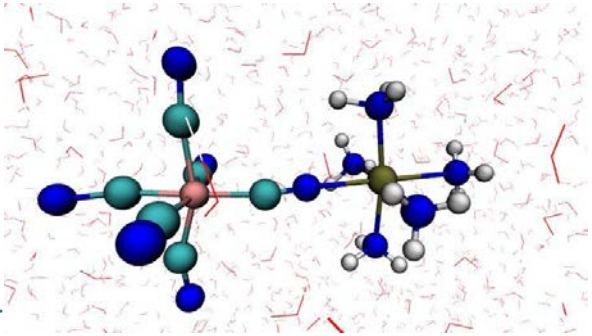
- Core-level spectroscopy of chemical systems
- Analyzing local chemical and solvation environments
- Linear and nonlinear X-ray signals in condensed phase



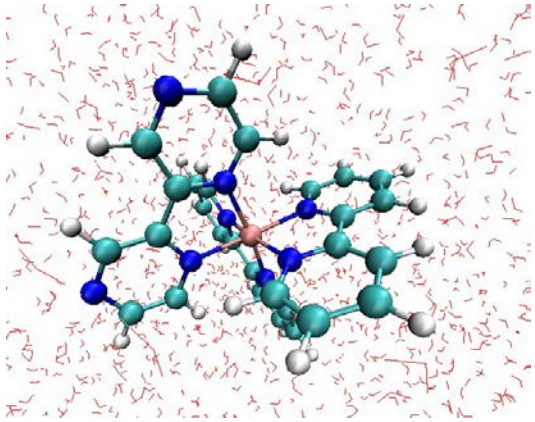
$V^{2+/3+}$ Cr^{3+} Mn^{2+} Fe^{3+} Co^{2+} Ni^{2+} Cu^{2+}



Transition metal ions in water



Fe(II) **Pt(IV)**



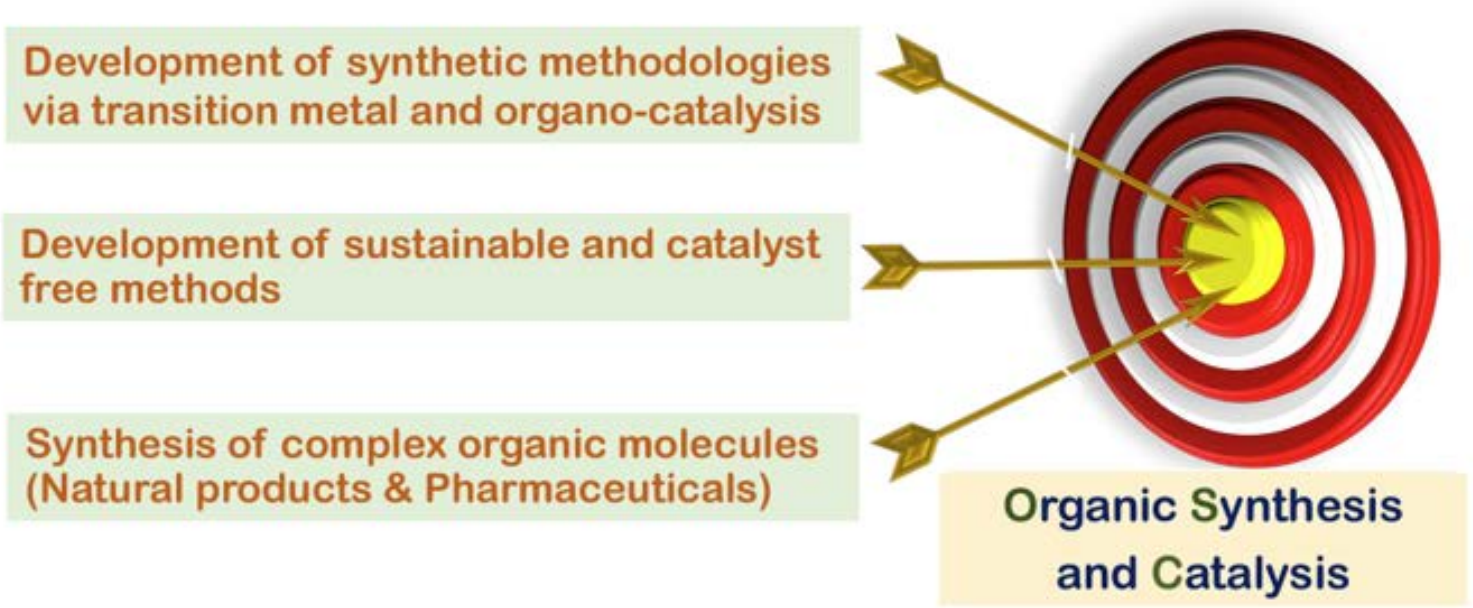
$Ru(II)(Bpy)_2(Bpz)$

Dr. Sudam G Dawande

Assistant Professor, Chemistry

sgdawande@iitm.ac.in

- **Organic Synthesis and Catalysis**
- **Asymmetric Synthesis**
- **Synthesis of complex organic molecules**



Dr. Sundargopal Ghosh

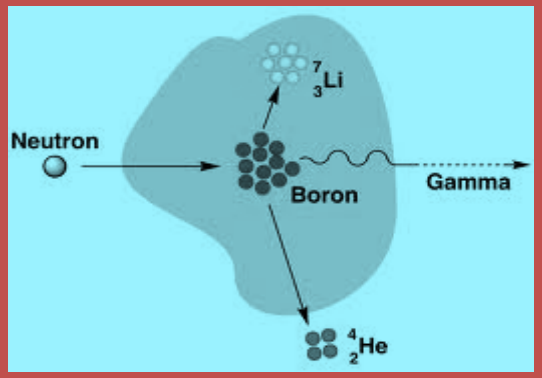
Professor, Chemistry

044-2257-4230; sghosh@iitm.ac.in

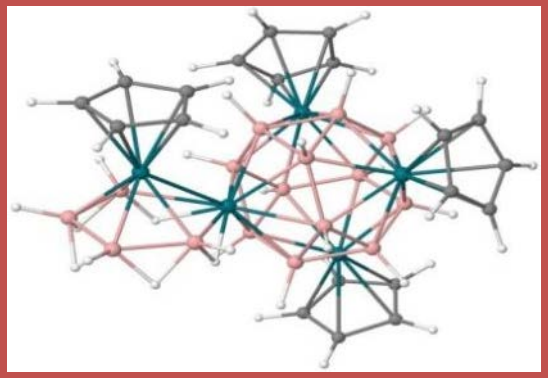
http://chem.iitm.ac.in/professordetails/profghosh

Major Areas of Research

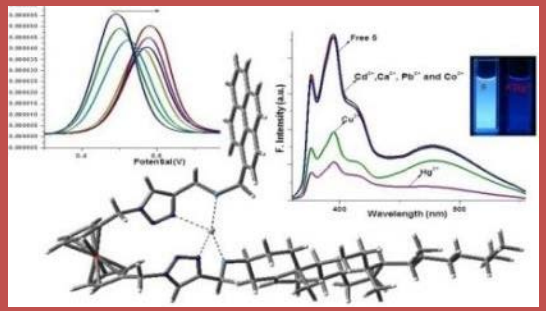
- Synthetic main group cluster chemistry, mainly polyhedral borane.
- Rare-earth metallaborane clusters; Metal-borides from metallaboranes.
- Metallaboranes in catalysis: Functionalization of hydrocarbons; catalytic cyclotrimerization of alkynes.
- Molecular recognition: Design and synthesis of new ferrocene derivatives containing boron centered functionalities.



Boron Neutron Capture Therapy



Supraicosahedral Clusters



MgB_2 the Superconductor Multichannel Probefor Metal Ions

Dr. Venkatakrishnan P

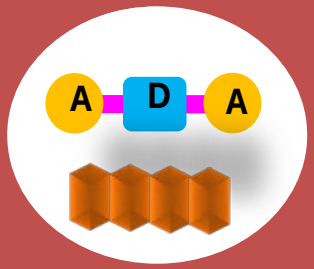
PhD, IIT Kanpur India

Assistant Professor, Chemistry

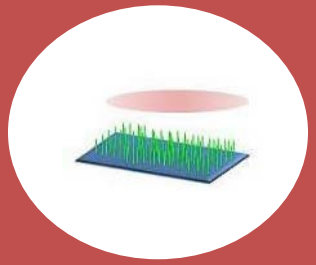
044-2257-4230; pvenkat@iitm.ac.in

http://chem.iitm.ac.in/professordetails/Venkatakrishnan.pdf

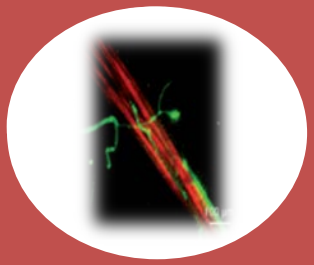
- Organic Electronics – Organic Materials for Solar Cells and Transistors
- Organic Sensors – Developing Organic Materials for Solid-State Sensing
- Organic Photonics – Brilliant Organic Emitter Dyes for Bio-Imaging



Organic Electronics



Organic Sensors



Organic Photonics

Functional Organic Materials for Electronics and Photonics

Dr. Yogesh Gangaram Shelke

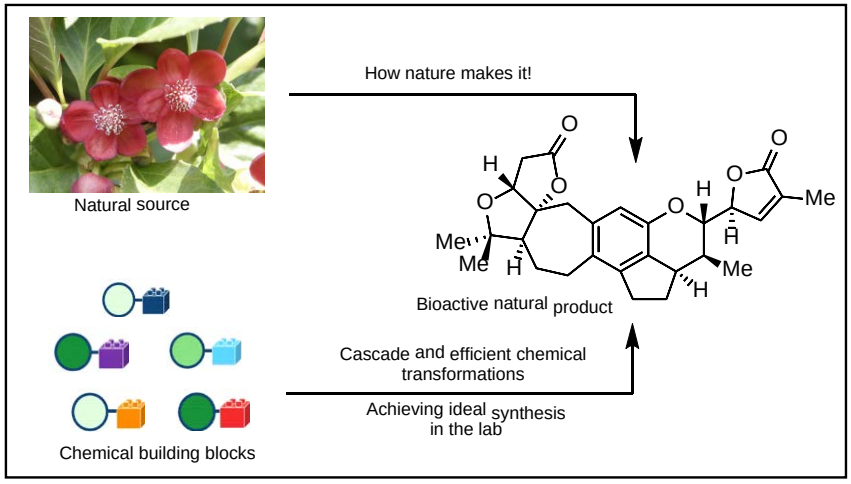
Ph.D., IIT Bombay, Mumbai, India

Assistant Professor, Chemistry

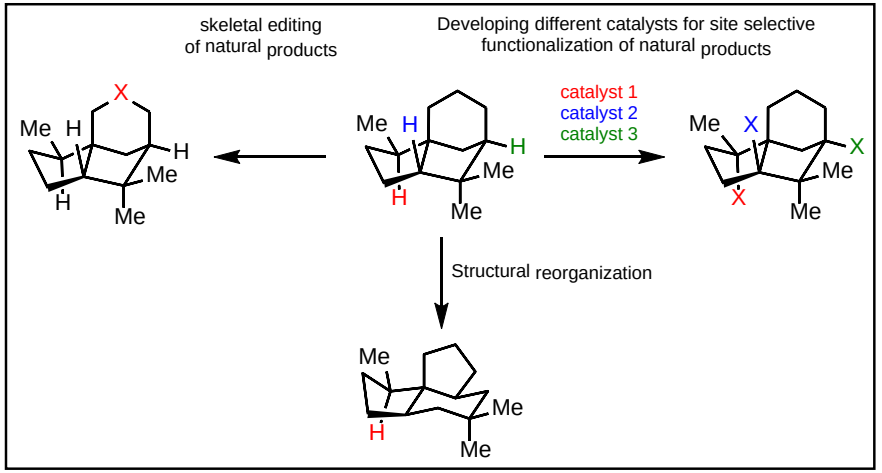
044-2257-11330; ygshelke@iitm.ac.in

Total Synthesis of Natural Products and Drug Discovery

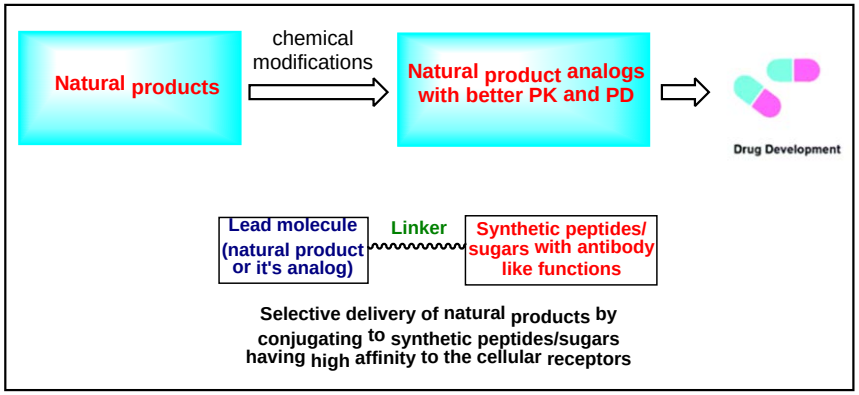
1) Development of cascade synthetic strategies for ideal and efficient synthesis of natural products.



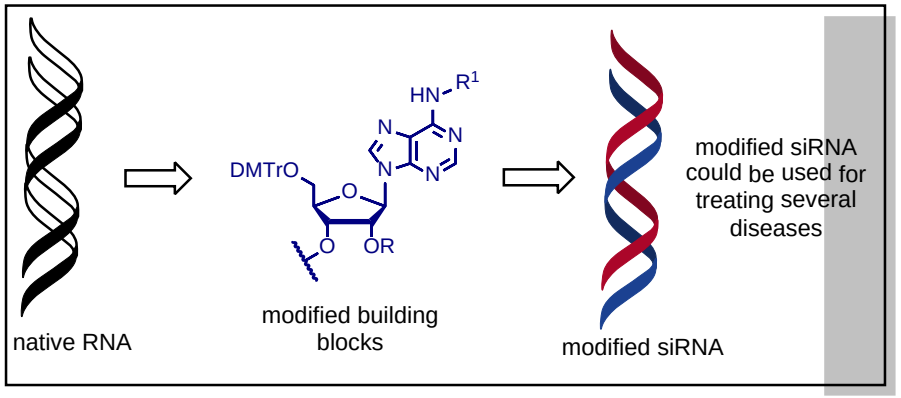
2) Structural reorganization, skeletal editing, and site-selective functionalization of natural products.



3) Drug discovery based on natural products.



4) Medicinal chemistry of oligonucleotide therapeutics.



INDIVIDUAL FACULTY PROFILE

DEPARTMENT OF CIVIL ENGINEERING

LIST OF FACULTY

- Alagappan P
- Alagusundaramoorthy P
- Anmol Pahwa
- Amlan Kumar Sengupta
- Anmol Pahwa
- Aritra Pal
- Arul Jayachandran
- Arun Menon
- Ashwin Mahalingam
- Aslam Kunhi Mohamed
- Atul Narayan S P
- Balaji Narasimhan
- Benny Raphael
- Bhargava Rama Chilukuri
- Chandan Sarangi
- Chandrasekhar A.S
- Dali Naidu Arnepalli
- Dodagoudar G
- Gangolu Appa Rao
- Goudappa Dodagoudar
- Indumathi Manivannan Nambi
- Karthik K. Srinivasan
- Keerthana Kirupakaran
- Koshy Varghese
- Lakshmi Priya P S
- Lelitha Devi V
- Ligy Philip
- Manu Santhanam
- Mathava Kumar S
- Meher Prasad A
- Mohanakrishnan Logan
- Murali Jagannathan
- Murali Krishnan J
- Murthy C V R
- Nageswara Rao B
- Nikhil Bugalia
- Phanisri Pradeep Pratapa
- Piyush Chaunsali
- Prakash Singh Badal
- Radhakrishna G.Pillai
- Raghukanth S T G
- Ramesh Kannan K
- Ravindra Gettu
- Robinson R G
- Rupen Goswami
- Sachin S. Gunthe
- Saravanan U
- Satishkumar S. Rajaram
- Satyanarayana K N
- Shiva Nagendra S M
- Sivakumar Palaniappan
- Soumendra Nath Kuiry
- Sreeparvathy Vijay
- Subbarao Pichuka
- Subhadeep Banerjee
- Sudheendra Herkal
- Sudheer K P
- Surender Singh
- Tanushree Parsai
- Tarun Naskar
- Thyagaraj T
- Venkatraman Srinivasan
- Venu Chandra
- Vidya Bhushan Maji

Dr. Alagappan Ponnalagu

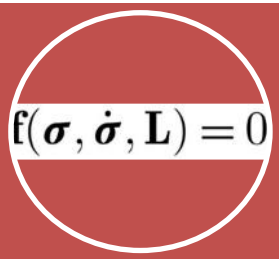
Associate Professor, Civil Engineering

044-2257-4320; alagappan@iitm.ac.in

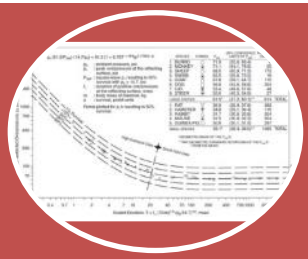
Major Areas of Research

- Modelling of ballistic and blast resistant structures
- Impact studies of fast moving projectile on nuclear domes
- Damage modelling
- Aortic dissection and Aneurysm

Develop experimental setup to study the ballistic and blast impact on structures



Developing a robust model taking into account the current drawbacks



Developing a safety criterion for ballistic and blast prone structures

Dynamic response of viscoelastic materials subjected to ballistic and blast impact

Dr. P Alagusundaramoorthy

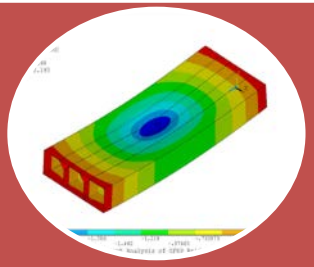
PhD., IIT Madras, India

Professor, Civil Engineering

044-2257-4276; aspara0@iitm.ac.in

http://www.civil.iitm.ac.in/faculty#st

- Advanced Composite Structures
- FRP Composites in Retrofitting and Rehabilitation of Structures
- Heat Straightening Process of Steel Structures



FRP Composites in Civil Infrastructure, Ship Structures, Offshore Oil Platforms and Aircraft Structures

Static and Seismic Strengthening of Concrete, Steel and Masonry Structures with GFRP and CFRP Composites

Heat Straightening Process for Damage in Strong Axis, Weak Axis, Twisting and Bulging of Steel Structural Members

Dr. Amlan K Sengupta

PhD, Missouri University of Science & Technology Rolla, USA

Professor, Civil Engineering

044-2257-4277; amlan@iitm.ac.in

http://www.iitm.ac.in/component/faculty/70/amlan/

- Behaviour of reinforced and pre-stressed concrete members
- Earthquake engineering as applicable to building design
- Assessment of concrete bridge decks for deterioration

Shear Walls

Building Frames

Bridge Decks

Numerical analysis and experimental investigation of structural concrete members

Dr. Anmol Pahwa

PhD, University of California, Davis, USA

Assistant Professor, Civil Engineering

044-2257-4275; anmpahwa@iitm.ac.in

- Sustainable Transportation
- Freight Transportation
- City Logistics
- Last-Mile
- Operations Research

Fundamentals of Continuous Approximation

$$L = 2\rho + kC/\sqrt{\delta}$$

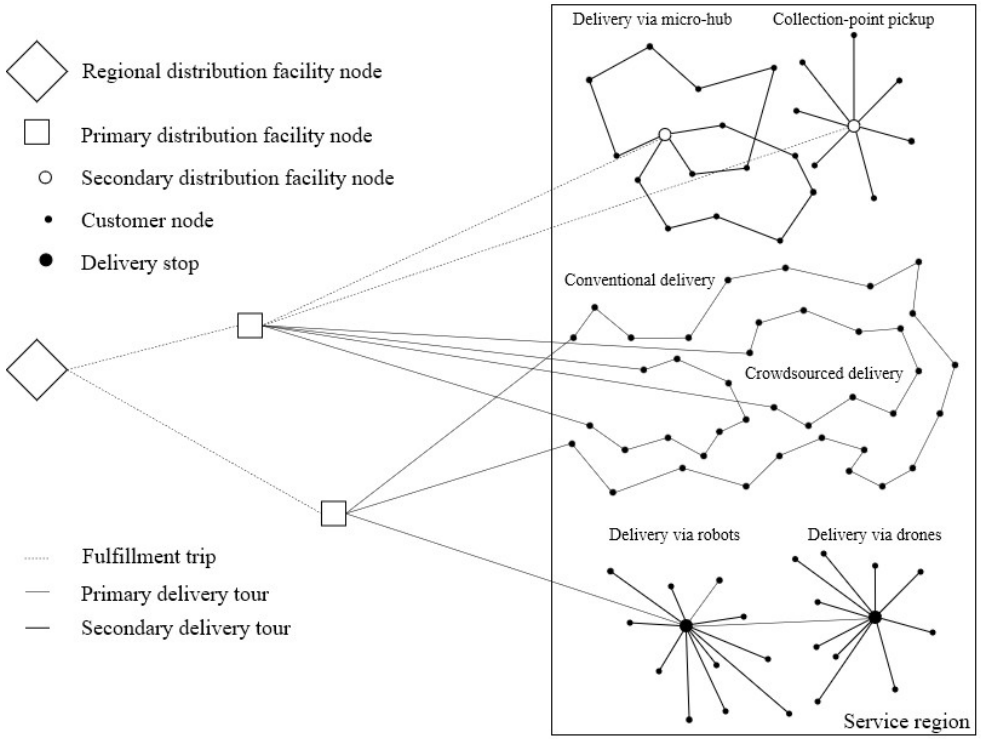
distance traveled in last-mile

distance traveled in long-haul

$$T = C\tau_f + \frac{2\rho}{v} + C\left(\frac{k}{v\sqrt{\delta}} + \tau_c\right)$$

travel time in last-mile

travel time in long-haul

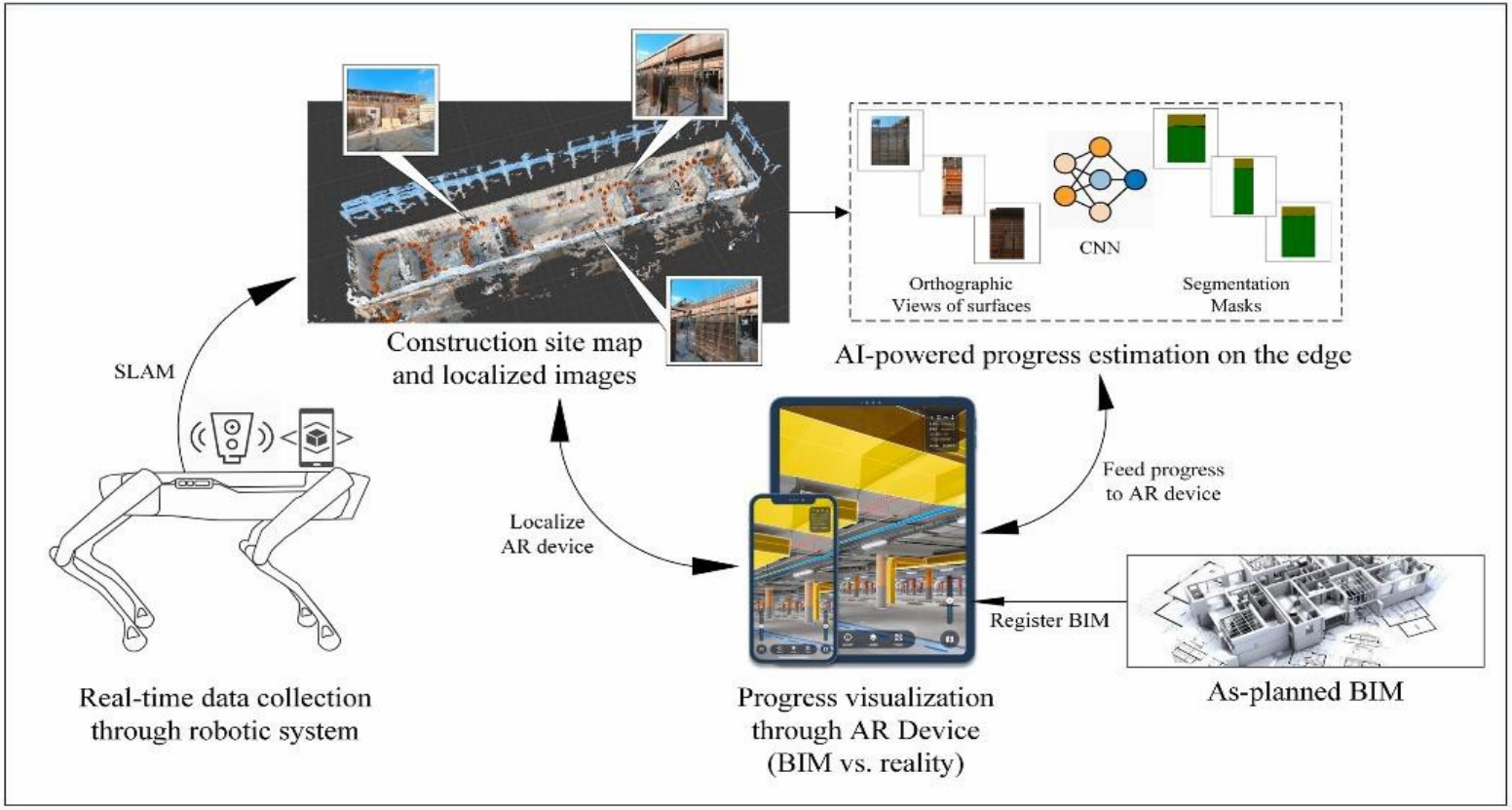


Last-mile distribution

Dr. Aritra Pal
PhD, National Taiwan University, Taipei, Taiwan
Assistant Professor, Civil Engineering,
044-2257-4333; aritrapal@civil.iitm.ac.in

- Construction performance monitoring (Progress/ Safety/ Quality/ Sustainability)

- AI/ML applications in Construction Management
- Smart and sustainable infrastructure management



Real-time Construction Progress Monitoring

Dr. Arul Jayachandran

PhD, IIT Madras, India

Professor, Civil Engineering

044-2257-4292; aruls@iitm.ac.in

- Stability design of structural steelwork
- Cold-formed/ Light Gauge Steel structures
- Glass structural engineering

LGS / Cold formed steel housing

Advanced analysis and design of structural steelwork

Structural Glass and façade engineering

Steel and glass blended for sustainable structures in India

Dr. Arun Menon

PhD, University of Pavia, Italy

Professor, Civil Engineering

044-2257-4299; arunmenon@iitm.ac.in

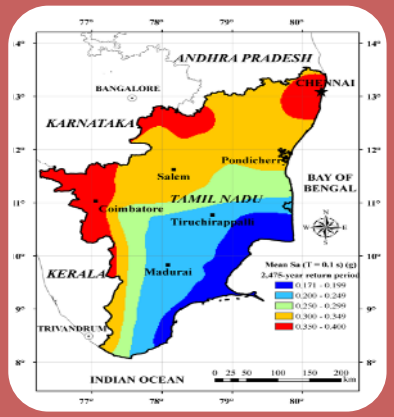
http://www.civil.iitm.ac.in/new/?q=arun_edu

- Structural Safety of Historical Monuments
- Seismic Behaviour, Assessment and Retrofit of Masonry Structures
- Seismic Risk Assessment of Structures at Urban Scale
- Historical Seismicity and Seismic Hazard Analysis

STRUCTURAL MODELLING & ANALYSIS

SEISMIC BEHAVIOUR OF MASONRY

FIELD & LABORATORY INVESTIGATIONS



SEISMIC HAZARD ANALYSIS

Dr. Ashwin Mahalingam

PhD, Stanford University, USA

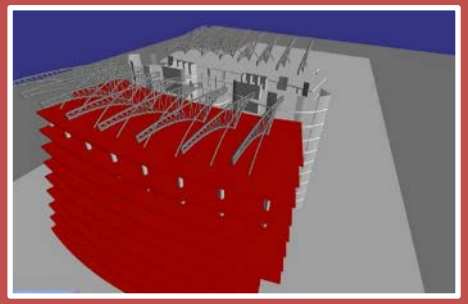
Professor, Civil Engineering

044-2257-4318; mash@civil.iitm.ac.in

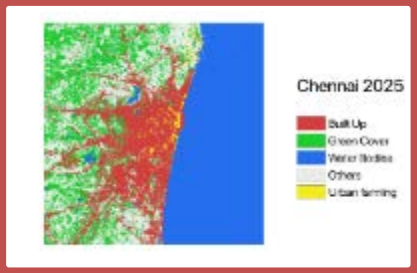
http://www.civil.iitm.ac.in/new/?q=ash_edu

- Public Private Partnerships and Megaproject Governance
- Virtual Planning, Design and Construction
- Infrastructure Policy, Urbanization and Sustainability

PPPs and Project Governance: When should PPPs be selected? What challenges arise as these projects are operational ? How can we govern megaprojects better so that more value is created?



Virtual Planning, Design and Construction: How can project planning be optimized using visualization? How can technology adoption be enhanced?



Policy, Urbanization and Sustainability: How can we reduce the carbon footprint of urbanization? How can we use agent-based models to test how urbanization policies perform in the future?

Dr. Aslam Kunhi Mohamed

PhD, EPFL Switzerland

Assistant Professor, Civil Engineering

044-2257-4311; akm@iitm.ac.in

- Molecular modeling of cementitious materials
- Cement hydration atomic structures
- Low CO2 cements

Dr. Atul Narayan SP

PhD, Texas A&M University

Associate Professor, Civil Engineering

044-2257-4300; atulnryn@iitm.ac.in

http://www.civil.iitm.ac.in/atulnryn

- Bitumen
- Bituminous concrete
- Granular materials
- Cement paste and fresh concrete

Experimental characterization

$$f(\mathbf{T}, \dot{\mathbf{T}}, \ldots, \mathbf{D}, \dot{\mathbf{D}}, \ldots) = 0$$

$$\mathbf{T} \cdot \mathbf{D} - \rho\dot{\psi} \geq 0$$

Modeling within the framework of continuum mechanics

Prediction of field performance

Material characterization and performance prediction

Dr. Balaji Narasimhan

PhD, Texas A&M University, USA

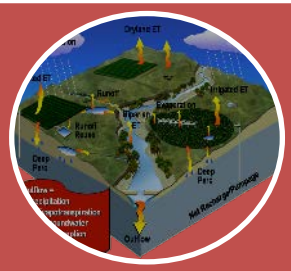
Professor, Civil Engineering

044-2257-4293; nbalaji@iitm.ac.in

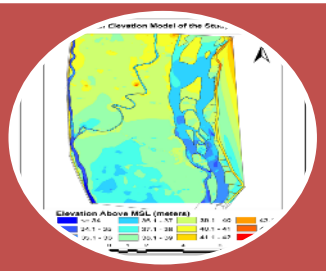
http://www.iitm.ac.in/component/faculty/70/nbalaji/

- Remote Sensing and GIS
- Hydrological Modeling
- Irrigation water management

Crop Evapotranspiration, Inter-basin water transfer, Irrigation efficiency



Impact of climate and landuse changes on the water resources



Floods & droughts extent, magnitude, duration and frequency

Dr. Benny Raphael

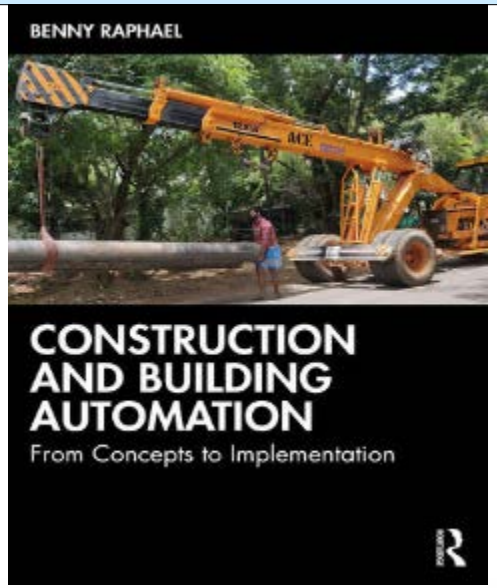
Professor, Civil Engineering

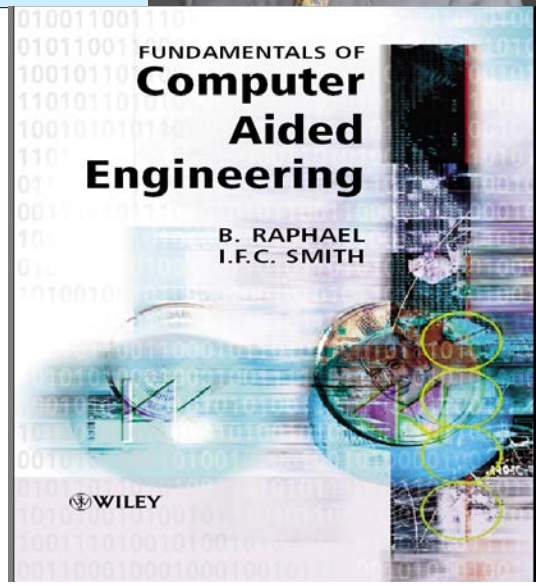
044-2257-4310; benny@iitm.ac.in

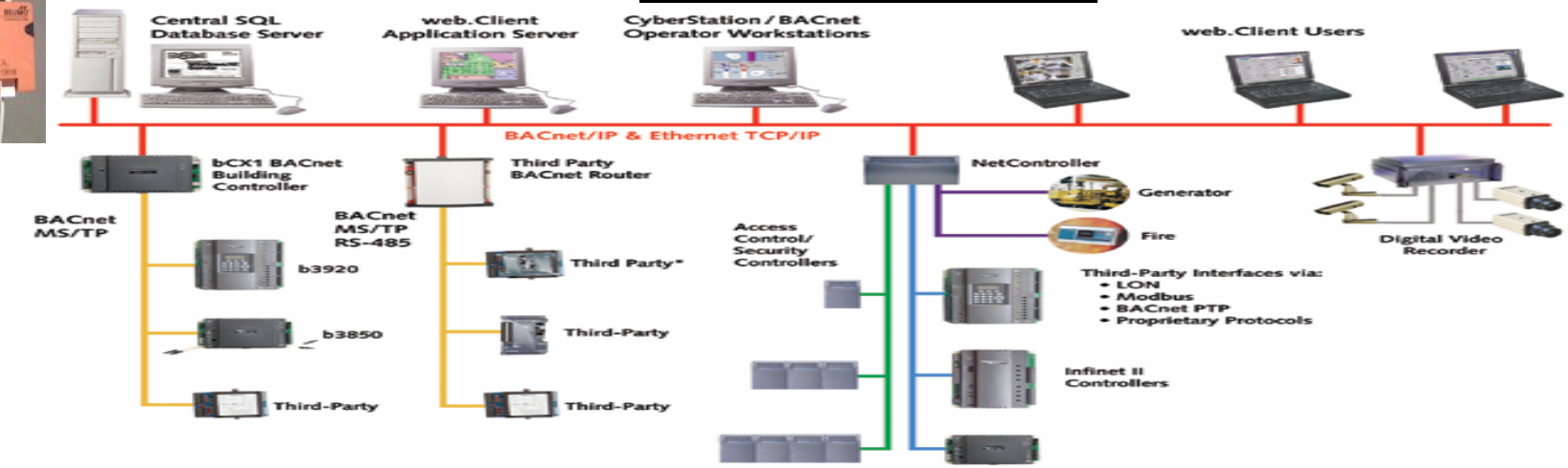
http://www.civil.iitm.ac.in/benny_edu

Major Areas of Research

- Construction automation, Building automation and control, Sustainable and Green Buildings
- Optimisation, Machine Learning







Dr. Bhargava Rama Chilukuri

PhD, Georgia Institute of Technology Atlanta

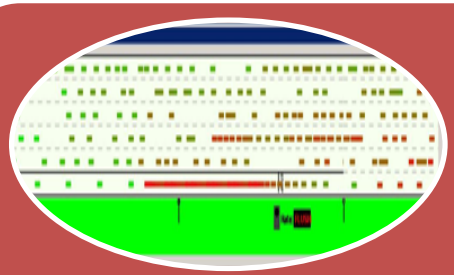
Associate Professor, Civil Engineering

044-2257-4270; bhargava@iitm.ac.in

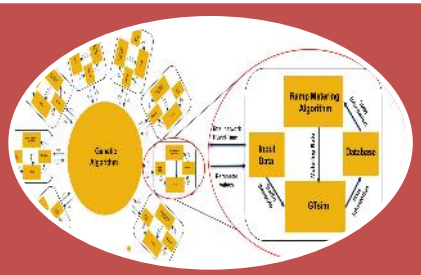
Major Areas of Research

- Traffic Flow Theory of Homogenous and Heterogeneous Traffic
- Numerical Simulation of Traffic Flow Models
- Optimal Control of Traffic Systems

Develop analytical models for homogenous and heterogeneous traffic flow based on empirical data



Numerical simulation of the traffic flow models to validate and fine-tune them



Optimal control of traffic systems and traffic network flow

Traffic Flow Theory and Optimal Control

Dr. Chandan Sarangi

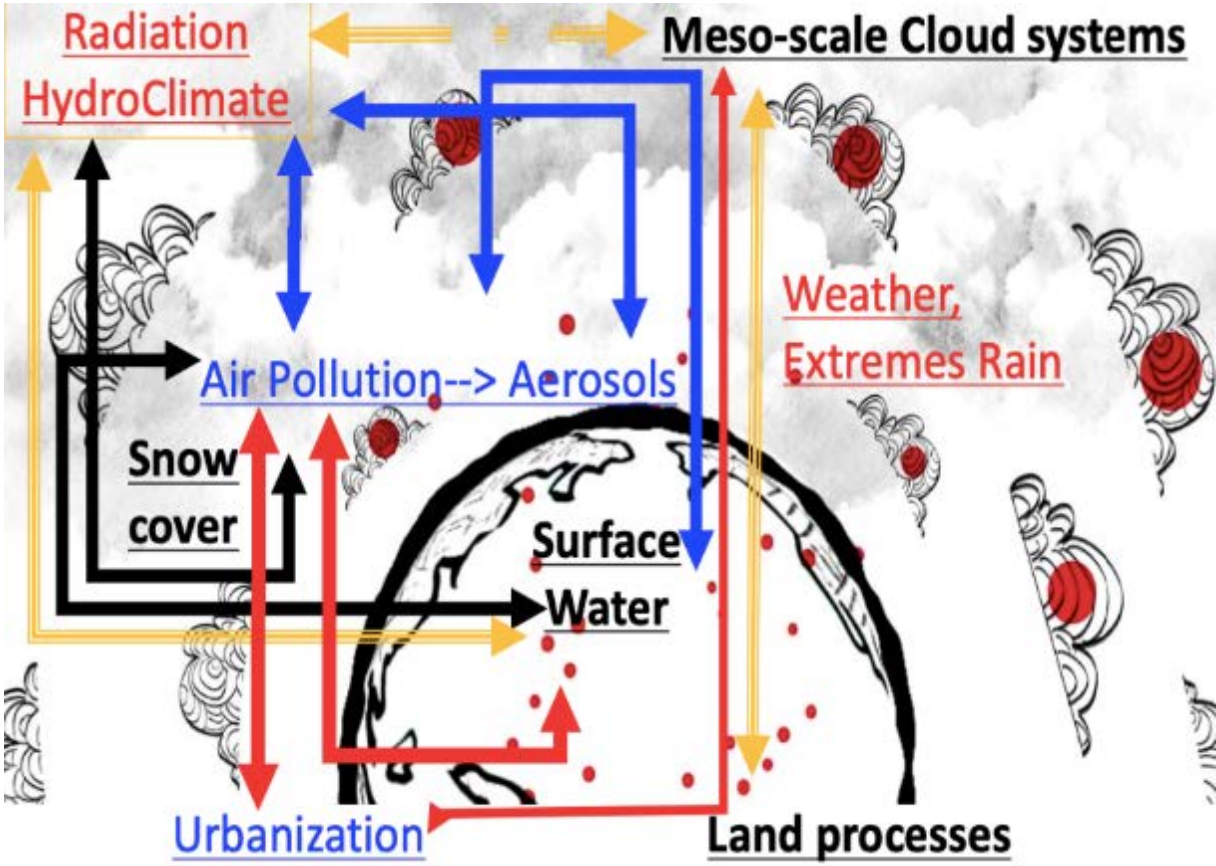
PhD, IIT Kanpur, India

Associate Professor, Civil Engineering

chandansarangi@iitm.ac.in

Major Areas of Research

- Impact of aerosols (particulate air pollution) on hydrometeorological processes (clouds, rainfall, fog, transpiration)
- Impact of dust deposition on Himalayan hydrology
- Modelling fate and transport of aerosols at regional and global scale
- Relative role of aerosols on temperature and extreme rainfall over Megacities



Aerosols and Hydro-Meteorology (ahm) Lab

Dr. Chandrasekhar Annavarapu Srinivas

PhD, Duke University, US

Associate Professor, Civil Engineering

044-2257-4325; annavarapuc@iitm.ac.in

Major Areas of Research

- **Computational Mechanics**
- **Finite element method development**
- **Numerical analysis**
- **Fracture mechanics**
- **Geomechanics**

Source: Faculty website

Dr. Dali Naidu Arnepalli

PhD, IIT Bombay, India

Professor, Civil Engineering

044-2257-4297; arnepalli@iitm.ac.in

http://www.iitm.ac.in/component/faculty/70/arnepalli/

- Geosequestration of Carbon for Mitigation of Green House Gases
- Design of Barrier Systems and Their Long Term Performance
- Geoenvironmental Engineering
- Unsaturated Behaviour of Geomaterials and Geosynthetic Clay Liners

Geosequestration of Green House Gases

Service life Prediction of Geosynthetics

Geomaterial Contaminant Interaction

FUNDAMENTAL BEHAVIOUR OF GEOMATERIALS

Dr. G R Dodagoudar

Professor, Civil Engineering

2257 4280 ; 9884078303; goudar@iitm.ac.in

http://www.civil.iitm.ac.in/new/?q=gd_edu

Seismic reliability analysis, Computational geomechanics

G

Geotechnical earthquake engineering, Seismic-soil structure interaction

Analysis of rain-induced slope instability, Seismic microzonation of urban centres

Landslide hazard and risk analysis, Fuzzy logic in geotechnics

R

Contaminant transport modelling, Stochastic soil dynamics

Nonlinear finite element analysis

D

Analysis and design of piled-raft foundation systems, Performance-based earthquake geotechnics

Dr. Gangolu Appa Rao

PhD, IISc. Bangalore

Professor, Civil Engineering

044-2257-4279; garao@iitm.ac.in

https://civil.iitm.ac.in/?page_id=814#

Major Areas of Research

- **Fracture Mechanics of Concrete Applications**
- **Reinforced and Prestressed Concrete**
- **FE Modeling and Strengthening of RC Joints Connections**
- **Structural Materials**

Source: Faculty website

Dr. Indumathi M Nambi

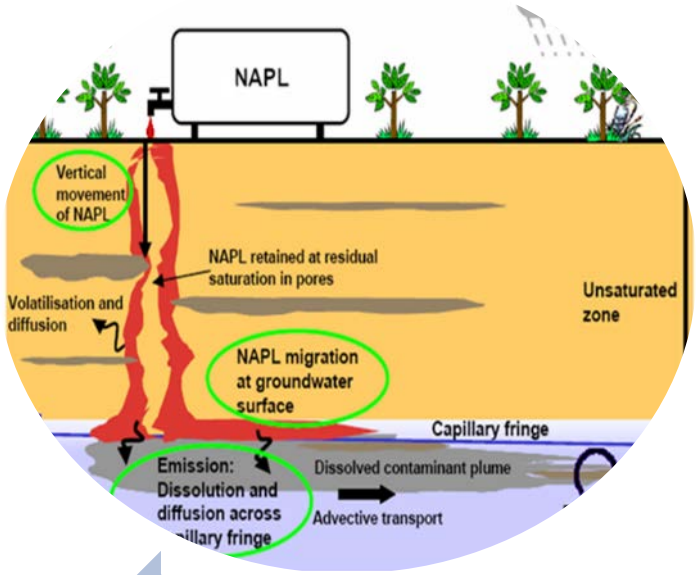
PhD, Clarkson University, USA

Professor, Civil Engineering

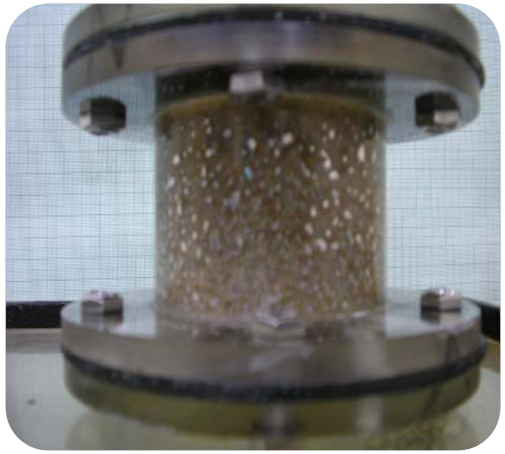
044-2257-4289; indunambi@iitm.ac.in

http://www.iitm.ac.in/indu_edu

- Ground Water Contamination including NAPL /Transport and Remediation
- Industrial Wastewater Treatment/Physical and Chemical Processes
- Water and Waste Water /Tertiary treatment for reuse



Mercury entrapped in soil



Nano Iron

Experimental Studies span from pore scale to lab scale and field scale

Dr. Karthik K Srinivasan

PhD, The University of Texas at Austin, USA

Professor, Civil Engineering

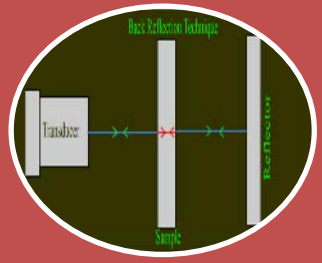
044-2257-4282; karthikks@iitm.ac.in

http://www.civil.iitm.ac.in/new/?q=ks_edu

- Travel Demand Modeling
- Transportation Network Optimization and Reliability
- Intelligent Transportation System

Transportation Planning and Evaluation

Advanced Traveler Information Systems



Transport Routing and Congestion Reduction

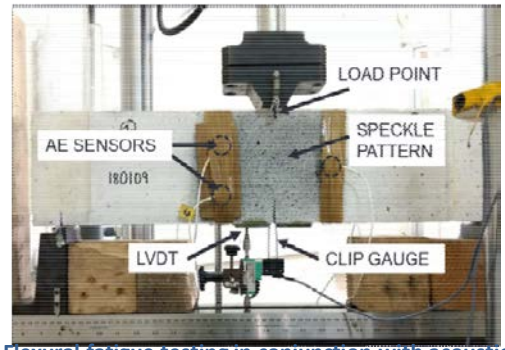
Dr. Keerthana Kirupakaran

PhD, Indian Institute of Science, Bangalore

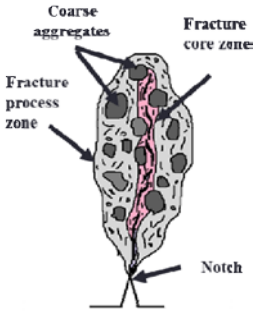
Assistant Professor, Civil Engineering

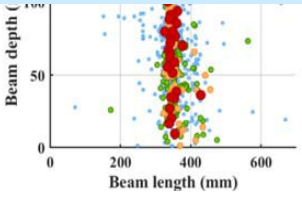
044-2257-4295; keerthanak@iitm.ac.in

- Acoustic emission-based fracture characterization
- Life cycle assessment and modelling

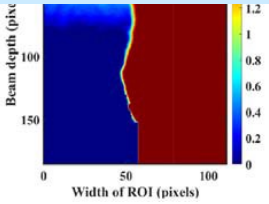


Flexural fatigue testing in conjunction with acoustic emission (AE) and digital image correlation (DIC)





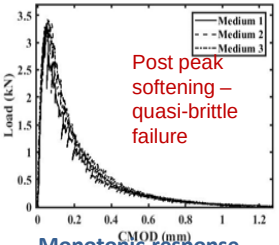
Localization of acoustic emission events



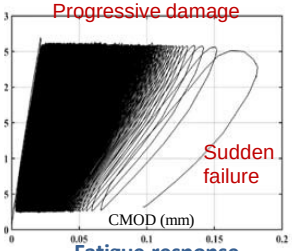
Surface displacement from DIC analysis

$$\int_{N_1}^{N_2} dN = \frac{f_t E}{\sigma_{eq}^2 R_v}\left(\frac{d}{w}\right)^{-2.7} \frac{1}{(1-R)^3}\int_{D_1}^{D_2} \frac{(1-D)^2}{D^{0.2}} dD$$

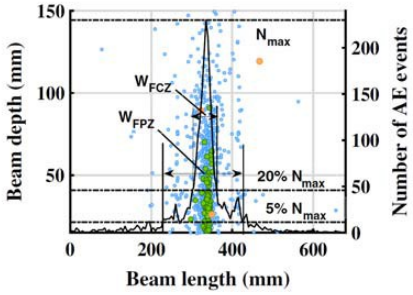
Fatigue life predictive model based on fracture and damage mechanics



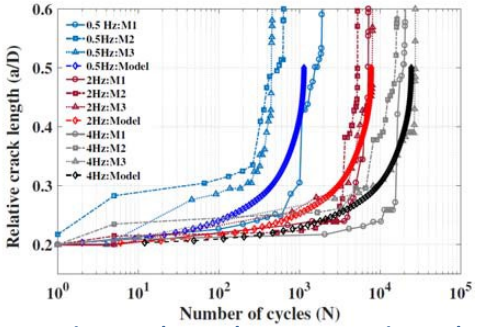
Monotonic response



Fatigue response



AE based characterization of fracture process zone formed in concrete



Fatigue crack growth curve – Experimental validation of proposed model

Dr. Koshy Varghese

PhD, The University of Texas at Austin, USA

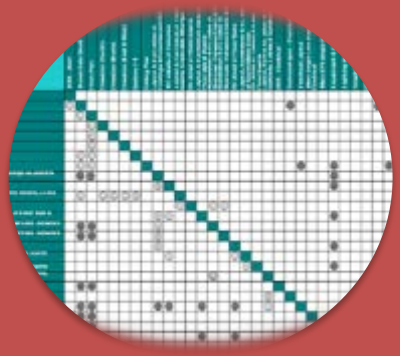
Professor, Civil Engineering

044-2257-4257; koshy@iitm.ac.in

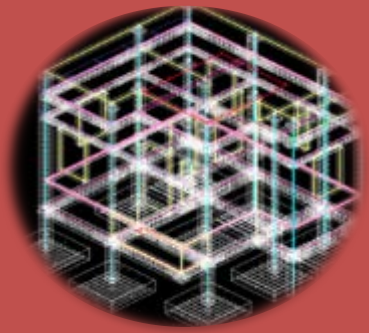
http://www.civil.iitm.ac.in/people/faculty/koshy/

- Automation in Construction
- Design Information Management
- Computer Integrated Project Delivery

Automated Crane Lift Planning



Design-Construction Interface Management on Fast-Track Projects



Building Information Modeling for Lean Project Delivery

Automation and Information Technologies for Built Environment Projects

Dr. Lakshmi Priya Subramanian

PhD, Georgia Institute of Technology, USA

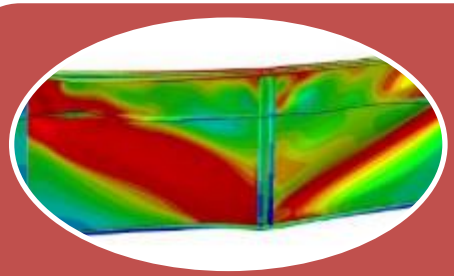
Associate Professor, Civil Engineering

044-2257-4319; lakshmipriya@iitm.ac.in

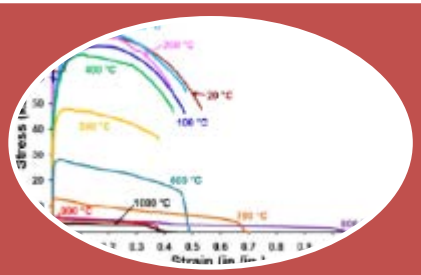
Major Areas of Research

- Stability of steel structures
- Numerical and computational analysis of stability models
- Structural - Fire engineering

Collapse of members due to instability



Analysis of stability models



Structural fire engineering

Dr. Lelitha Devi Vanajakshi

PhD, Texas A&M University, USA

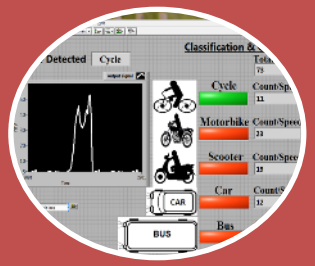
Professor, Civil Engineering

044-2257-4291; lelitha@iitm.ac.in

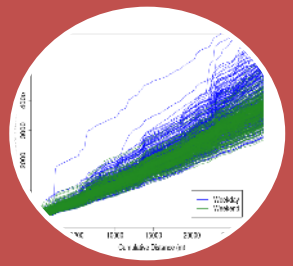
http://www.iitm.ac.in/component/faculty/70/lelitha/

Major Areas of Research

- Traffic Flow Modeling
- Traffic Operations
- Intelligent Transportation Systems



Traffic Data Collection – Development of sensors, Evaluation of sensors



Data Analysis and Modeling– Traffic data analysis, Empirical and mathematical modeling of transportation systems

Intelligent Transportation Systems Applications – Prototype development and field implementations

Modeling, Development and Implementations of ITS Solutions for Indian Traffic

Dr. Ligy Philip

PHD, IIT Kanpur, India

Professor, Civil Engineering

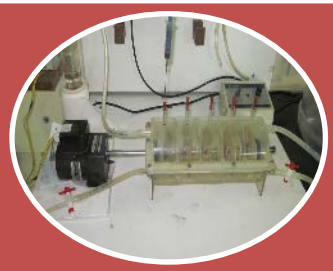
044-2257-4274; ligy@iitm.ac.in

http://www.civil.iitm.ac.in/new/?q=ligy_edu

- Bioremediation of Contaminated Water, Soils, Air and Aquifers
- Water Treatment and Rural Water Supply
- Domestic and Industrial Wastewater Treatment, Recycle and Reuse

To cleanup soils , aquifers and air contaminated with organic and inorganic toxic pollutants

Water quality assessment and providing tailor made centralized and point of use water treatment technologies

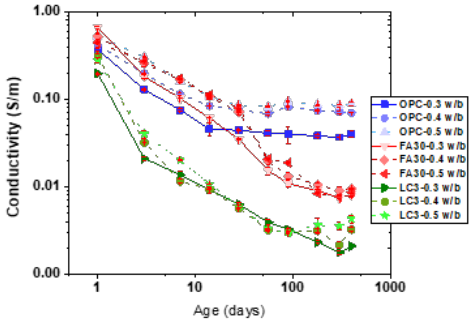


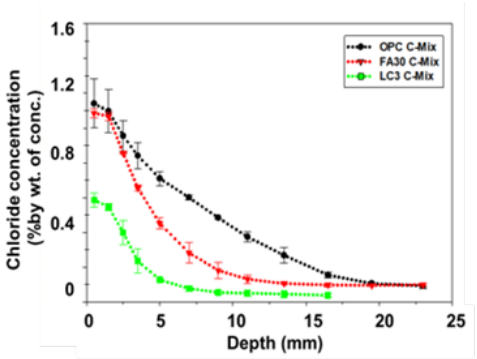
Sustainable Wastewater management using centralized/decentralized and onsite systems

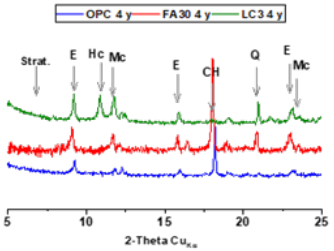
Pollution Abatement, Drinking water quality assessment and treatment

Dr. MANU SANTHANAM
PhD, Purdue University, USA
Professor, Dept. of Civil Engineering
044-22574283; manus@civil.iitm.ac.in
https://civil.iitm.ac.in/faculty/manus/

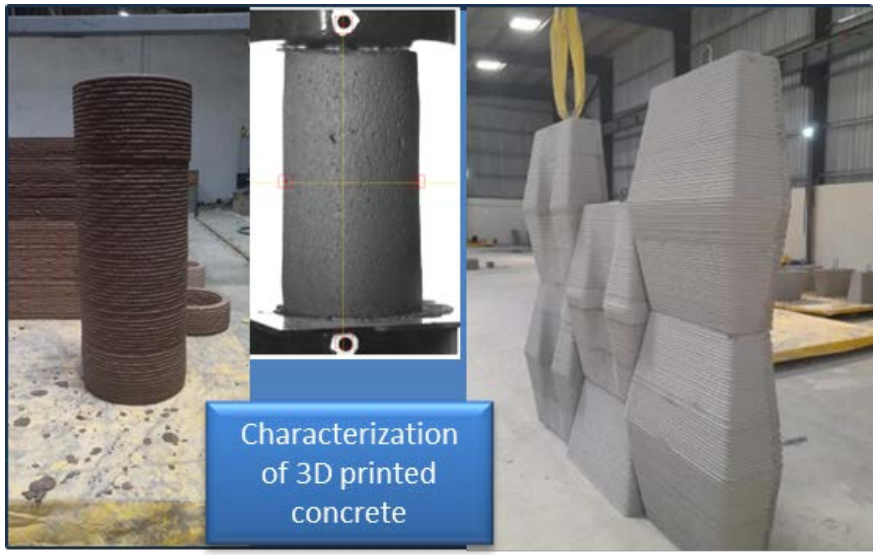
- Supplementary Cementing Materials for Concrete Durability
- Multi-scale Characterization of Concrete and Heritage Materials
- Special Concretes for Additive Manufacturing



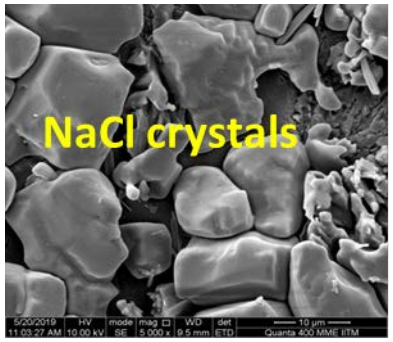




Microstructure – durability relationship for concrete with SCMs



Characterization of 3D printed concrete



Salt crystallization damage of heritage brick masonry

INTERDISCIPLINARY APPROACH TO UNDERSTANDING CONSTRUCTION MATERIALS

Dr. S Mathava Kumar

Associate Professor, Civil Engineering

044-2257-4267; mathav@iitm.ac.in

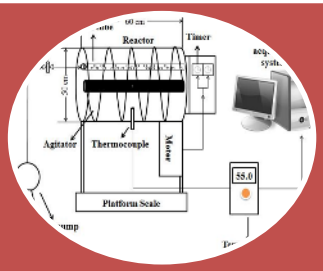
http://www.civil.iitm.ac.in/mathav_edu

Major Areas of Research

- Water and Wastewater Treatment
- Emerging Contaminants/Micro-Pollutants Removal
- Bioremediation of Contaminated Systems and Biogenic Metal Removal

Technology for Emerging Contaminants/Micro-Pollutants Removal

Membrane Bioreactor for industrial wastewater treatment



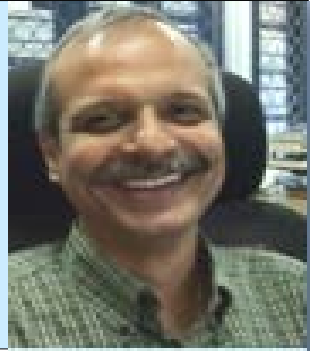
Reactor for high-rate composting of solid waste

Application of technologies for water, wastewater and solid waste management

Dr. A Meher Prasad

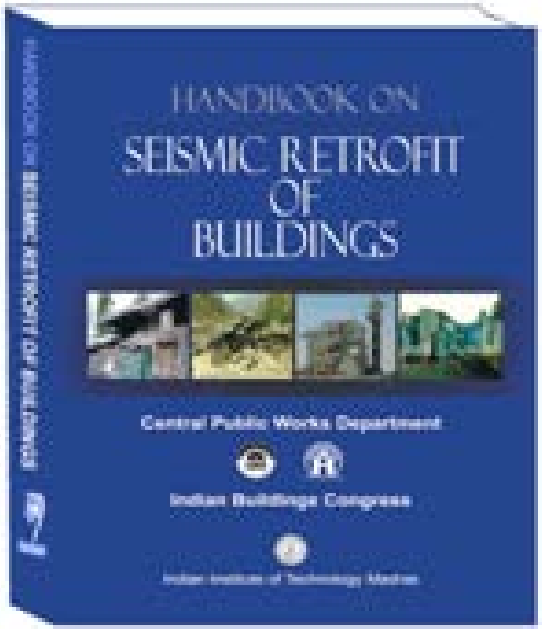
Professor, Civil Engineering

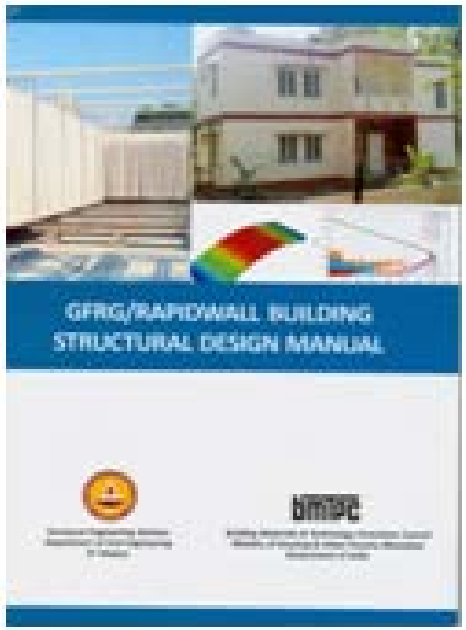
T: 044 2257 4260; M: 9444017194; prasadam@iitm.ac.in



Major Areas of Interest

- Structural Dynamics
- Structural Analysis & Reliability
- Structural Health Monitoring
- Affordable Mass Housing
- Wind & Earthquake Engineering
- Computational Mechanics





Dr. Mohanakrishnan Logan

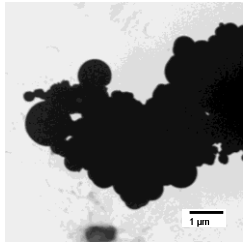
PhD, University of Galway, Ireland

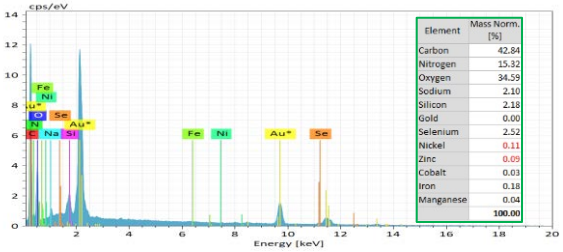
Assistant Professor, Civil Engineering

044-2257-4273; mohanlogan@iitm.ac.in

- Bioprocess for energy and chemical harvesting
- Metal biotechnology (critical raw metals and rare earth elements)
- Environmental bioremediation
- Chalcogen science and technology

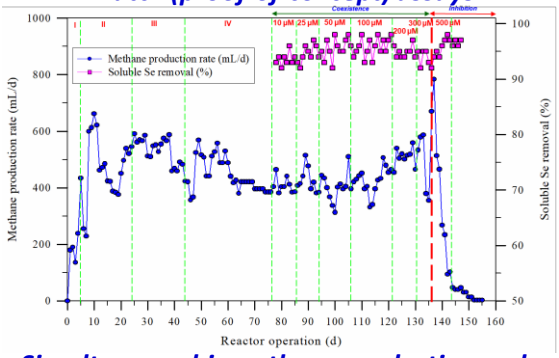
Batch (proof-of-concept) assays



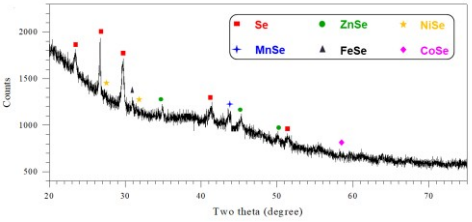


TEM and EDX showing biogenic elemental selenium nanoparticles

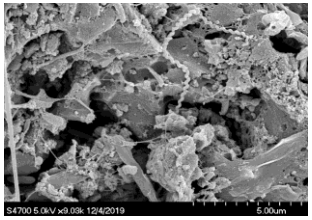
Up-flow anaerobic sludge bed reactor



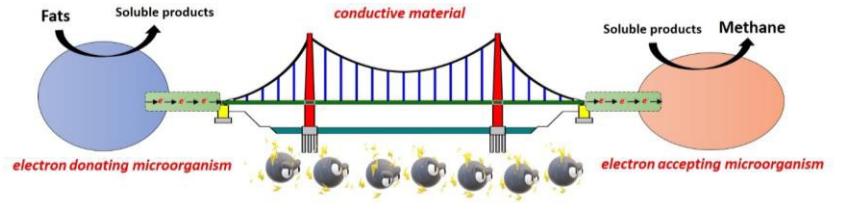
Simultaneous biomethane production and selenium bioremediation



XRD: Selenium and metal selenides



E-pili as electron shuttle



Conductive material amended anaerobic digestion

Dr. Murali Jagannathan

PhD, IIT Bombay, India

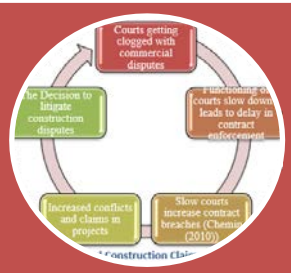
Assistant Professor, Civil Engineering

044-2257-4329; muralij@iitm.ac.in

https://civil.iitm.ac.in/faculty/muralij/

- Construction Contracts and Claims Management
- Lean Construction Management
- Application of Natural Language Processing (NLP) in contract management

Extracting learnings from court cases and developing training modules



Developing contract clauses to support lean implementation

Use of technology to assess contract risks

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

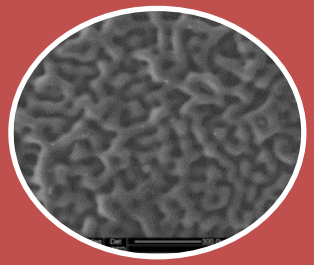
Dr. J Murali Krishnan

PhD, IIT Madras, India

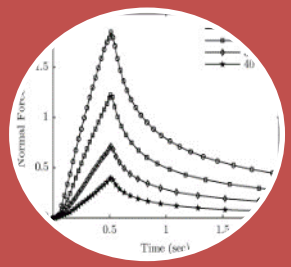
Professor, Civil Engineering

044-2257-4284; jmk@iitm.ac.in

- Asphalt Rheology
- Viscoelasticity
- Pavement Engineering



Development of Binders



Non-linear Models

Stress-strain analysis

From binder rheology to pavement engineering

Dr. C V R Murty

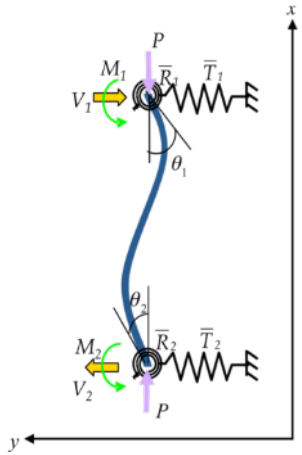
PhD, CalTech, USA

Professor, Civil Engineering

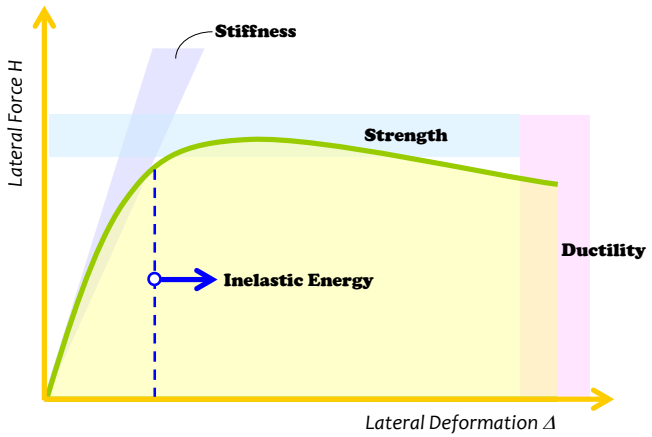
044 2257 4302; cvrm@iitm.ac.in

www.iitm.ac.in/cvrm

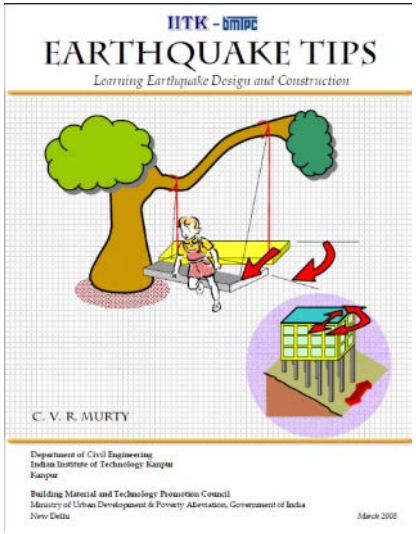
- Nonlinear Seismic Behavior of Structures
- Earthquake-Resistant Design of Buildings and Bridges
- Seismic Design Codes; Books in Earthquake Engineering



Geometric and Material Nonlinearity



Displacement-Based Seismic Design



Codes and Books

Earthquake Engineering

Dr. B Nageswara Rao

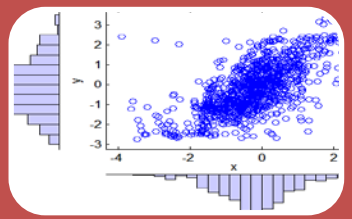
PhD, University of Iowa, USA

Professor, Civil Engineering

044-2257-4285; bnrao@iitm.ac.in

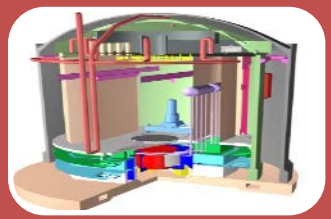
http://www.civil.iitm.ac.in/?q=rao_rp

- Computational solid mechanics, finite element analysis, meshless analysis
- Fracture mechanics, micromechanics and homogenization methods
- Structural reliability & optimization, fuzzy structural analysis, dimension reduction methods



Data Analysis–Statistics, Distribution

FEM/Meshless–Stress/Displ./ Damage/Fatigue/Creep/ Fracture/Corrosion



Probabilistic Methods, Reliability, Sensitivity, Design Optimization, NDE Scheduling

Dr. Nikhil Bugalia

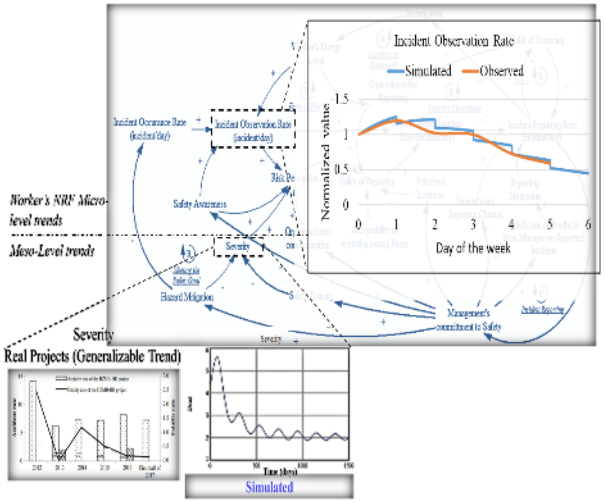
PhD, The University of Tokyo, Japan

Assistant Professor, Civil Engineering

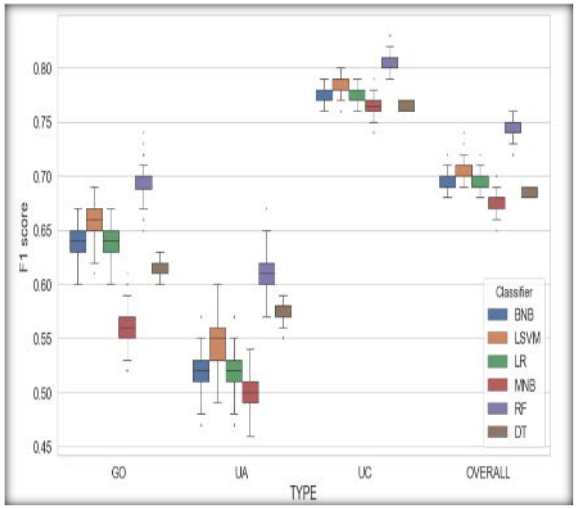
044 - 2257 4264; nbugalia@civil.iitm.ac.in

- Safety Management – Railway/Construction
- Organizational Management, Policy for safety management
- Machine-learning for Safety Management

Generalized institutional accident mechanism in Japanese High-Speed Railway



System Dynamics based Numerical simulation for near-miss reporting system



Machine-learning based classification of safety reports

System-Thinking based process map and numerical simulations

Dr. Phanisri Pradeep Pratapa

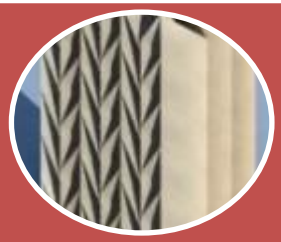
PhD, Georgia Institute of Technology USA

Associate Professor, Civil Engineering

044 2257 4323; ppratapa@iitm.ac.in

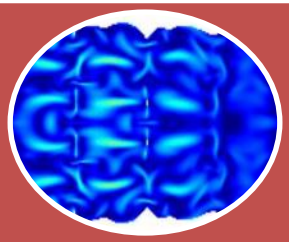
Major Areas of Research

- Origami-based engineering for novel structures and materials
- Meta-materials for civil engineering applications
- Structural dynamics of lattice systems



Design origami lattices for target properties

Explore the mechanics of lattice systems



Understand the dynamics of lattice structures

Lattice-based structures and materials for engineering applications

Dr. Piyush Chaunsali

PhD (University of Illinois at Urbana-Champaign)

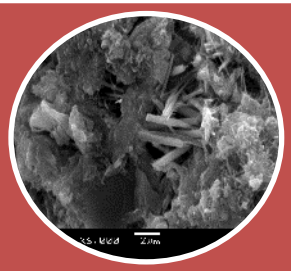
Associate Professor, Civil Engineering

044-2257-4312; pchaunsali@iitm.ac.in

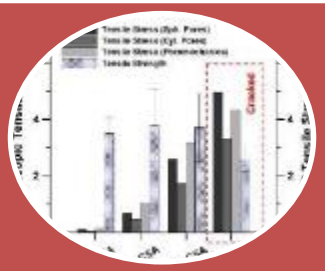
Major Areas of Research

- Cement chemistry and concrete durability
- Processing-microstructure-performance relationships of low CO_2 cements
- Characterization of industrial by-products for their beneficial reuse

Synthesize low CO_2 cements from industrial by-products



Develop Processing-microstructure-performance relationship



Large-scale application and performance modeling

Valorization of industrial by-products in novel cementitious materials

Dr. Radhakrishna G Pillai

PhD, Texas A&M University, USA

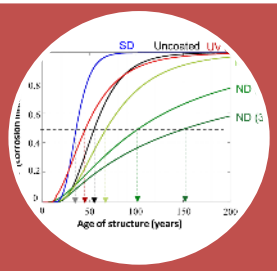
Professor, Civil Engineering

044-2257-4303; pillai@iitm.ac.in

http://www.civil.iitm.ac.in/pillai

- Understanding corrosion and its effects on concrete structures
- Testing/modelling the corrosion & durability parameters of concrete structures
- Durability of repairs & cathodic protection in concrete structures

Assessing corrosion in concrete structures



Estimating service life of concrete structures

Extending service life of concrete structures

Protecting and saving concrete structures from the menace of corrosion

Dr. Raghukanth S T G

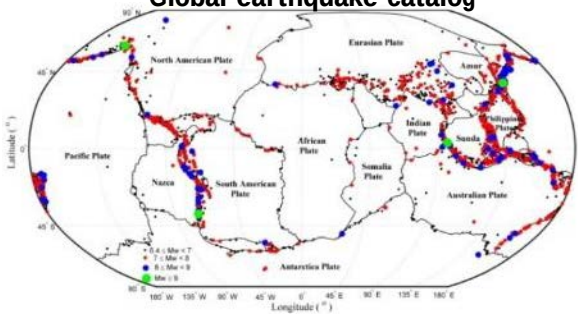
PhD, IISc, Bangalore

Professor, Civil Engineering

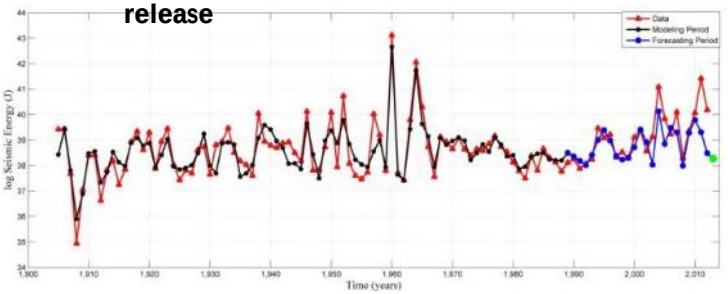
044-2257-4296; raghukanth@iitm.ac.in

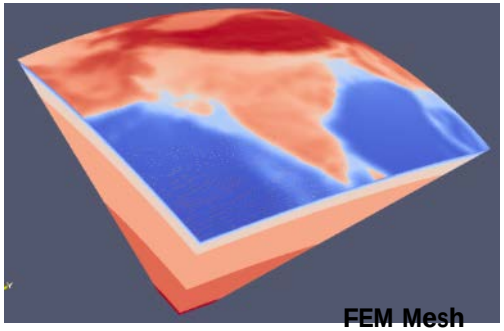
- Natural Hazards
- Risk Assessment
- Wave Propagation
- Structural Dynamics
- Earthquake Engineering

Global earthquake catalog

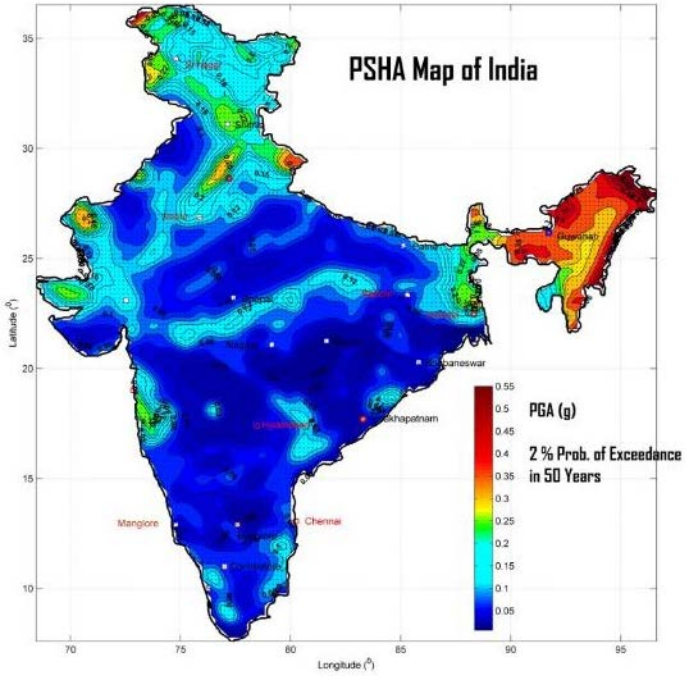


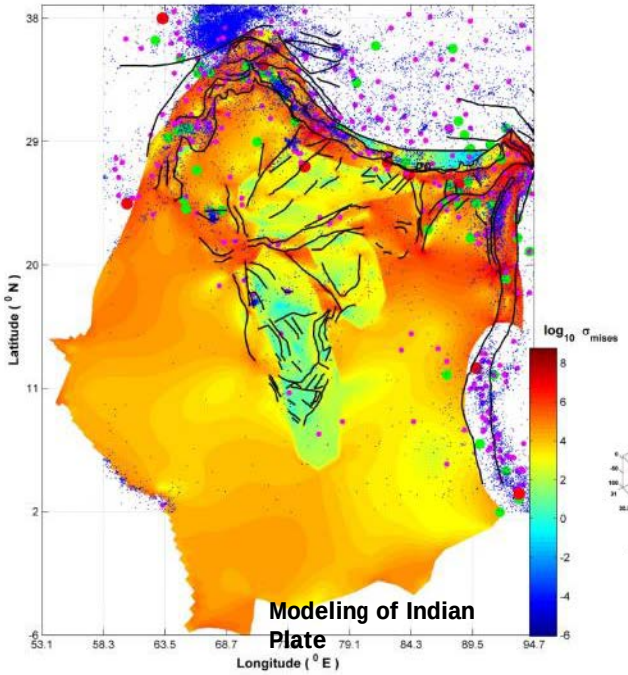
Forecasting of Global earthquake energy release





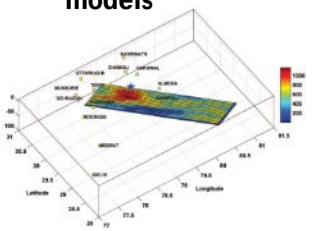
FEM Mesh

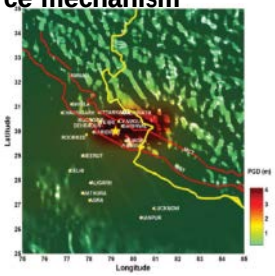




Modeling of Indian Plate

Ground motion simulation for earthquakes by source mechanism models





Dr. Ramesh Kannan Kandasami,

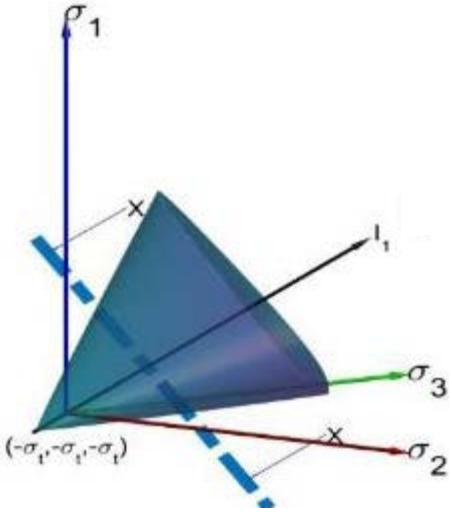
PhD, IISc Bangalore

Associate Professor, Civil Engineering

T: 044 2257 4259; rameshkk@iitm.ac.in

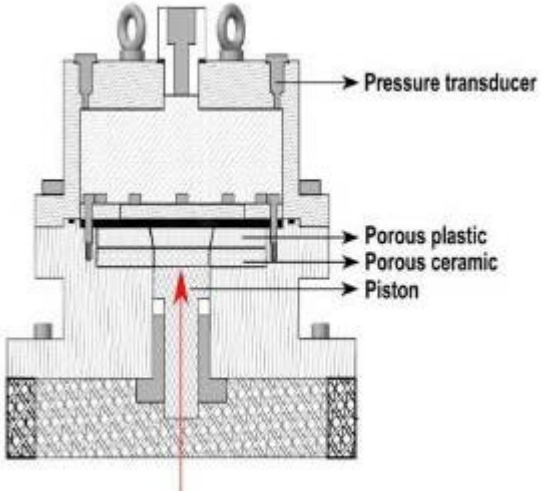
Areas of research:

1. Constitutive behavior of transitional geo-materials
2. Hydraulic fracturing
3. Wellbore strengthening
4. Bio-inspired geotechnics

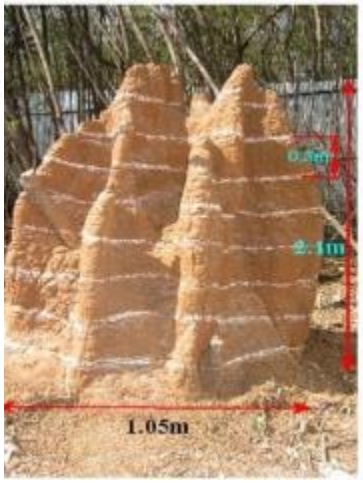


Failure locus for cohesive-frictional geo-materials

Fracture propagation in an anisotropic granular system



Rupture device to determine the strength of filter cake across different fracture width



Strength and stability of termite mounds

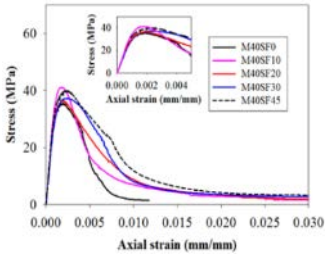
Dr. Ravindra Gettu

PhD, Northwestern University, USA

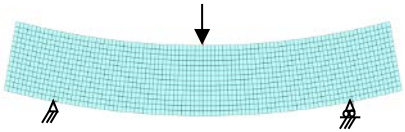
Chair Professor, Civil Engineering

044-2257-4266; gettu@iitm.ac.in

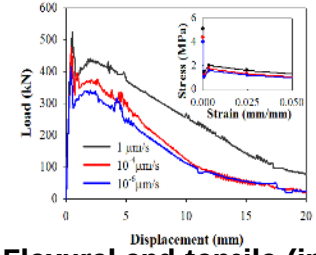
- High Performance concrete, Self Compacting Concrete
- Fibre and Textile reinforced Concrete
- Sustainability assessment of concrete systems



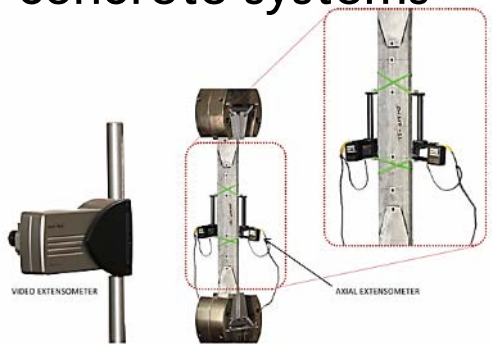
Compressive stress-strain response



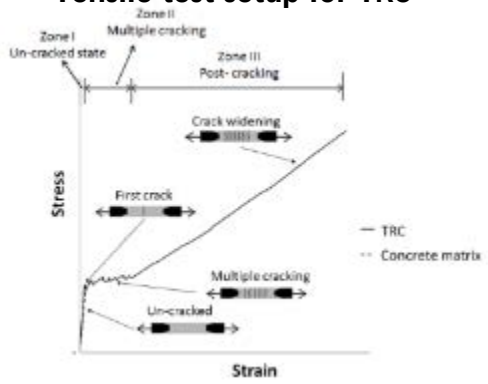
Finite element modelling of FRC tunnel segment



Flexural and tensile (inset) response

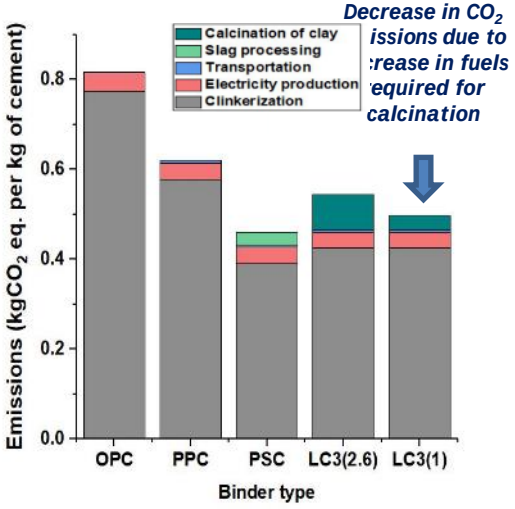


Tensile test setup for TRC



Typical response of TRC with 4 layered textile under tensile loading

Flexural creep testing



LCA of different cements (Indian case)

Dr. R G Robinson

PhD, IISc, Bangalore, India

Professor, Civil Enginerring

044-2257-4286; robinson@iitm.ac.in

http://www.civil.iitm.ac.in/new/?q=rob_rp

- Soft Clay Engineering
- Ground Improvement
- Physical modelling

Vacuum consolidation

Piles in expansive soils

Flowable fills

GEOTECHNICAL ENGINEERING

Dr. Rupen Goswami

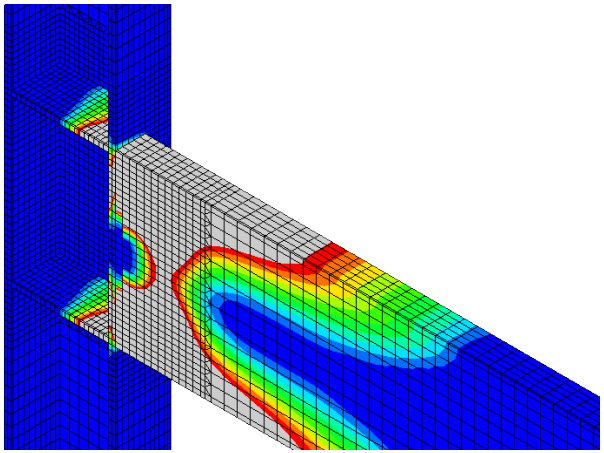
PhD, IIT Kanpur, India

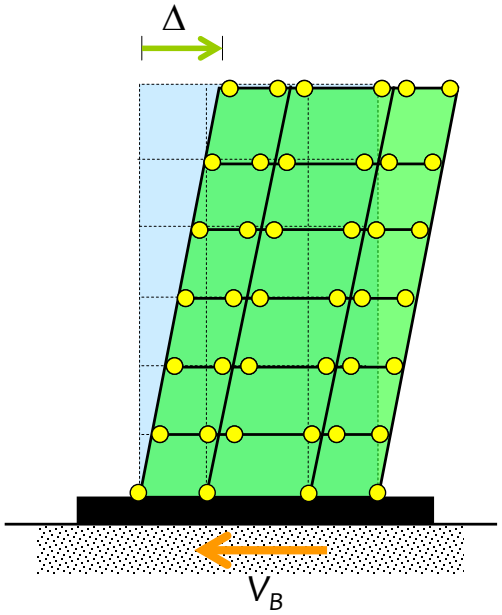
Professor, Civil Engineering

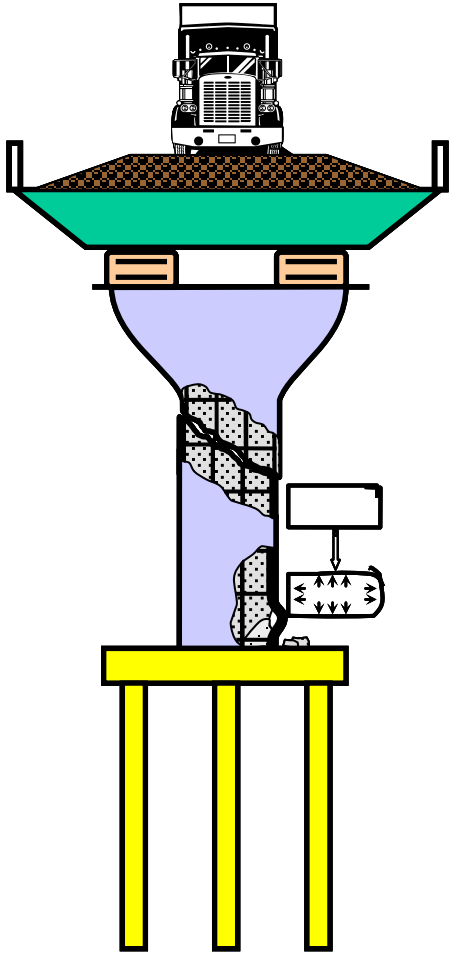
+91 44 2257 4301; rg@iitm.ac.in

http://www.civil.iitm.ac.in/new/?q=rupen_edu

- Earthquake Resistant Design of Buildings and Bridges
- Nonlinear Behaviour of Structures
- Steel Structures







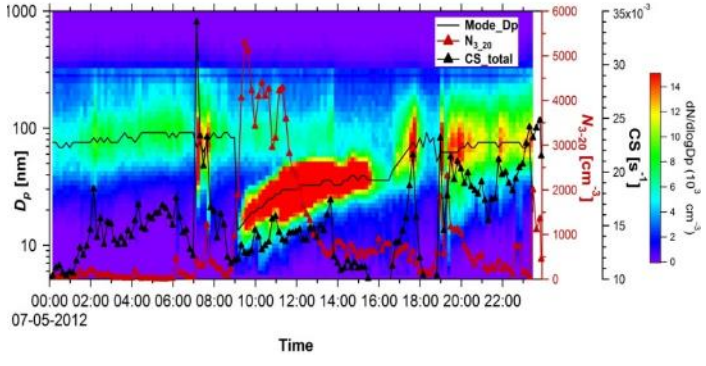
Dr. Sachin S Gunthe

PhD, Indian Institute of Tropical Meteorology, India

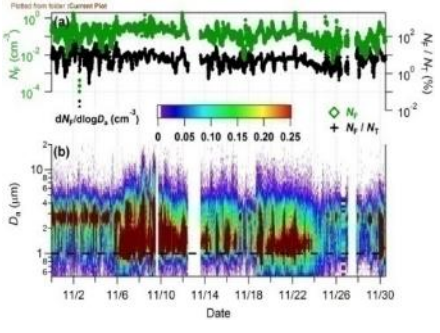
Professor, Civil Engineering

044-2257-4308; s.gunthe@iitm.ac.in

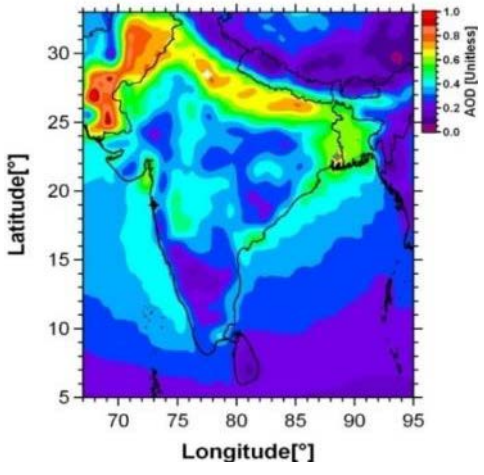
- Properties and interaction of atmospheric aerosols including bioaerosols
- Role of atmospheric aerosols in Earth system science
- Aerosol cloud precipitation interaction – Indian monsoon



Field campaigns



Laboratory studies



Numerical simulations

Dr. U Saravanan

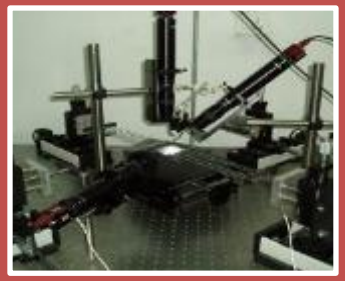
PHD, Texas A&M University, USA

Professor, Civil Engineering

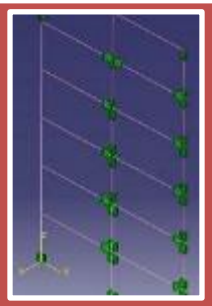
044-22574314 Email: saran@iitm.ac.in

http://www.civil.iitm.ac.in/new/?q=sar_edu

- Constitutive modeling
- Nonlinear analysis
- Structural health monitoring



Setup for testing elastomers



Hybrid model for analyzing frames

Determining load spectrum on a rail bridge

Next generation constitutive models and analysis algorithms for safer and economical design

Dr. Satish Kumar S R

D.Eng, Nagoya University, Japan

Professor, Civil Engineering

044-2257-4287; kim@iitm.ac.in

http://www.civil.iitm.ac.in/new/?q=satish_edu

- Structural Engineering / Design of Steel Structures
- Structural Engineering / Earthquake Resistant Design & Seismic Testing

Dr. K N Satyanarayana

PhD, Clemson University, USA

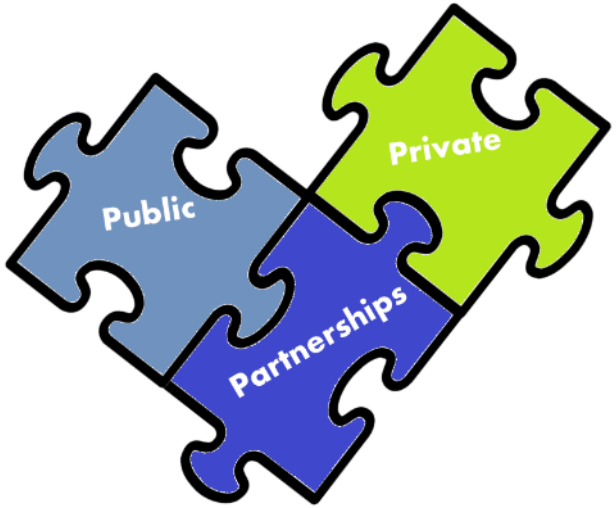
Professor, Civil Engineering

044-2257-4268; satyakn@iitm.ac.in

http://www.civil.iitm.ac.in/new/?q=satya_edu

Major Areas of Research

- Infrastructure & Construction Project Management
- Public Private Partnerships – Risk Management, Capacity Building
- Construction Procurement & Contracts
- Construction Mechanisation



Dr. S M Shiva Nagendra

PhD, IIT Delhi, India

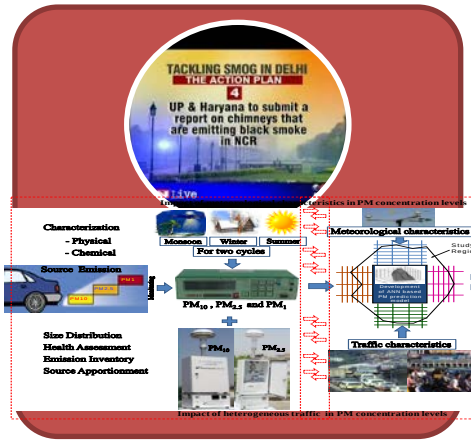
Professor, Civil Engineering

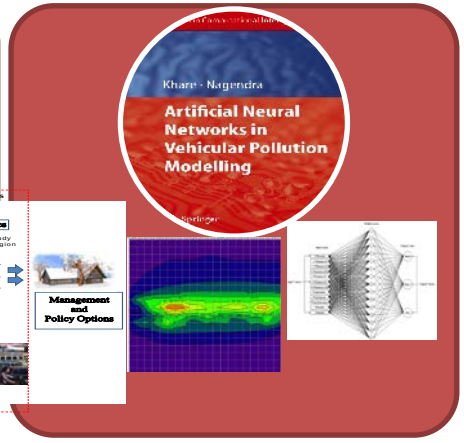
044-2257-4290; snagendra@iitm.ac.in

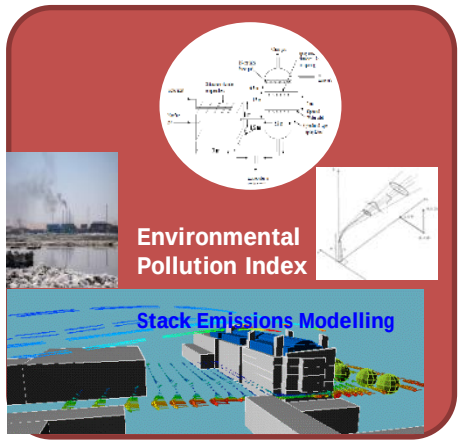
http://www.iitm.ac.in/component/faculty/70/snagendra/

RESEARCH INTERESTS

URBAN AIR QUALITY MANAGEMENT	Emission inventory, air quality monitoring, modelling , source-receptor modelling and control strategies
VEHICULAR POLLUTION MODELLING	Deterministic, statistical and artificial neural network approaches
INDOOR AIR QUALITY	Monitoring, modelling and control strategies
INDUSTRIAL AIR POLLUTION CONTROL	Design of air pollution control equipments and environmental impact assessment
ENVIRONMENTAL DATA ANALYSIS	Multivariate data analysis and environmental auditing







Urban Air Quality Management **Indoor Air Quality Management** **Industrial Pollution Control**

Dr. Sivakumar Palaniappan

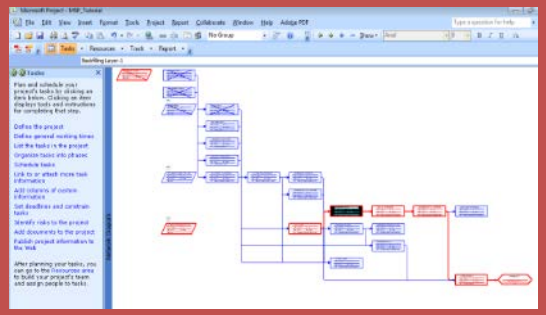
PhD, Arizona State University, USA

Associate Professor, Civil Engineering

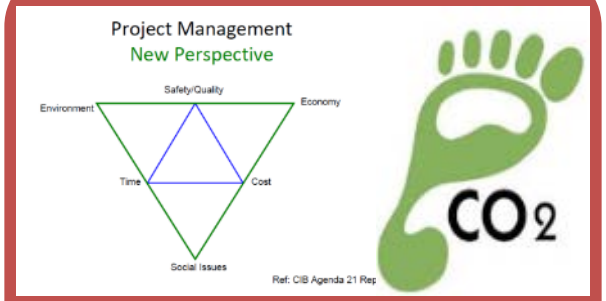
044-2257-4258; sp@iitm.ac.in

http://www.civil.iitm.ac.in/new/?q=sp_edu

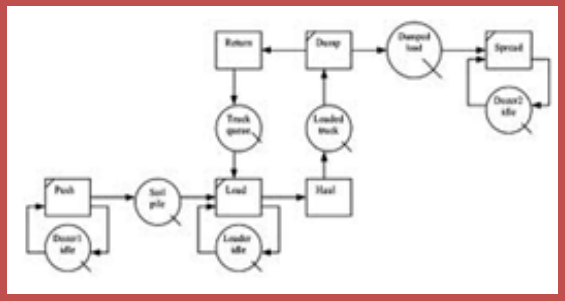
- Construction Project Planning and Control, Information Technology Applications in Project Management
- Sustainable Construction: Life cycle energy use in buildings, carbon footprint of construction processes
- Modelling and Simulation of Construction Processes using discrete event simulation



Planning, Monitoring and Control of Construction Projects



Energy use and carbon emissions of construction processes



What-if scenarios evaluation for construction planning using discrete event simulation

Construction Project Management, Sustainability in Construction, Modelling and Simulation

Dr. Somendra Nath Kuiry

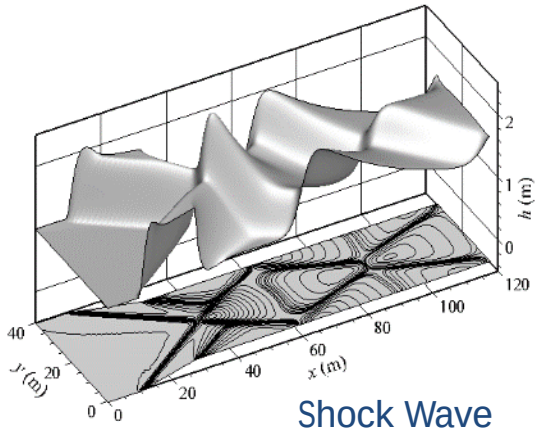
PhD, IIT Kharagpur

Associate Professor, Civil Engineering

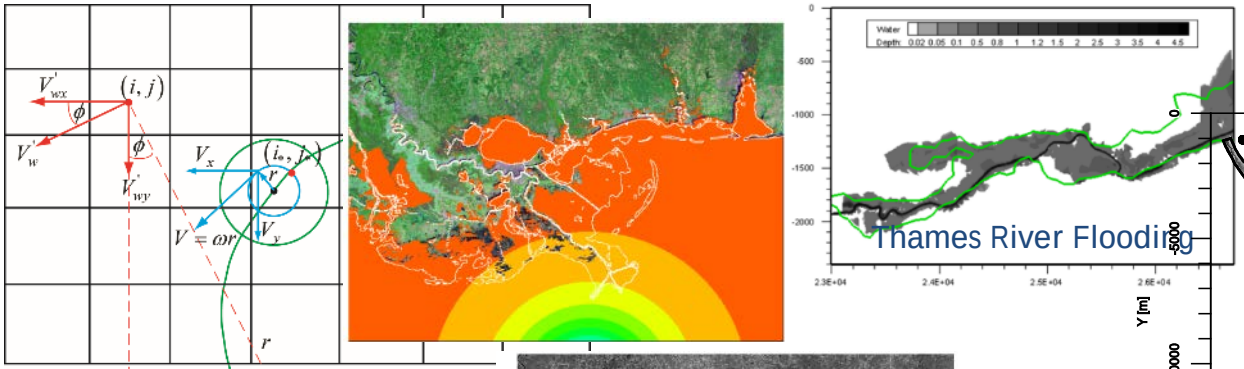
044 -2257 4309; snkuiry@iitm.ac.in

http://www.civil.iitm.ac.in/new/?q=kuiry_edu

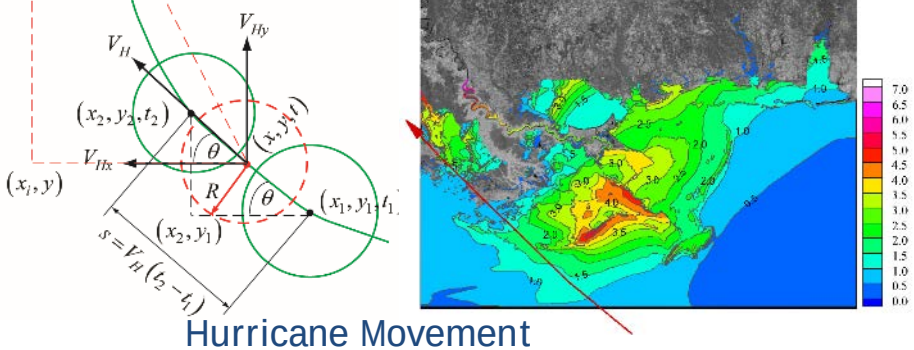
- Computational hydraulics – river, coastal and dam-break flow
- Modelling of hurricane and tsunami wave propagation
- Modelling of sediment transport in rivers and coasts
- Experimental study on dam-break and river flow



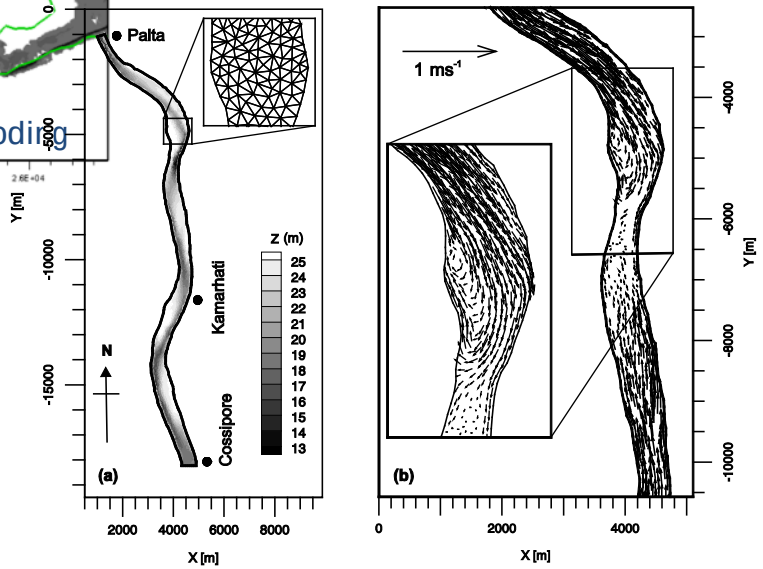
Shock Wave



Thames River Flooding



Hurricane Movement



River Flow

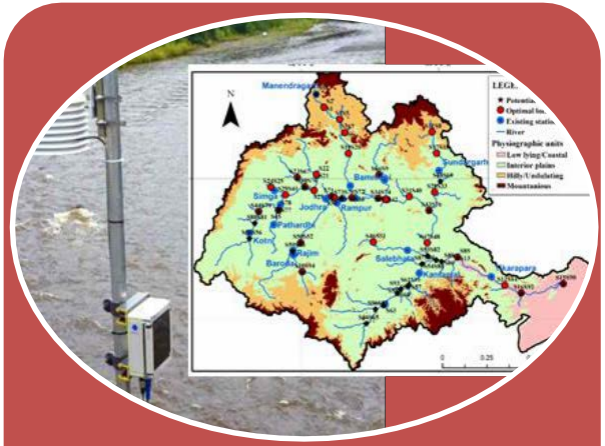
Dr. Sreeparvathy Vijay

Ph. D, Indian Institute of Science (IISc), Bangalore,
Assistant Professor, Civil Engineering

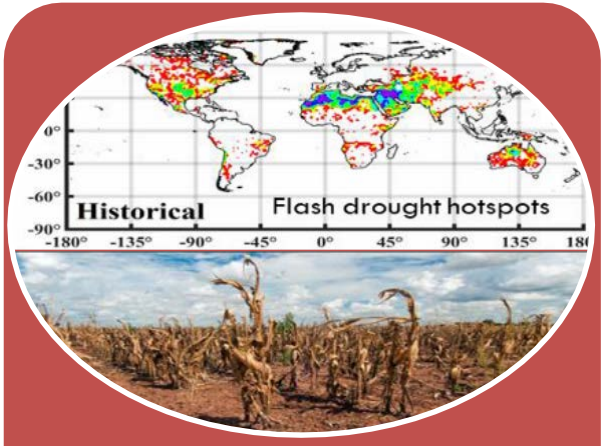
044-2257 4317; sreeparvathyvijay@iitm.ac.in
https://civil.iitm.ac.in/faculty/sreeparvathyvijay/

Major Areas of Research

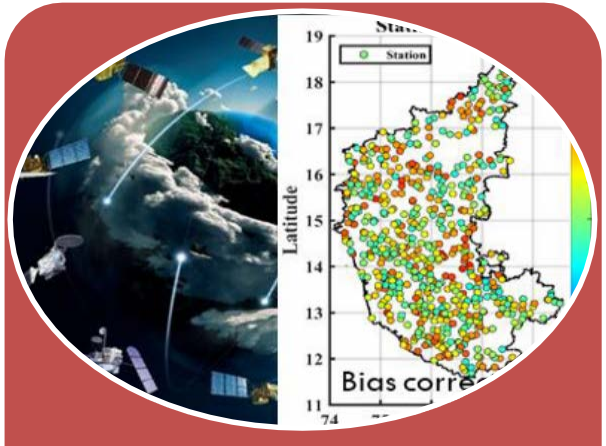
- Hydroclimatic extremes
- Design of hydrometeorological monitoring networks
- Climate change impact assessment
- Remote sensing for hydrological applications



Design of optimal hydrometeorological monitoring networks for integrated water resources planning and management



Assessment and mitigation of hydrological extremes for present and future climate change conditions



Development of bias corrected remote sensing data products using advanced machine learning techniques for hydrological applications

Assessment, predication and monitoring of hydrometeorological variables for changing climatic conditions

Dr. Sudheendra Herkal

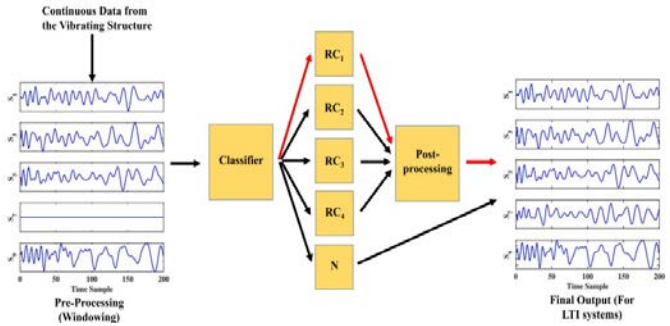
PhD, Rice University, USA

Assistant Professor, Civil Engineering

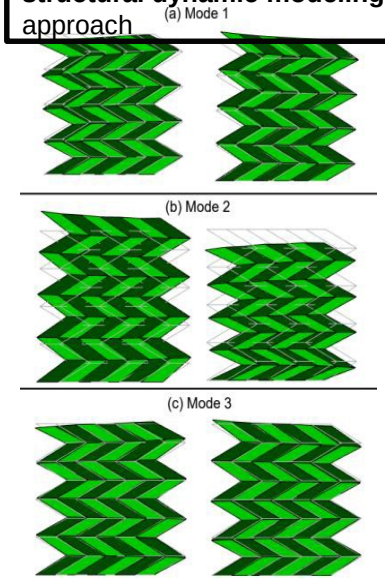
044-2257-4334; sherkal@iitm.ac.in

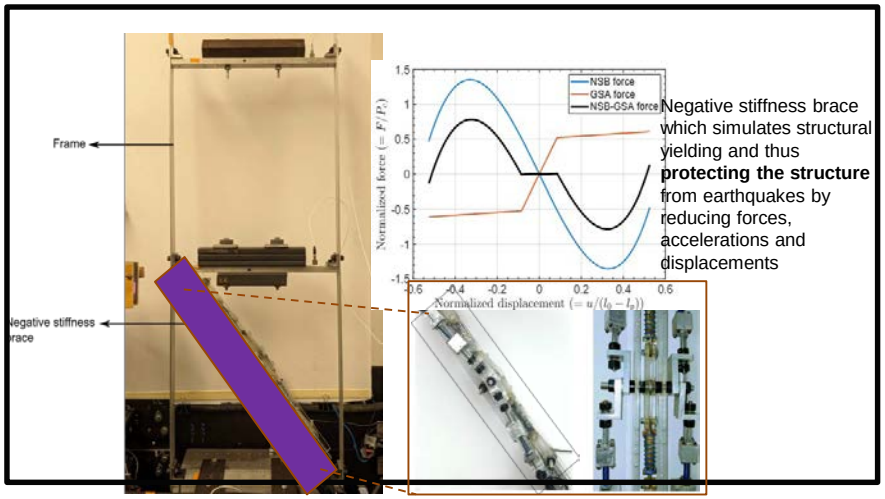
- Seismic protection of structures
- Structural dynamics
- Structural health monitoring

Real-time reconstruction of faulty sensor data which allows for continuous **structural health monitoring**



Mode shapes of Miura-Ori origami using proposed **structural dynamic modeling** approach

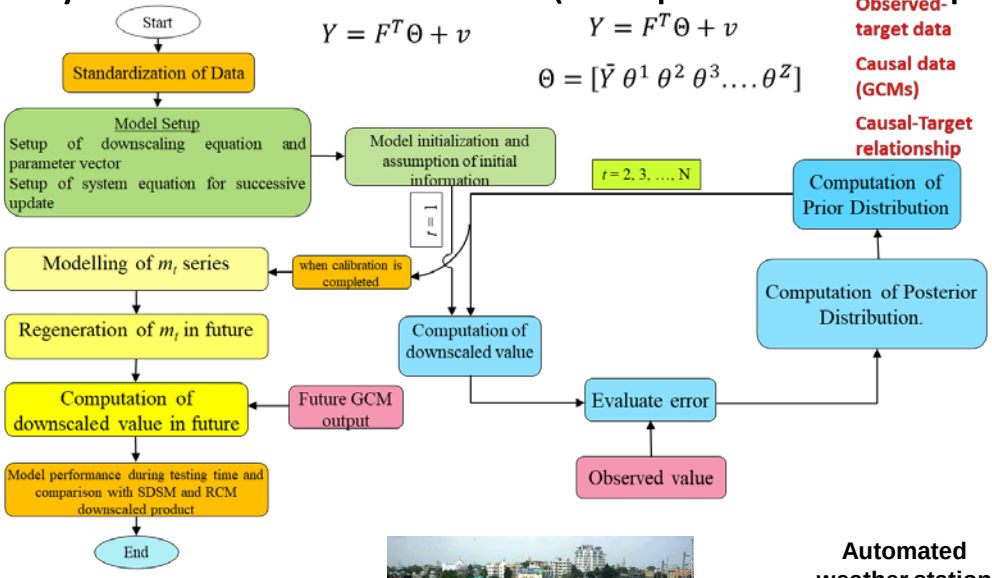




Negative stiffness brace which simulates structural yielding and thus **protecting the structure** from earthquakes by reducing forces, accelerations and displacements

Dr. Subbarao Pichuka
PhD, IIT Kharagpur, India
Assistant Professor, Civil Engineering
044-2257-4269; srp@iitm.ac.in

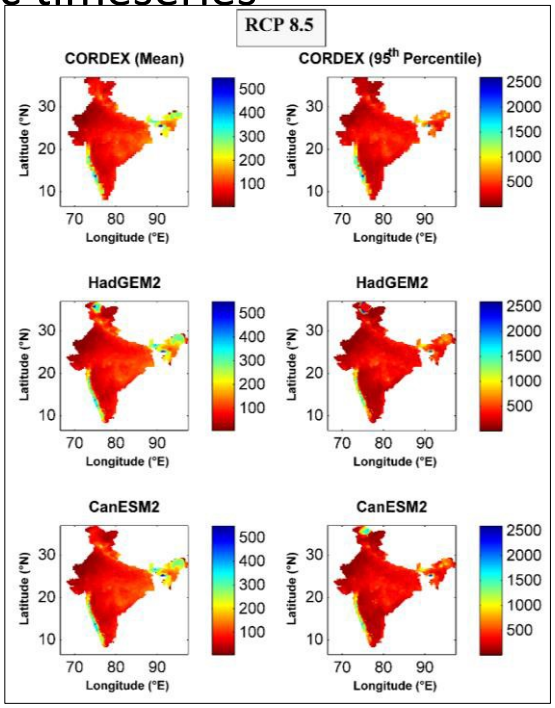
- Modelling the non-stationary relationship in the hydroclimatic timeseries through Time-Varying Downscaling Model (TVDM)
- Downscaling the precipitation over Indian mainland
- Hydroclimatic extremes (Temperature and precipitation)



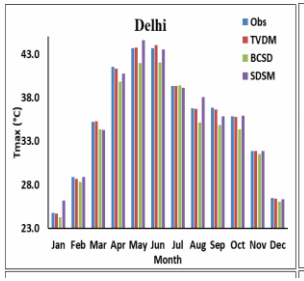
TVDM Methodology

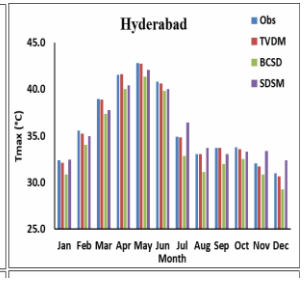
Automated weather station

Urban floods



Modelling the rainfall patterns over entire India





T_{max} downscaling in the Indian metropolitan cities

Dr. Subhadeep Banerjee

PhD, National University of Singapore

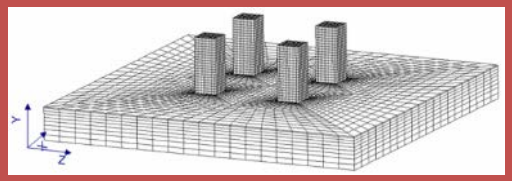
Professor, Civil Engineering

044-2257-4304; subhadeepn@iitm.ac.in

www.civil.iitm.ac.in/new/?q=subh_edu

- Soil Dynamics and Earthquake Engineering
- Constitutive Relationship of Soil
- Finite Element Modelling
- Physical modelling and laboratory testing

Centrifuge Modelling



Numerical Simulations for Large Scale Problems

Safe and Economic Design

Advanced earthquake resistant design of foundation

Dr. K P Sudheer

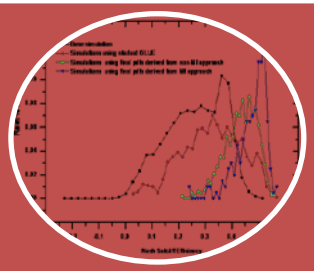
PHD, IIT Delhi, India

Professor, Civil Engineering

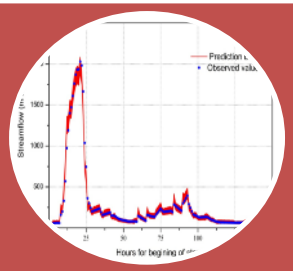
044-2257-4288; sudheer@iitm.ac.in

http://www.iitm.ac.in/component/faculty/70/sudheer

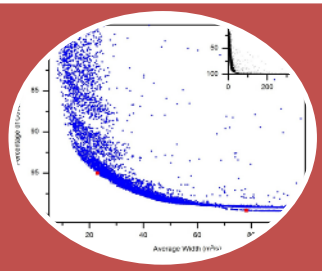
- Hydrologic Modeling
- Predictions in Ungauged Basins (PUB)
- Uncertainty and Sensitivity Analysis



Distributed Hydrological Models for PUB



Hydrologic Prediction Band



Construction of Prediction band

Employing Distributed Hydrological Models for Water Resources Assessment

Dr. Surender Singh

PhD, IIT Roorkee, India

Assistant Professor, Civil Engineering

044-2257-4313; surender@iitm.ac.in

https://civil.iitm.ac.in/faculty/surender/

Major Areas of Research

- Valorization of C&D Waste & other Industrial/Agricultural Waste
- Design, Monitoring and Rehabilitation of Concrete Pavements
- Special Cement Concrete Pavements

Developing Economical Techniques for Beneficiation of Recycled Aggregates for Sustainable Pavement Applications

Evaluation & Monitoring of Rigid Pavements

Special Concrete Pavements

Valorization of Different Wastes for Sustainable Rigid Pavement Applications

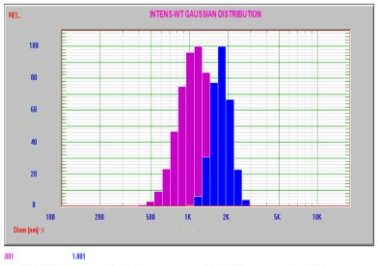
Dr.Tanushree Parsai

PhD, IIT Delhi, India

Assistant Professor, Civil Engineering

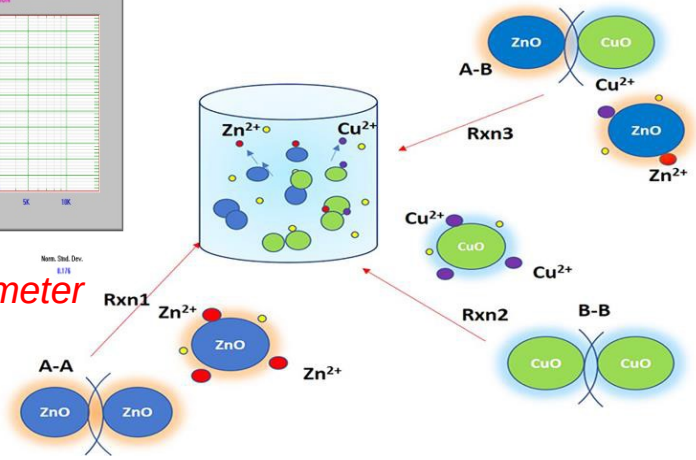
parsai@iitm.ac.in

- Emerging Contaminants (ECs) fate and transport
- Nanoparticles, Microplastics
- Mixture interaction of ECs
- Human Health Risk Assessment
- Water Treatment

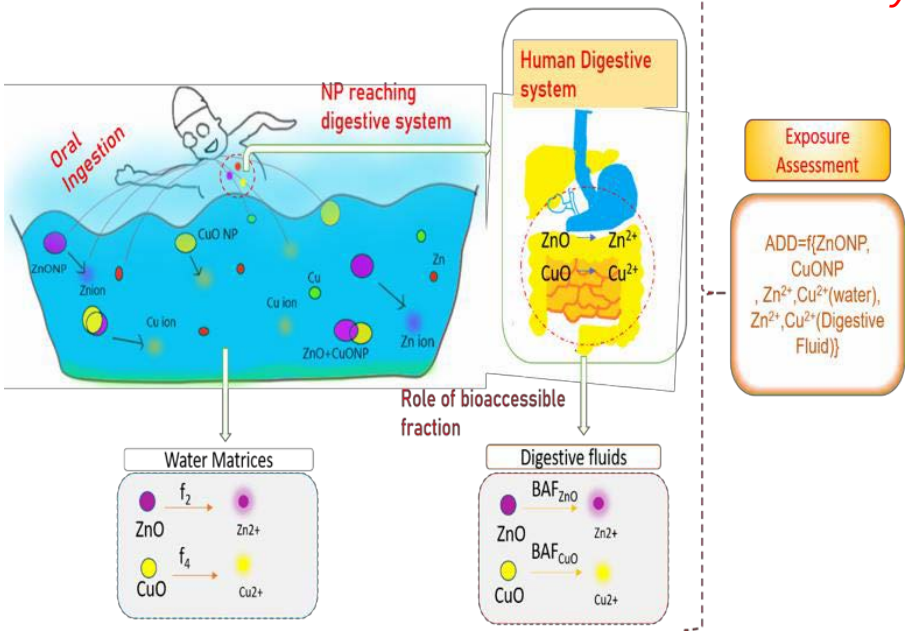


Hydrodynamic diameter

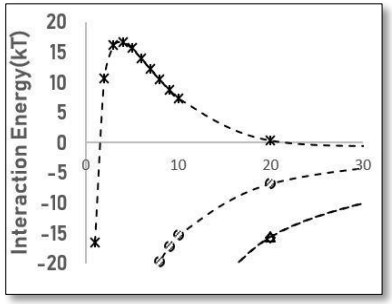
Nanoparticle Mixture Interaction



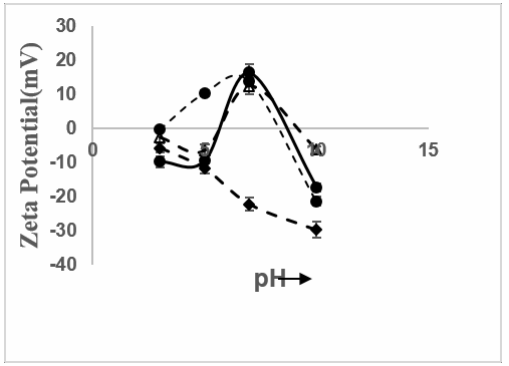
Risk associated with mixture of nanoparticles



DLVO Interaction energy



Zeta Potential and pHzpc



Dr. Tarun Naskar

PHD, IISc Bangalore

Associate Professor, Civil Engineering

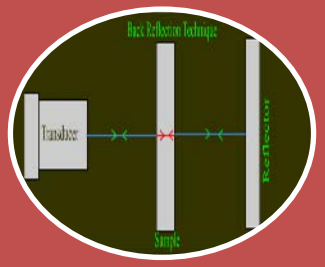
044-2257-4322; tarunnaskar@iitm.ac.in

https://www.iitm.ac.in/info/fac/tarunnaskar

- NDT
- Inverse Analysis
- Surface Wave Propagation

Subsurface exploration

Non Destructive Testing



Signal Processing

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

Dr. T Thyagaraj

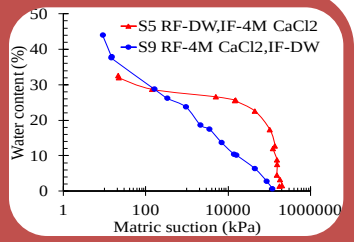
PhD, Indian Institute of Science, India

Professor, Civil Engineering

044-2257-4271; ttraj@iitm.ac.in

http://www.civil.iitm.ac.in/new/?q=tt_edu

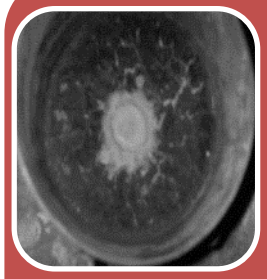
- Unsaturated soil behaviour
- Ground improvement
- Geoenvironmental engineering



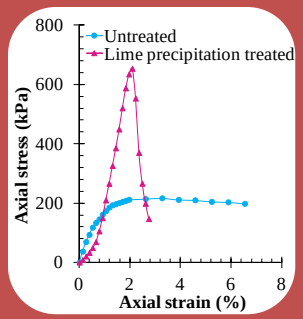
SWC Cell **SWCCs**

Ongoing research:

Physico-chemical effects on soil-water characteristic curves of compacted and geosynthetic clay liners



Lime slurry permeation



Stress-strain curves

Ongoing research:

Deep stabilization of expansive soils by lime precipitation technique

GCL **GCL after 2nd drying**

Ongoing research:

Effect of physico-chemical factors on behavior of compacted and geosynthetic clay barriers
Effect of physico-chemical factors on collapse behaviour of soils

Dr. Venkatraman Srinivasan

PhD, University of Illinois Urbana Champaign, USA

Assistant Professor, Civil Engineering

044-2257-4321; venkatraman@iitm.ac.in

Major Areas of Research

- Process based eco-hydrological models of vegetated land surfaces
- Climate change impact on food and water security
- Experimental manipulation of crop micro climate environment

Develop an experimental greenhouse facility to study plant behavior under various microclimatic conditions

Develop a high resolution 3D explicit architecture plant canopy and root system ecohydrological model

Predict impact of climate change on future food and water security and suggest mitigation measures

Predict the response of vegetation under abiotic stresses and climate change

Dr. Venu Chandra

PhD, IIT Kanpur, India

Professor, Civil Engineering

044-2257-4281; vc@iitm.ac.in

http://www.civil.iitm.ac.in/vc_edu

- Experimental Hydraulics
- Sediment Transport
- Cohesive Sediment Dynamics
- River Training and Scour Protection Works

Acoustic Doppler Velocimeter (Velocity measurement)

Annular flume (to study about sediments)

Field application

Laboratory to field to prevent sediments at hydraulic structures

Dr. Vidya Bhushan Maji

PhD, IISc Bangalore, India

Professor, Civil Engineering

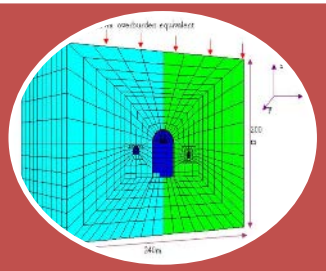
044-2257-4294; vbmaji@iitm.ac.in

http://www.civil.iitm.ac.in/new/?q=maji_edu

- Rock mechanics / Geotechnical Engineering
- Behaviour of jointed rocks
- Underground excavation and slope stability

Rock mechanics / Geotechnical engineering

Behaviour of jointed rocks



Underground excavation and slope stability

Rock Mechanics /Geotechnical Engineering

INDIVIDUAL FACULTY PROFILE

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

LIST OF FACULTY

- Aishwarya Thiruvengadam
- Akanksha Agrawal
- Anantha Padmanabha Matikurke Shankara Narayana
- Anurag Mittal
- Ayon Chakraborty
- Chandra Sekhar C
- Chester Dominic Rebeiro
- Gopalakrishnan Srinivasan
- Janaki Ram D
- Jayalal Sarma M N
- John Ebenezer Augustine
- Kamakoti V
- Kartik Nagar
- Krishnamoorthy Sivalingam
- Krishna Nandivada V
- Madhu Mutyam
- Manikandan N
- Meghana Nasre
- Narayanaswamy N S
- Nishad Bharat Kothari
- Prashanth L A
- Raghavendra Rao B V
- Rupesh Nasre
- Shreyas Kiran Pai
- Shweta Agrawal
- Siva Ram Murthy C
- Sivaramakrishnan K C
- Sreenivasa Kumar P
- Sukhendu Das
- Sutanu Chakraborti
- Yadu Vasudev

Dr. Aishwarya Thiruvengadam

Assistant Professor, Computer Science and Engineering

044-2257-4388; aishwarya@cse.iitm.ac.in

http://www.cse.iitm.ac.in/profile.php?arg=MjY5MQ==

Major Areas of Research

- Cryptography
- Information Security
- Theoretical Computer Science

Dr. Akanksha Agrawal
Ph.D., University of Bergen, Norway
Assistant Professor (Grade II), Computer Science and Engineering
044-2257-4391; akanksha@iitm.ac.in

Parameterized Complexity

A paradigm to deal with hard problems. Each instance has an integer called the parameter.

Typical Goals:

Fixed parameter tractability: Limit the exponential factor in the runtime of the algorithm to the parameter alone.

Kernelization: Polynomial time preprocessing algorithm to reduce the instance size to a function of the parameter.

Computational Geometry

Some problems from the field, to be studied in the realm of Parameterized Complexity:

Fundamental Visibility Problems: Art Gallery and Terrain Guarding, and their variants.

Graph Modification to Geometric Graphs: Make at most k modification to the given graph, to obtain geometric graphs like Delaunay graphs, geometric intersection graphs, etc.

Classical Graph Problem on Geometric Graphs: Obtain (more) efficient algorithms for classical graph problems when restricted to geometric graphs like unit disc graphs, unit square graphs, etc.

Dr. Anantha Padmanabha

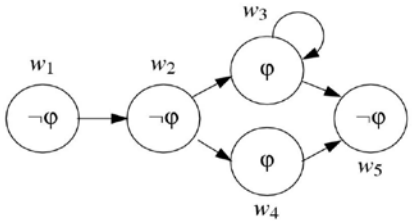
PhD, Institute of Mathematical Sciences

Assistant Professor, Computer Science and Engineering

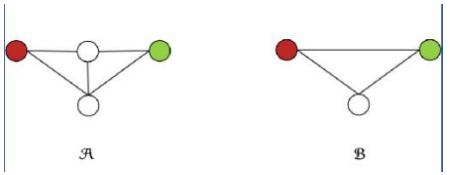
044-2257-4397; ananthap@iitm.ac.in

- Foundations of Databases
- Modal Logic
- Logic in Computer Science

- Algorithms for Query Processing
- Graph databases and homomorphisms



- Decidable fragments of Predicate Modal Logics
- Model Theory of Predicate Modal Logics



- Logical Aspects of Game Theory
- Finite Model Theory
- Descriptive Complexity

Dr. Anurag Mittal

PhD, Univ. of Maryland College Park, USA

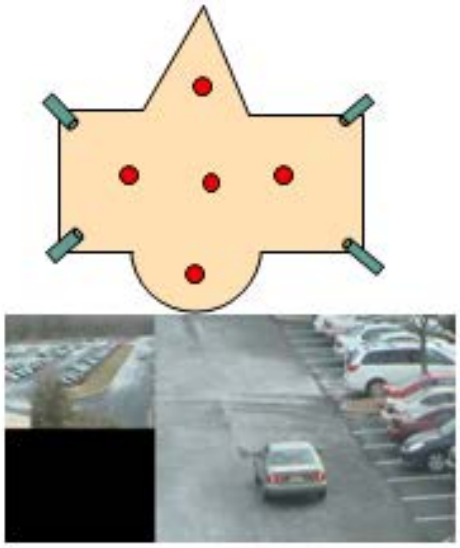
Professor, Computer Science and Engineering

044-2257-4372; amittal@iitm.ac.in

http://www.cse.iitm.ac.in/~amittal

Computer Vision

- Multi-Camera Security and Surveillance
- Contour-based Object Detection & Recognition
- Feature Detection and Description



After Stitching

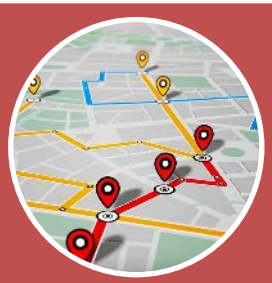
Dr. Ayon Chakraborty
PhD, SunyStony Brook, United States
Assistant Professor, Computer Science and Engineering
044-2257-4390; ayon@iitm.ac.in
http://www.cse.iitm.ac.in/~ayon

- Mobile Sensing (using IoT-based systems)
- Location Tracking Technologies
- Wireless Spectrum Sensing

SENSE
Sensing and Networked Systems Engineering
@IIT Madras

My research interests are in designing IoT-based/mobile systems that interact with and interpret (*sense*) the physical world, spanning both algorithm design as well as end-to-end system prototyping

Context, Smart Homes, Smart Retail Spaces, Gesture Recognition



Calibration-free Infrastructure-free indoor positioning (Disaster Response)

Spectrum Cartography, Coverage optimization,

Mobile Spectrum Sensing

Dr. C Chandra Sekhar

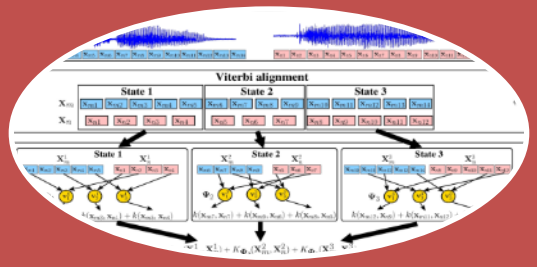
PhD., IIT Madras, India

Professor, Computer Science and Engineering

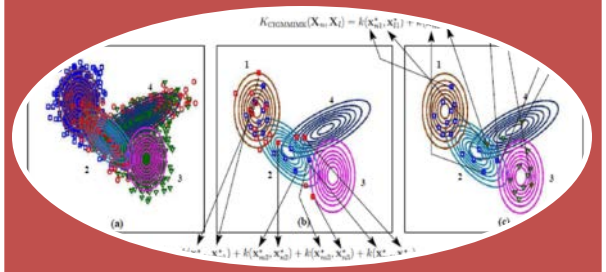
044-2257-4363; chandra@cse.iitm.ac.in

http://www.cse.iitm.ac.in/chandra

- Machine Learning for Speech Technology
- Kernel Methods for Pattern Analysis
- Content based Information Retrieval



Support Vector Machines based Approaches to Acoustic Modeling for Speech Recognition



Design of Dynamic Kernels for Speech and Image Data

Scene Image Retrieval using Kernel Methods

Dr. Chester Rebeiro

Associate Professor, Computer Science and Engineering

044-2257-4355; chester@iitm.ac.in

http://www.cse.iitm.ac.in/~chester/

Major Areas of Research

- **Hardware Security**
  - Side Channel Analysis
  - Hardware Trojans
  - PUFs
- **Cryptography**
  - Implementations in Hardware and Software
- **Operating Systems**
  - Secure Operating Systems Design

Dr. Dharanipragada Janakiram

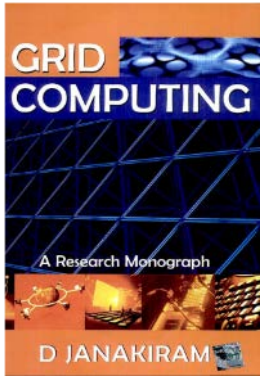
Professor, Computer Science and Engineering

044-2257-4354; djram@iitm.ac.in

http://dos.iitm.ac.in/djwebsite

Major Areas of Research

- Distributed Systems, Grid Computing and Cloud Compuitng
- Service Oriented Architectures for Operating Systems
- Big Data Analytics and Database Systems
- Internet of Things (IoT)
- Sensor Device Integration into Cloud Systems
- Android Security
- Research Challenges in Building Large Scale Software Systems



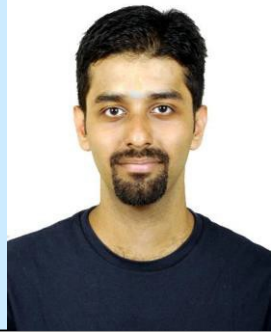
Dr. Gopalakrishnan Srinivasan

PhD, Purdue University, USA

Assistant Professor, Computer Science and Engineering

044-2257-4394; sgopal@cse.iitm.ac.in

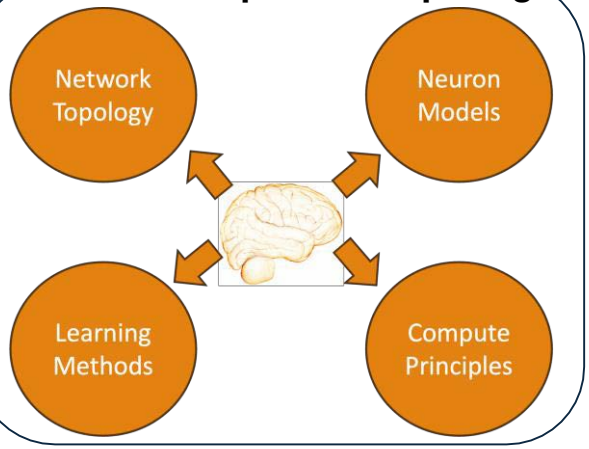
https://rbcdsai.iitm.ac.in/people/gopalakrishnan_srinivasan



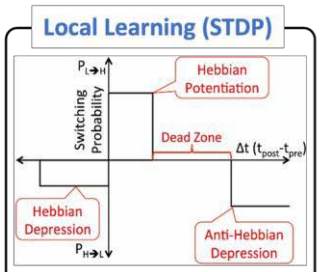
Major Areas of Research

- Brain-Inspired (Spike-based) Neuromorphic Computing
- Hardware-Software Co-Design for Machine Learning Applications
- Energy-Efficient Edge Computing
- Approximate Computing
- AI Accelerator Architecture and Algorithms
- RISC-V SoC Architecture and Design

Brain-Inspired Computing

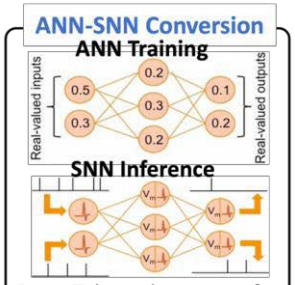


Spike-Based Training Algorithms



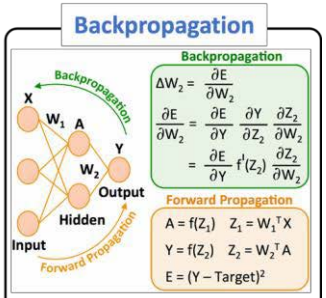
Pros: Unsupervised local learning, memory efficiency

Cons: Limited accuracy and shallow spiking networks



Pros: Takes advantage of standard ANN training

Cons: Incurs much higher inference latency



Pros: Competitive accuracy and lower inference latency

Cons: Higher training effort

Dr. Jayalal Sarma

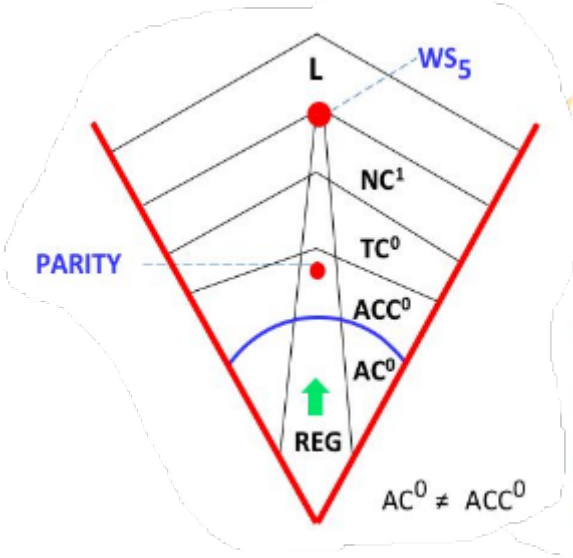
Professor, Computer Science & Engineering

044-2257-4357; jayalal@iitm.ac.in

http://www.cse.iitm.ac.in/~jayalal

Areas of Research:

- Theoretical Computer Science, Computational Complexity Theory
- Structural, Arithmetic & Boolean Circuit Complexity
- Algebra and Computation, Pseudo-randomness, De-randomization

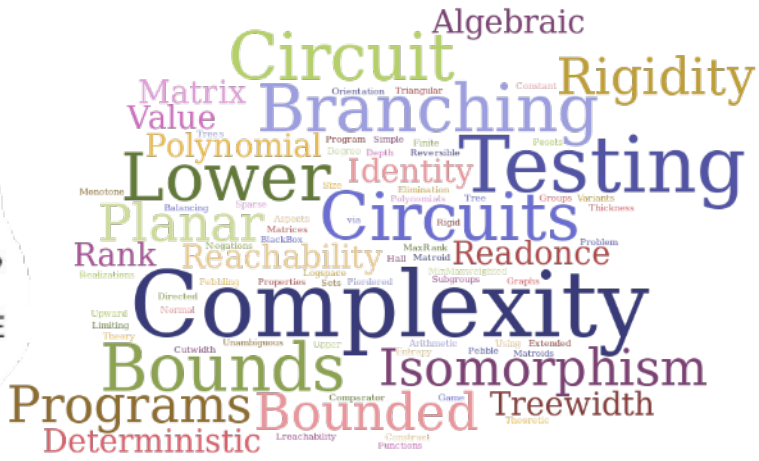


Unknown but Commonly Believed:

- $L \neq NL$ ..... $L \neq PH$
- $P \neq NP \cap co\text{-}NP$ ..... $P \neq PSPACE$
- $NP \neq \sum^P_2 \cap \Pi^P_2$ ..... $NP \neq EXP$

Best Known Separations:

- $AC^0 \subset ACC^0 \subset PP$, also $TC^0 \subset PP$
- $NC^1 \subset PSPACE$, ... , $NL \subset PSPACE$
- $P \subset EXP$, $NP \subset NEXP$
- $PSPACE \subset EXPSPACE$



Picture Credits : http://www.cse.buffalo.edu/~regan/papers/ComplexityPoster.jpg

Dr. John Augustine

PhD., Univ. of California, Irvine, USA

Professor, Computer Science and Engineering

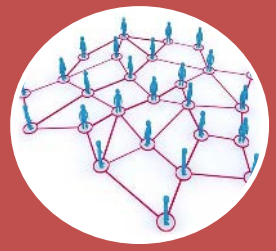
044-2257-4383; augustine@cse.iitm.ac.in

http://www.cse.iitm.ac.in/~augustine/

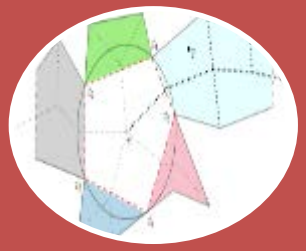
Algorithms at large including:

- Distributed Algorithms
- Computational Geometry
- Online Algorithms

Big Data



Networks



Geometry

Dr. V Kamakoti

Reconfigurable Intelligent Systems Engineering (RISE) Lab

Director & Professor, Computer Science and Engineering

044-2257-4368; veezhi@gmail.com

http://rise.cse.iitm.ac.in/people/faculty/kama/kama.html

V. Kamakoti specializes in the areas of VLSI Design and Computer Architecture. His specific interests include power-aware design and testing of digital circuits, secure compute and network architectures, wireless sensor networks and thermal imaging based embedded systems for medical diagnosis.

He is one of the co-founders of the Reconfigurable Intelligent Systems Engineering (RISE) group. The RISE Lab is involved in development of indigenous secure computing and networking platforms.

Dr. Kartik Nagar

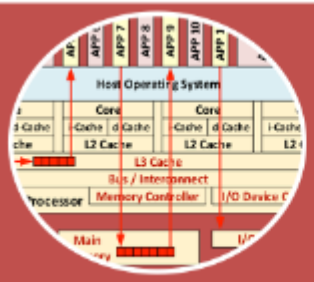
PhD, IISc, India

Assistant Professor, Computer Science and Engineering

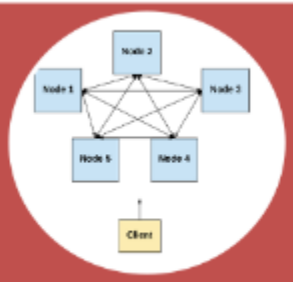
044-2257-4387; nagark@iitm.ac.in

http://kartiknagar.github.io

- Automated Formal Verification
- Program Analysis
- Programming Languages



CONCURRENT SYSTEMS



DISTRIBUTED SYSTEMS

SECURITY AGAINST ATTACKS

PROVABLE SAFETY AND SECURITY OF MODERN COMPUTING SYSTEMS

Dr. Krishna Moorthy Sivalingam

Ph.D., State Uni. of New York, Buffalo, USA

Gopalakrishnan Institute Chair Professor, Dept. of CSE

044-2257-4378; skrishnam@iitm.ac.in

http://www.cse.iitm.ac.in/~skrishnam

- Programmable Data Plane Switches
- 5G/6G Network Slicing Mechanisms
- Data Center Networks: AI/LLM Workload Management
- Digital Twins of Computer Networks

Computer Network Protocols and Algorithms: Design, Analysis & Implementation

Dr. V Krishna Nandivada

PHD, UCLA, USA

Professor, Computer Science and Engineering

044-2257-4380; nvk@iitm.ac.in

http://www.cse.iitm.ac.in/~krishna

- Compiler Optimizations – Optimizations for multicore systems
- Compiler Optimizations – Semantics preserving optimizations.
- Language design for performance and programmability.
- Software security – Security for mobile applications

Serial programs and Multicore systems

$ g++ a.cc –o a.out

Q: a.cc == a.out?

Semantics preserving compilers

Secure Mobile Apps

Performance, Programmability and Security in Software Systems

Dr. Madhu Mutyam

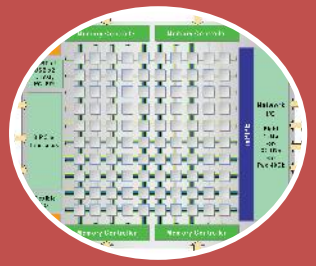
PHD, IIT Madras, India

Professor, Computer Science and Engineering

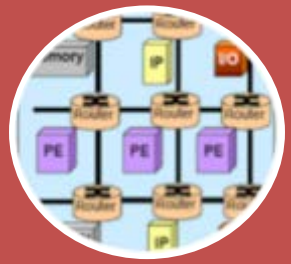
044-2257-4379; mutyam@iitm.ac.in

http://www.iitm.ac.in/mutyam

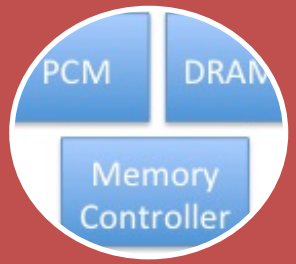
- Multi-core Architectures
- Network-on-Chip
- Emerging Memory Technologies



Shared resource management in multi-core processors



Optimizing communication among cores of a multi-core processor



Dealing with hybrid memory systems

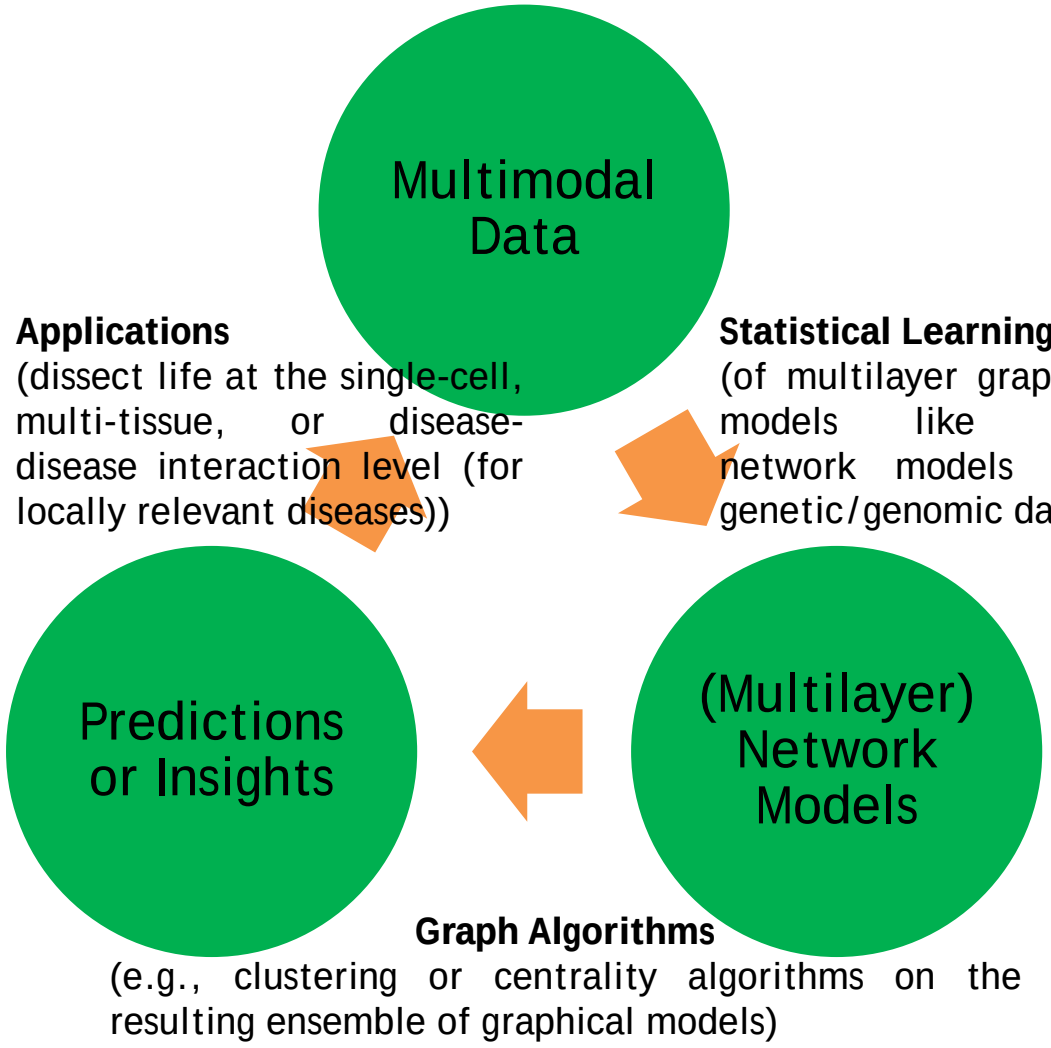
Dr. Manikandan Narayanan

Associate Professor, Computer Science and Engineering
Core Faculty, Initiative for Biological Systems Engg. (IBSE)
Robert Bosch Centre for Data Science and AI (RBC-DSAI)
044-2257-4375; nmanik@cse.iitm.ac.in
http://www.maninarayanan.com

Major Areas of Research

Computational methods (multilayer graphical models, ensemble graph algorithms) that've crucial applications in biology and beyond!

- Bioinformatics and Computational Biology; Systems Biology/Genomics of Health and Disease
- Complex (Multilayer) Network Models and Graph Algorithms; Integrative Data science



Dr. Meghana Nasre

Associate Professor, Computer Science and Engineering

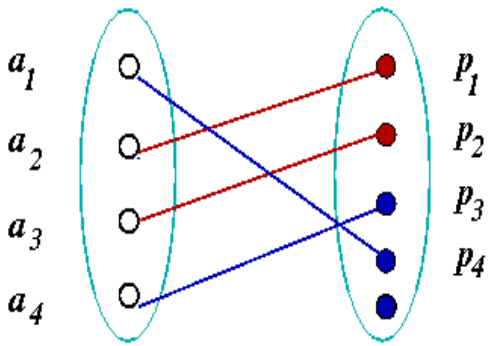
044-2257-4373; meghana@iitm.ac.in

http://www.cse.iitm.ac.in/~meghana

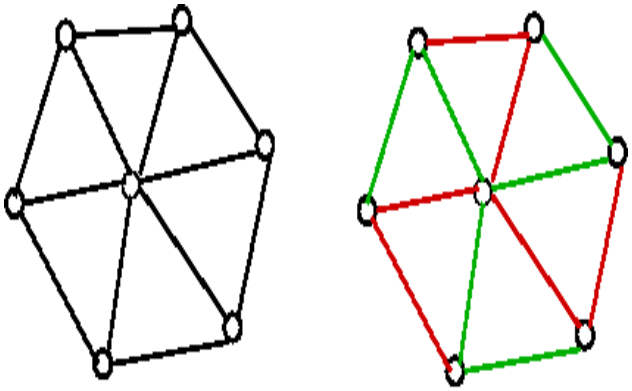
Major Areas of Research

- Graph Theory, Algorithms
- Matchings in graphs under preferences

	p_1	p_2	p_3	p_4	p_5
a_1	1	2	4	3	
a_2	1	3	5	4	2
a_3	2	1	3		
a_4	3	1	2	5	4



Popular Matching



Rainbow Connectivity

Dr. N S Narayanaswamy

Indian Institute of Technology Madras, India

Professor, Computer Science and Engineering

044-22574369; swamy@iitm.ac.in

https://www.cse.iitm.ac.in/~swamy

- Algorithms, Complexity, Combinatorics, Combinatorial Optimization
- Software Systems for Resource allocation, Scheduling
- Software Systems for Knowledge Representation and automated planning
- System design for Electronic Voting

Algorithms Analysis for running time and solution optimality

Studies on Special classes of inputs

Domain Classification using Ontologies and Automated Planning Techniques

Design of systems using knowledge representation, automated planning, optimization algorithms

Domain Knowledge, Efficient Optimization Algorithms

Dr. Nishad Kothari

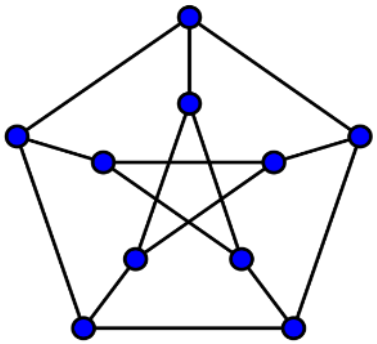
PhD, University of Waterloo, Canada

Assistant Professor, Computer Science and Engineering

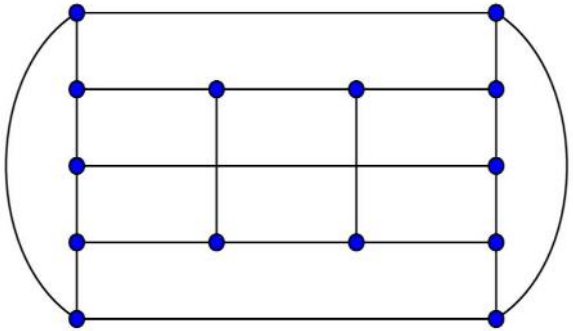
044-2257-4360; nishad@iitm.ac.in

Research Areas: Matching Theory, Structural Graph Theory

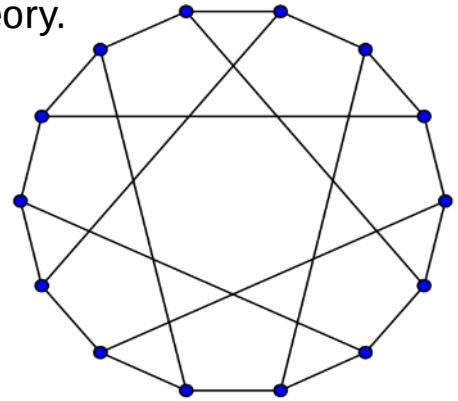
- One of the main objectives is to find NP and co-NP characterizations of graph classes; for example:
  - Classes motivated by Combinatorial Optimization: ***PM-compact*** graphs, ***Birkhoff-von Neumann*** graphs
  - Classes defined by excluding certain matching minors: ***K4-free*** graphs, ***prism-free*** graphs
  - Classes motivated by theoretical physics and enumerative combinatorics: ***Pfaffian*** graphs
- Developing induction tools (i.e., generation theorems) that are useful in characterizing graph classes
- Discovering graphs that play a special role in certain areas of Graph Theory.



Petersen Graph



The Trellis



Heawood Graph

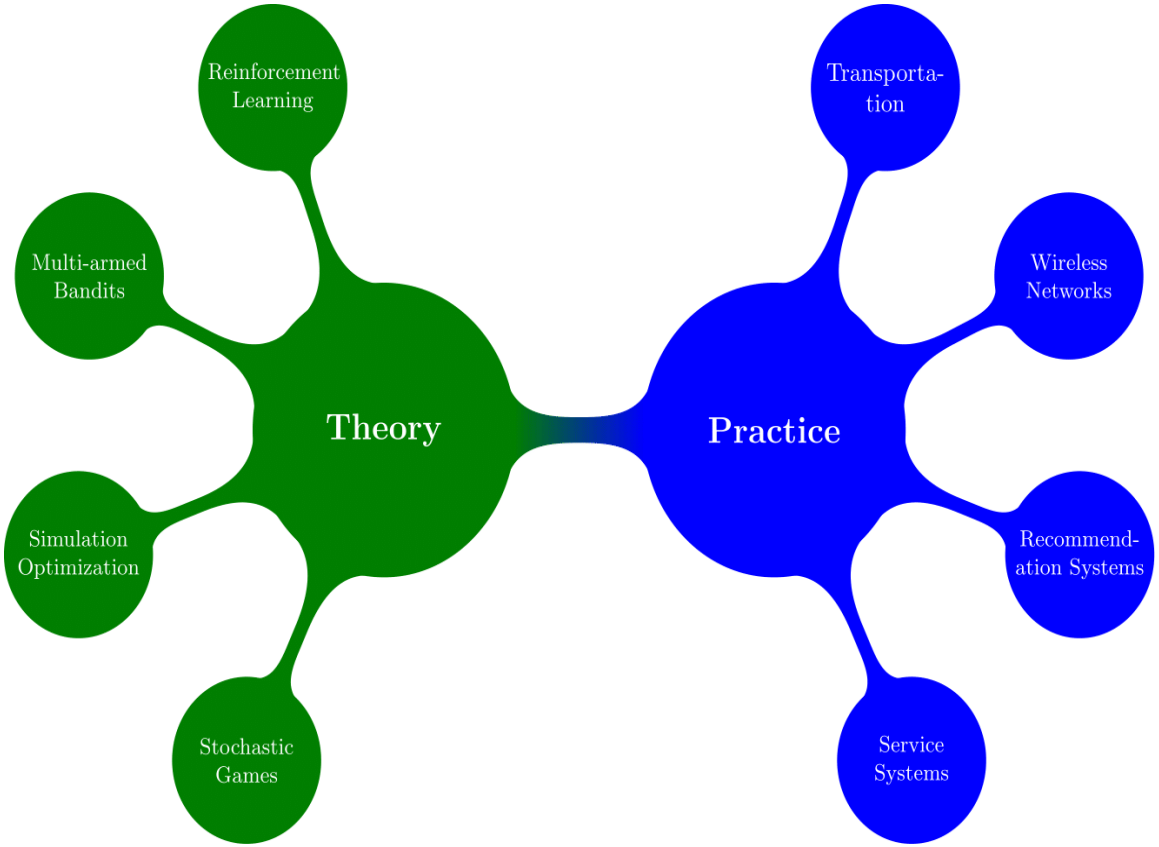
Dr. Prashanth L. A.

PhD, Indian Institute of Science

Associate Professor, Computer Science and Engineering

044-2257-4377; prashla@iitm.ac.in

http://www.cse.iitm.ac.in/~prashla



How to take decisions that maximize the rewards accumulated in the long run?

Need an algorithm that

- is **efficient, autonomous**
- handles **uncertainties** and multiple timescales
- is **model-free** and **scalable**

Sequential decision making under uncertainty

Dr. Raghavendra Rao B V

Associate Professor, Computer Science and Engineering

044-2257-4381; bvrr@iitm.ac.in

http://www.cse.iitma.c.in/~bvrr

Major Areas of Research

- Computational Complexity Theory
- Algebraic Complexity Theory
- Combinatorial Commutative Algebra
- Analysis of Algorithms
- Computational problems on algebraic and combinatorial structures

Source: Faculty website

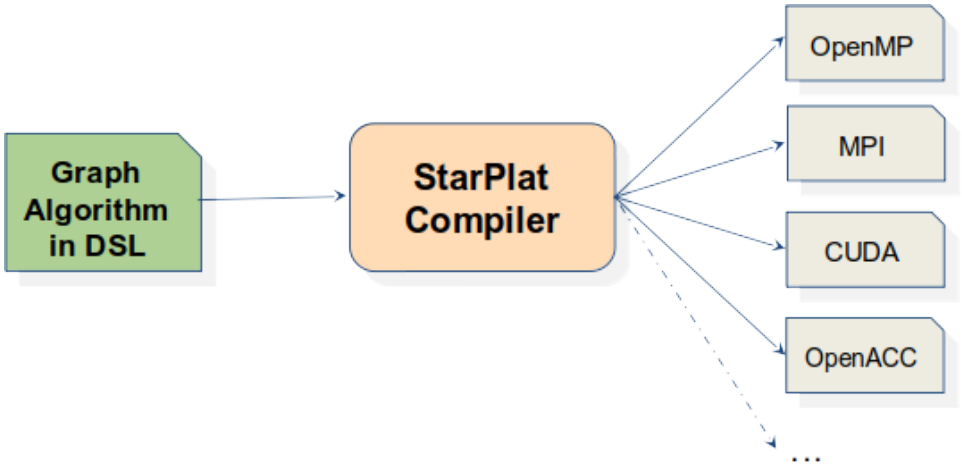
Dr. Rupesh Nasre

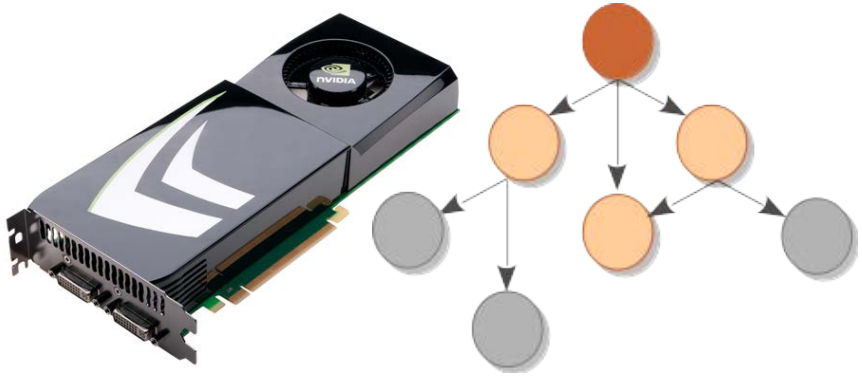
PhD, Indian Institute of Science Bangalore
Professor, Computer Science and Engineering
044-2257-4374; rupesh@iitm.ac.in
http://www.cse.iitm.ac.in/~rupesh

- **GPUs, High Performance Computing**
- **Graph Algorithms, Vehicle Routing**
- **Compilers and Domain-Specific Languages**

- Excellence in Teaching Award at IIT Madras
- APJ Abdul Kalam Cray HPC Award
- NVIDIA Special Prize for CodeForScience
- ICPC Coach Award

- 10 patents, 2 books
- 10 PhD Theses
- Distinguished Paper Award at PPoPP
- Associate Editor of CCPE Journal





Dr. Shweta Agarwal

PhD, University of Texes at Austin

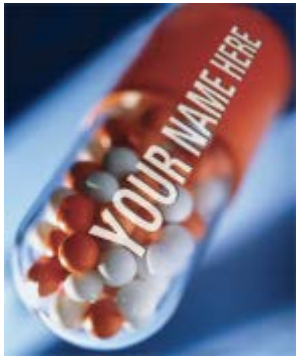
Professor, Computer Science and Engineering

044-2257-4384; shweta@iitm.ac.in

http://www.cse.iitm.ac.in/~rupesh

- Cryptography, particularly post-quantum cryptography from hard lattice problems
- Applications of Blockchain technology to socially relevant problems
- Computing on encrypted data to enable machine learning on encrypted data
- Resolving conflict between utility and privacy in age of big data

Secure Cloud computing



Patient private medicine

Patient private medicine

Dr. Shreyas Pai

PhD, University of Iowa, USA

Assistant Professor, Computer Science and Engineering

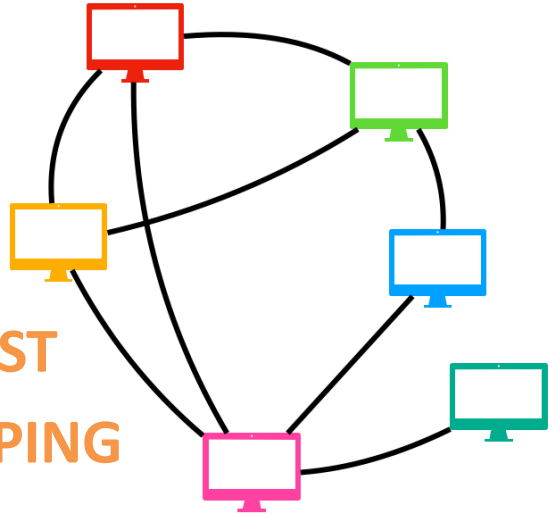
044-2257-4395; shreyas@iitm.ac.in

- **Distributed Graph Algorithms**
  - Round and Message Efficiency
  - Singularly Optimal Algorithms
  - Low Energy Complexity

LOCAL

CONGEST

SLEEPING



- **Massively Parallel Algorithms**
  - Solving Problems with Sublinear Space
  - Taking advantage of Adaptivity

hadoop MapReduce

APACHE Spark™

Dr. C Siva Ram Murthy

PhD, Indian Institute of Science

Professor, Computer Science and Engineering

044-2257-4361; murthy@iitm.ac.in

Major Areas of Research

- **Ad hoc wireless networks**
- **Parallel and distributed computing**
- **Real-time systems**
- **Computer networks**

Source: Faculty website

Dr. Sreenivasa Kumar P

PhD, IISc. Bangalore

Professor, Computer Science and Engineering

044-2257-4366; psk@cse.iitm.ac.in ; psk@iitm.ac.in

https://www.cse.iitm.ac.in/~psk/

Major Areas of Research

- **Database systems,**
- **Semi-structured data and XML,**
- **Data mining,**
- **Graph algorithms,**
- **Parallel computing.**

Source: Faculty website

Dr. **Sukhendu Das**

Professor, Computer Science and Engineering

+91-44-2257-4367; sdas@iitm.ac.in

http: //www.cse.iitm.ac.in/~sdas, …./~vplab

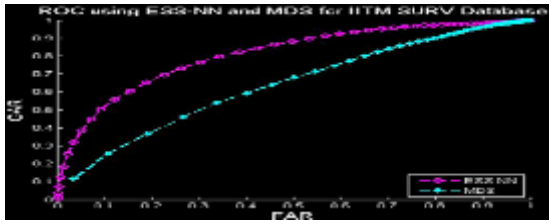
Major Areas of Research

CBVR using DMST-CSS and Hyper-strings

(Proposed VIDCAR) *(ICPR-10)*

Unconstrained Face Recognition

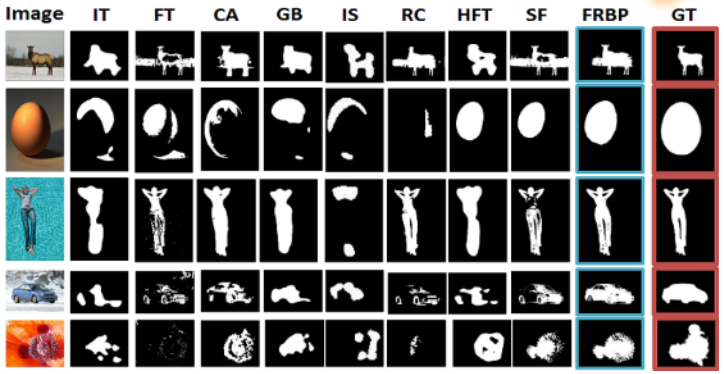
- EDT
- ESS
- Subband



SLAR for "Smart CBIR"

MTH *SLAR*

Domain Adaptation, Saliency (FRBP), Soft object and biped dynamics



← *Unifying Visual Perception and Visualization for cognitive intelligence algorithms* →

Dr. Sutanu Chakraborti

PhD, The Robert Gordon University, UK

Professor, Computer Science and Engineering

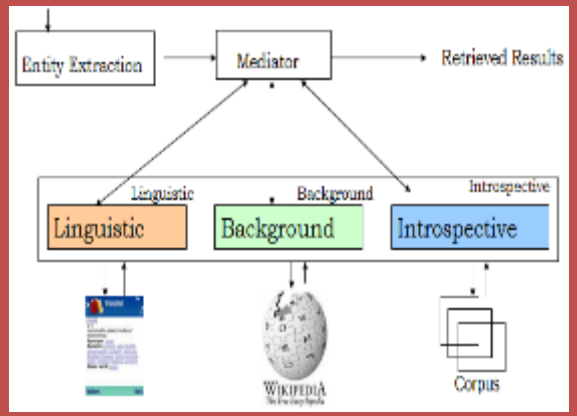
044-2257-4376; sutanuc@iitm.ac.in

http://www.cse.iitm.ac.in/~sutanuc/

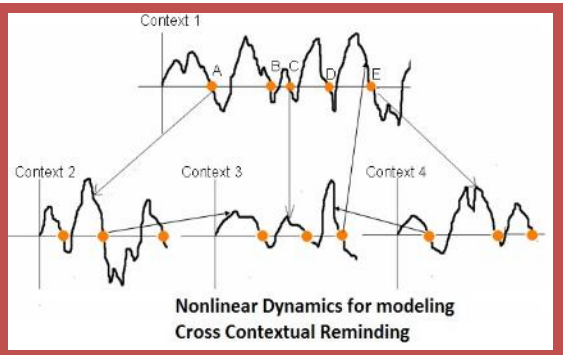
- Text and Web Analytics
- Machine Learning for Knowledge Acquisition
- Cognitive Aspects of Language and Memory

Search, Recommendation and Corporate Memory Systems

Machine Learning for Natural Language Processing



Looking into the Future: Non-conventional models of cognition (language and memory)



COMPUTATIONAL MODELS OF LANGUAGE, MEMORY AND LEARNING

Dr. Yadu Vasudev

Assistant Professor, Computer Science and Engineering

044-2257-4386; yadu@iitm.ac.in

http://www.cse.iitm.ac.in/~yadu

Areas of Research

- Sublinear Algorithms
  - Property testing algorithms for large sparse graphs
  - Distributed algorithms on sparse networks
- Computational Complexity Theory
  - Complexity of isomorphism problems
  - Randomness in computation

Source: Faculty website

INDIVIDUAL FACULTY PROFILE

DEPARTMENT OF DATA SCIENCE AND ARTIFICIAL INTELLIGENCE

LIST OF FACULTY

- Arun Rajkumar
- Arun Tangirala
- Balaji Srinivasan
- Chandrashekar Lakshminarayanan
- Ganapathy Krishnamurthi
- Gitakrishnan Ramadurai
- Harish Guruprasad Ramaswamy
- Karthik Raman
- Mitesh M Khapra
- Nandan Sudarsanam
- Ravindran B
- Sivaram Ambikarasan
- Sridharakumar Narasimhan
- Venkata Krishna Koundinya Pillutla

Dr. Arun Rajkumar

Assistant Professor, Data Science and Artificial Intelligence

+919986744842; arunr@cse.iitm.ac.in

Primary areas of Research

- Algorithmic Machine Learning
- Learning to Rank
- Multi Armed Bandits

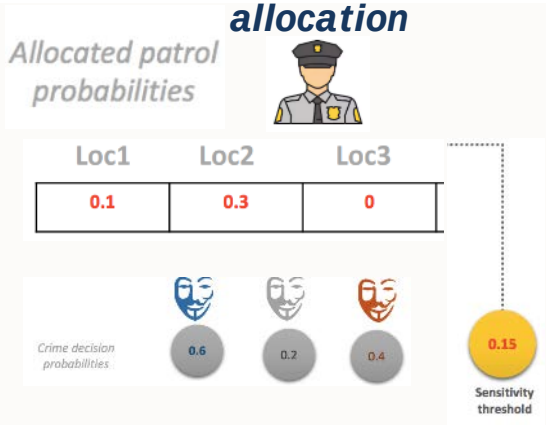
Application Domains of Interest

- Education
- Healthcare
- Transportation

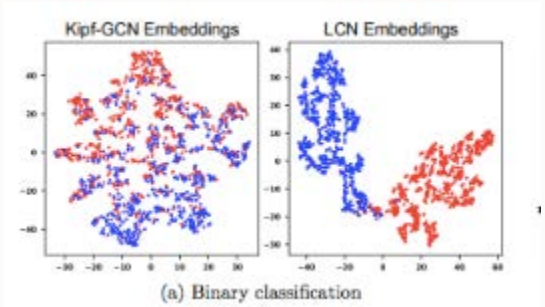
Research directions

Optimal and efficient ranking from pairwise comparisons

Combinatorial Semi Bandits Algorithms for resource allocation



Learning Representations on Graphs and Networks



Dr. Arun K Tangirala

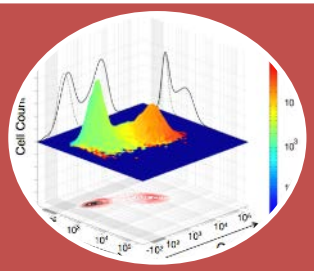
PhD, University of Alberta, Canada

Professor, Data Science and Artificial Intelligence

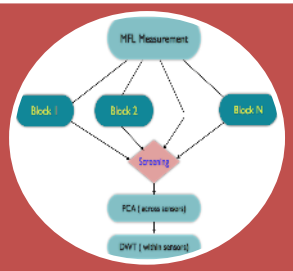
044-2257-4181; arunkt@iitm.ac.in

http://www.che.iitm.ac.in/~arunkt

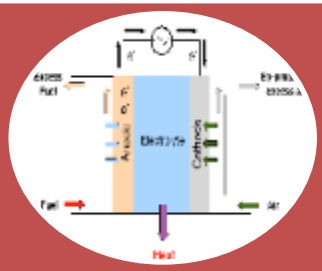
- Process Control, Identification & Monitoring
- Control loop performance assessment
- Data-driven process analysis and control



Systems Biology



Process & Pipeline Health Monitoring



Energy Systems

SYSTEMS ENGINEERING & INFORMATION-THEORETIC APPROACHES

Dr. Balaji Srinivasan

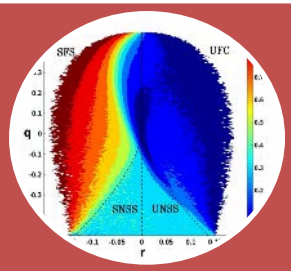
PhD, Stanford University, India

Professor, Data Science and Artificial Intelligence

044-2257-6657; sbalaji@iitm.ac.in

- Robust Numerical Methods for Compressible and Rarefied Flows
- Analysis and computation of Turbulent Flows
- Applied Machine Learning

Numerical Algorithms



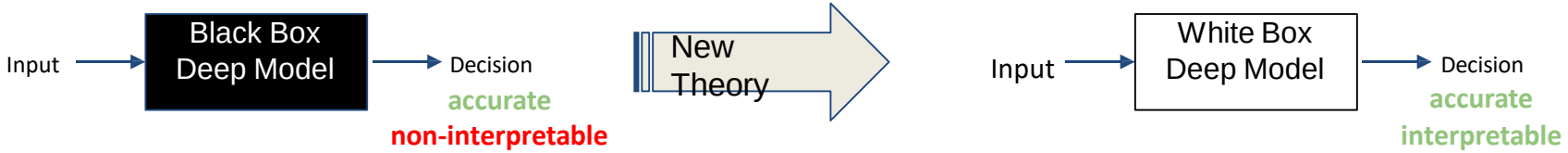
Computation of Turbulent Flows

Applied Machine Learning

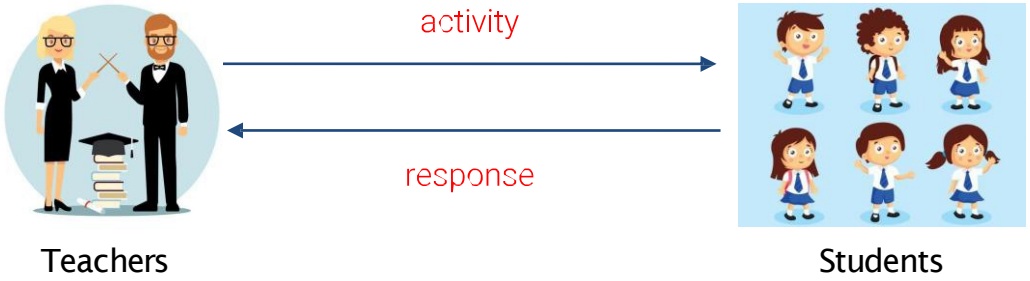
We are developing Autonomous Flow Solvers for Complex Situations

Dr. Chandra Shekar Lakshminarayanan
Assistant Professor, Data Science and Artificial Intelligence
044-2257-4358; chandrashekar@iitm.ac.in

- Deployable Deep Learning: Build interpretable deep models that achieve state-of-the-art performance in practical domains



- Reinforcement Learning For Education: Personalised activity assignment based on individual student response



Dr. Ganapathy Krishnamurthi

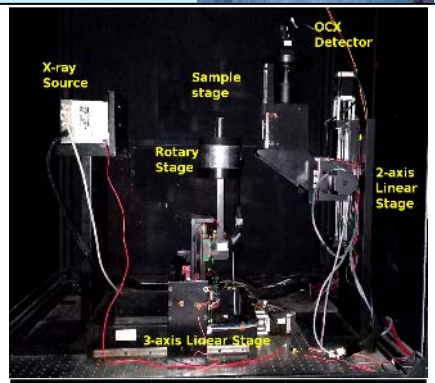
PhD, Purdue University, USA

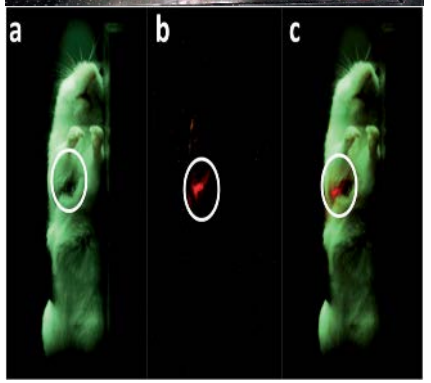
Professor, Data Science and Artificial Intelligence

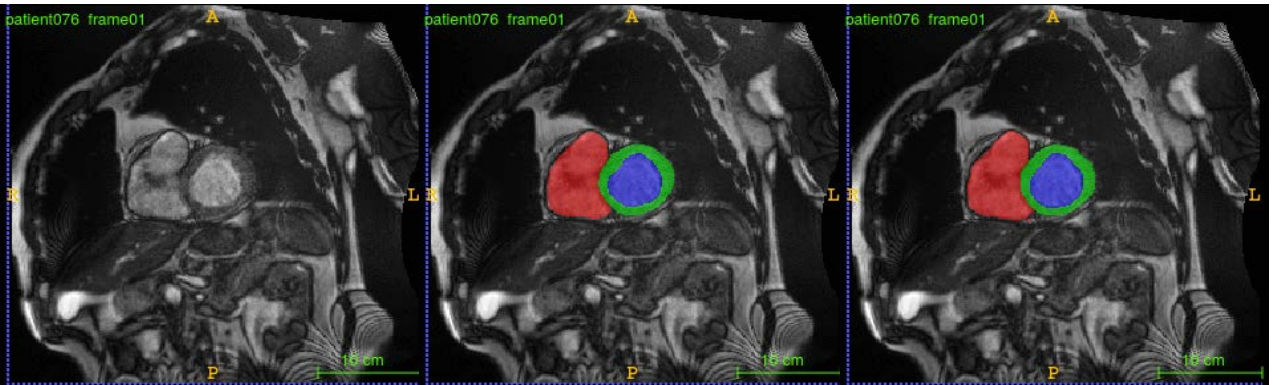
044-2257-4745; gankrish@iitm.ac.in

- Developing multi-modal pre-clinical imaging systems
- Developing software for medical image analysis

1. In close collaboration with Radiologists, we develop methods for automated analysis of medical images towards obtaining useful diagnostic and prognostic information.
2. We validate these methods on publicly available databases as well as using data from our radiologist collaborators.
3. We also develop low-cost pre-clinical imaging systems for enabling in-vivo imaging of rodent disease models.
4. Our focus is on developing low cost in-vivo fluorescence imaging systems as well as x-ray micro-CT systems







Dr. Gitakrishnan Ramadurai

PhD, Rensselaer Polytechnic Institute, USA

Professor, Data Science and Artificial Intelligence

044-2257-4298; gitakrishnan@iitm.ac.in

- Dynamic Traffic Assignment
- Transportation Network Modelling
- Econometric and Optimization Models in Transportation

Intelligent Transportation Systems

Sustainable Transportation

Pedestrian and Road Safety

Technological and management solutions for a safe and sustainable transportation system

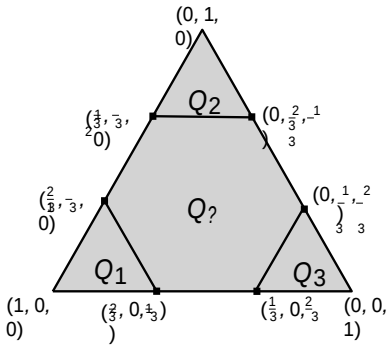
Dr. Harish Guruprasad Ramaswamy

Assistant Professor, Data Science and Artificial Intelligence

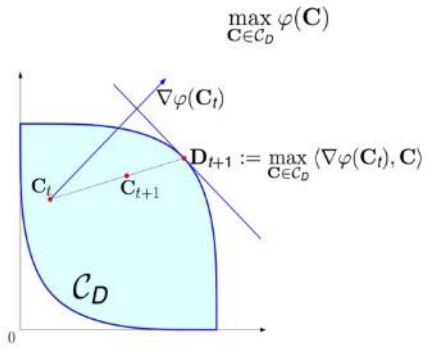
044-2257-4385; hariguru@iitm.ac.in

Major Areas of Research

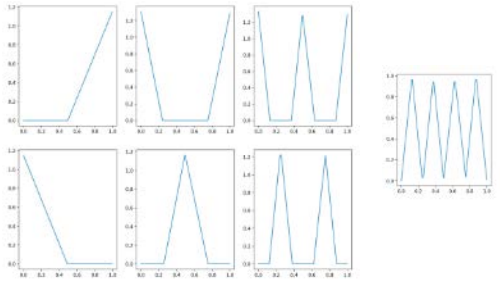
- Machine learning with Noisy/Weak Labels
- Theoretical Foundations of Deep Learning
- Optimising Complex Performance Measures in Machine Learning



Learning with noisy data and noisy predictions



Constrained classification for complex performance metrics



Aiding Deep Network Learning with symmetry and invariance

Geometry and Optimisation based approaches for Machine Learning

Dr. Karthik Raman

PhD, Indian Institute of Science, Bangalore

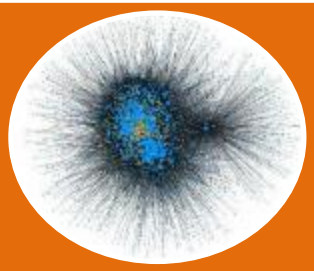
Professor, Data Science and Artificial Intelligence

Bhupat & Jyoti Mehta School of Biosciences

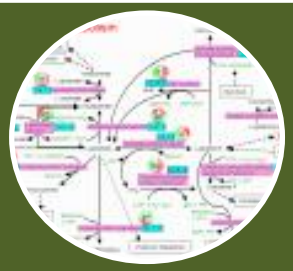
+91-44-2257-4139; kraman@iitm.ac.in;

https://home.iitm.ac.in/kraman/lab

- Computational Systems Biology/Modelling of Complex Biological Systems
- *In silico* Modelling for Metabolic Engineering
- High-performance Computing for Biology
- Synthetic Biology/Design of Biological Networks



Biological Network Analysis



in silico Metabolic Engineering

Synthetic Biology

Systems-level modelling of complex biological networks

Dr. Mitesh M Khapra

PHD, IIT Bombay, India

Associate Professor, Data Science and Artificial Intelligence

044-2257-4371; miteshk@cse.iitm.ac.in

http://www.cse.iitm.ac.in/~miteshk

- Developing robust evaluation metrics for Natural Language Generation
- Developing NLP tools and technologies for Indian languages
- Evaluating robustness of NLP systems to adversarial attacks

Dr. Nandan Sudarsanam

PhD, Massachusetts Institute of Technology, USA

Professor, Data Science and Artificial Intelligence

044-2257-4580; nandan@iitm.ac.in

Advancement of Algorithmic techniques for solving problems and achieving objectives

Core Methodologies Advanced

- Experimentation
- Data Mining/ Machine Learning
- Decision-making under uncertainty
- Applied Statistics

Research Approach Deployed

- Simulation of Meta Models

$$y(x_1, x_2, \ldots, x_n) = \beta_0 + \sum_{i=1} \beta_i x_i + \sum_{i=1} \sum_{\substack{j=1 \\ j>i}} \beta_{ij} x_i x_j + \varepsilon$$

$$x_i \sim NID(0, \sigma_x^2) \quad i \in 1 \ldots m$$

$$x_i \in \{+1, -1\} \quad i \in m+1 \ldots n$$

$$\varepsilon \sim NID(0, \sigma_\varepsilon^2)$$

$$\Pr(\delta_i = 1) = p$$

$$\Pr(\delta_{ij} = 1 | \delta_i, \delta_j) = \begin{cases} p_{00} & \text{if} \quad \delta_i + \delta_j = 0 \\ p_{01} & \text{if} \quad \delta_i + \delta_j = 1 \\ p_{11} & \text{if} \quad \delta_i + \delta_i = 2 \end{cases}$$

$$f(\beta_i | \delta_i) = \begin{cases} N(0,1) & \text{if} \quad \delta_i = 0 \\ N(0, c^2) & \text{if} \quad \delta_i = 1 \end{cases}$$

$$f(\beta_{ij} | \delta_{ij}) = \frac{1}{s_1} \begin{cases} N(0,1) & \text{if} \quad \delta_{ij} = 0 \\ N(0, c^2) & \text{if} \quad \delta_{ij} = 1 \end{cases}$$

Domains of Application

- Engineering Systems
- Demographic and Census Data
- Financial Data
- Manufacturing and Product Design

Dr. Ravindran B

Professor, Data Science and Artificial Intelligence

044-2257-4370; ravi@dsai.iitm.ac.in

Major Areas of Research

- **Machine learning**
- **Reinforcement learning**
- **Social Network Analysis**
- **Data and text mining**

Source: Faculty website

Dr. Sivaram Ambikasaran

Associate Professor, Data Science and Artificial Intelligence

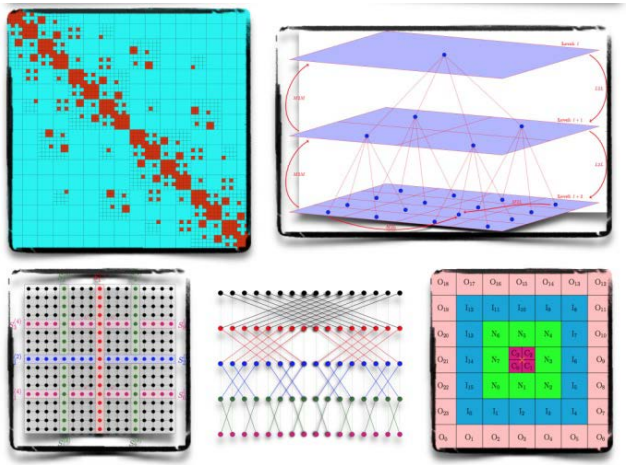
044-2257-4622; sivaambi@alumni.stanford.edu

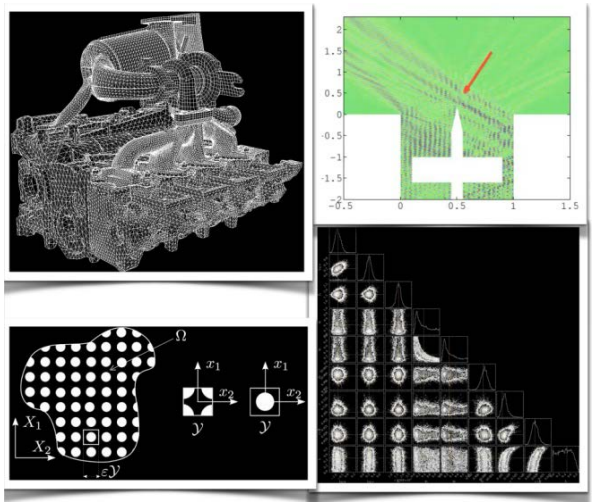
http://sivaramambikasaran.com/

Stable Accurate Fast Robust Algorithms & Numerics group

Theoritical & Computational Aspects of

- Numerical linear Algebra
- Approximation Theory
- Fast Stable Algorithms
- PDE's & Integral Equations





Applications include

- Acoustic & Electromagnetic scattering
- Finite Element & integral equation solvers
- Data driven physical modelling
- High dimensional statistics

Dr. Sridharakumar Narasimhan

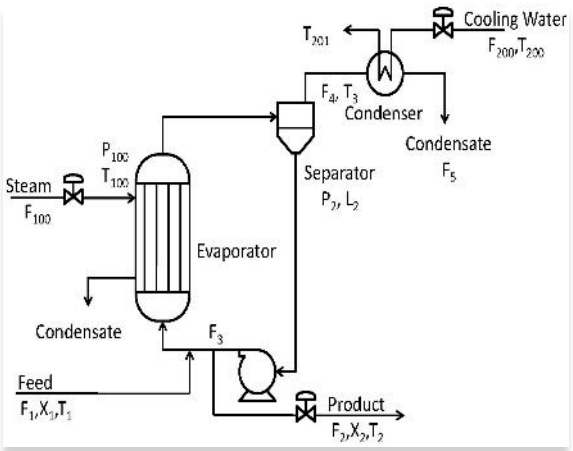
Professor, Data Science and Artificial Intelligence

044-2257-4177; naras@iitm.ac.in

http://www.iitm.ac.in/~naras

Research focus

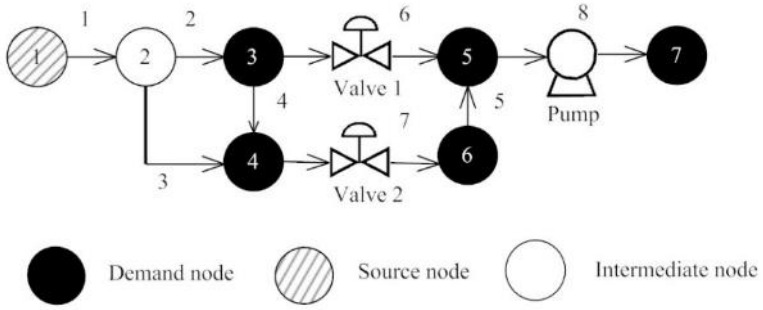
- Process systems engineering
- Sensor placement and scheduling
- Efficient control relevant model generation
- Optimal operation and design



Approach: Formulate and solve tractable (e.g., **convex) optimization** problems to guarantee performance

Applications

- Water treatment and distribution
- Pipeline operations
- Systems biology, imaging



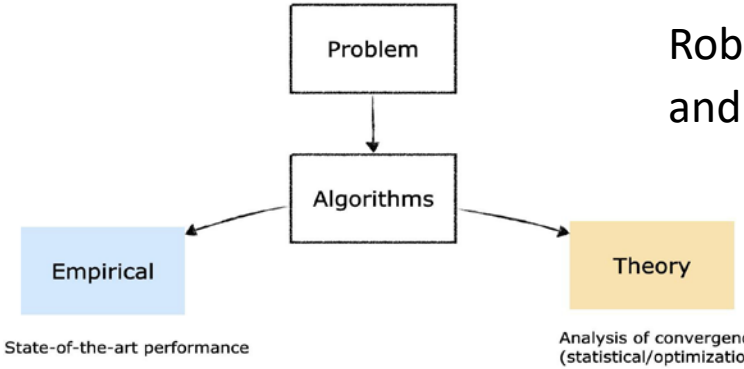
Dr. Krishna Pillutla

PhD, University of Washington, USA

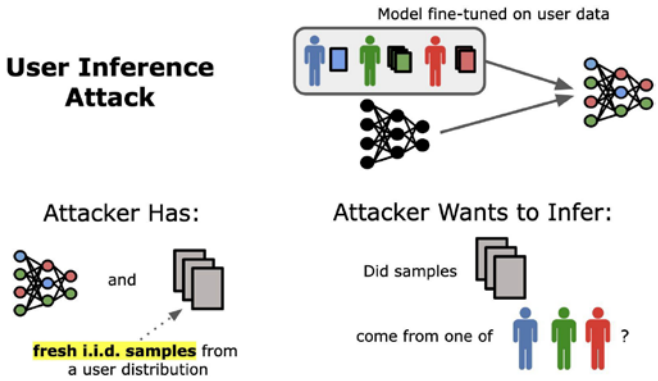
Assistant Professor, Data Science and Artificial Intelligence

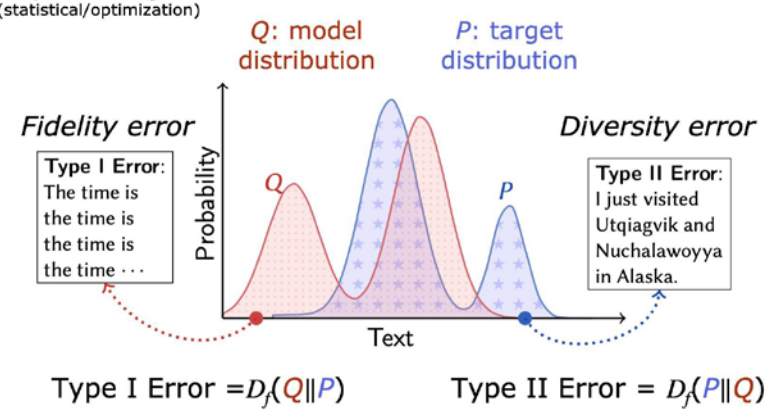
044-2257-4396; krishnap@iitm.ac.in

Data privacy in AI



Robustness of LLMs/GenAI and their evaluation·





INDIVIDUAL FACULTY PROFILE

DEPARTMENT OF ELECTRICAL ENGINEERING

LIST OF FACULTY

- Ananth Krishnan
- Anbarasu Manivannan
- Andrew Thangaraj
- Anil Prabhakar
- Aniruddhan S
- Anjan Chakravorty
- Arun Karuppaswamy B
- Arun Pachai Kannu
- Arun D Mahindrakar
- Arvind Rameshwar
- Avhishek Chatterjee
- Balaji Srinivasan
- Bharadwaj Satchidanandan
- Bharath Bhikkaji
- Bhaswar Chakrabarti
- Bijoy Krishna Das
- Debdutta Ray
- Deepa Venkitesh
- Deleep R Nair
- Devendra Jalihal
- Gaurav Raina
- Giridhar K
- Janakiraman Viraraghavan
- Jayaraj Joseph
- Kalyan Kumar B
- Kamalesh Hatua

Kaushik Mitra
Krishna S
Krishna Jagannathan
Krishna Vasudevan
Lakshmi Narasimhan Theagarajan
Lakshminarasamma
Mahesh Kumar
Manivasakan R
Mathiazhagan C
Mohanshankar Sivaprakasam
Nair Pravin Ramachandran
Nagendra Krishnapura
Nandita Dasgupta
Nitin Chandrachoodan
Pradeep Kiran Sarvepalli
Puduru Viswanadha Reddy
Rachael Kalaimani
Ramprasath S
Radha Krishna Ganti
Rahul Meshram
Rajagopalan A N
Ramalingam C S
Ramkrishna Pasumarthy
Ravinder David Koilpillai
Sarathi R
Saurabh Saxena
Saurav Prakash
Sayak Dutta Gupta
Shanthi Pavan
Shanti Bhattacharya
Sheetal Kalyani
Shivananju B N
Shreepad Karmalkar
Soumya Dutta
Sridharan K
Srikrishna Bhashyam
Srirama Srinivas
Sudharsanan Srinivasan
Swarup K S
Uday Khankhoje
Umesh S
Venkatesh T G
Venkatesh Ramaiyan
Vinita Vasudevan

Dr. Ananth Krishnan

PhD. from Texas Tech University

Professor, Electrical Engineering

044-2257-4451; ananthk@iitm.ac.in

http://www.ee.iitm.ac.in/~ananthk

Major Areas of Research

- Design, Fabrication and Characterization of Plasmonic devices
- Design, Fabrication and Characterization of Optical Metamaterials
- Wafer scale photonic devices

Source: Faculty website

Dr. Anbarasu Manivannan

PhD, IISc Bangalore

Professor, Electrical Engineering

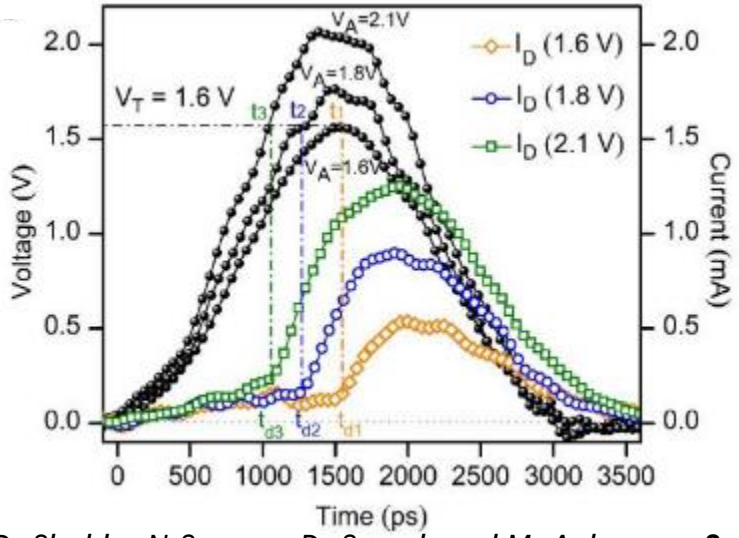
044-2257 4412; anbarasu@iitm.ac.in

https://anbuchalcogen.wixsite.com/anbarasu

Research Specialization

- Phase Change Memory (PCM) for high speed Non-volatile RAM & universal memory
- Novel two-terminal Selector Devices & 3D cross-point memory architectures
- Phase change materials for neuromorphic computing and Photonic applications

Sub-ns switching in AgInSbTe PCM devices



Research Thrusts

- Design of novel materials for high-speed NVRAM
- Development of prototype PCM with SRAM-speed
- Novel phase change photonic memory device
- Multi-bit data storage technology
- Phase change photonic memory & Optoelectronic devices
- Phase change synaptic devices and neuromorphic computing

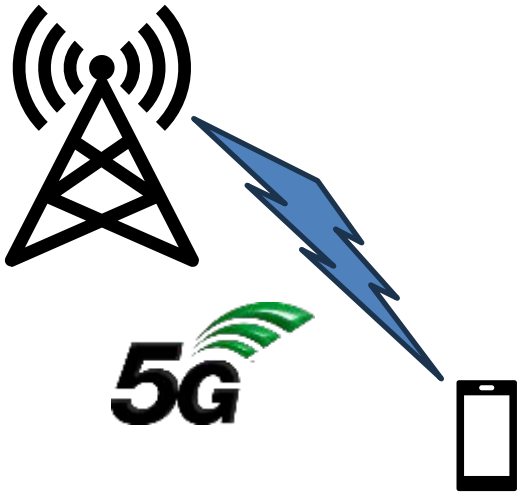
K.D. Shukla, N.Saxena, D. Suresh and M. Anbarasu, ***Scientific Rep. 6****, 37868 (2016)*

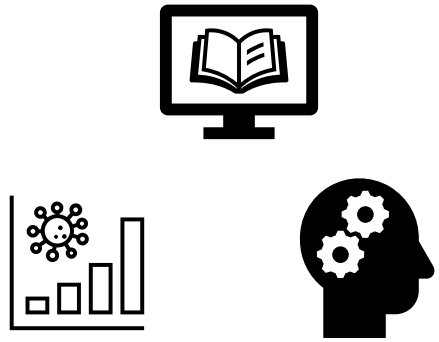
Dr. Andrew Thangaraj

Professor, Dept. of Electrical Engineering

044-2257-4424; andrew@ee.iitm.ac.in

https://www.ee.iitm.ac.in/andrew





Error control codes, Information theory	Statistical learning theory	AI for education
Classical and modern codes – theory & implementation Capacity bounds, Physical layer security	Missing mass and the Good-Turing estimator Model collapse in recursive retraining	Predicting and tracking student performance Item response theory and knowledge tracing

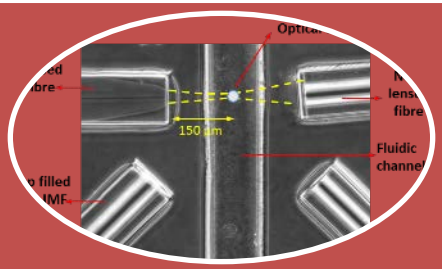
Dr. Anil Prabhakar

PhD, Carnegie Mellon University
Professor, Electrical Engineering
044-2257-4425; anilpr@iitm.ac.in
http://www.ee.iitm.ac.in/~anilpr/

Major Areas of Research

- Photonic & Quantum Technologies & Applications (quantum.iitm.ac.in)
- Quantum Networks, Quantum Computing, Quantum Machine Learning
- Assistive technologies and Rehabilitation Engineering (create.iitm.ac.in)

Quantum Information
Communication, Computing



Optofluidic
Flow Analyzer

Wearable Assistive
Rehabilitation Devices

Quantum and Embedded systems for societal benefit

Dr. S Aniruddhan

PhD, University of Washington, Seattle, USA

Professor, Electrical Engineering

044-2257-4468; ani@ee.iitm.ac.in

http://www.ee.iitm.ac.in/~ani/

- CMOS RFIC design
- Phase-locked loops and frequency synthesizers
- IC design for Biomedical Applications

Transceivers for Wireless Communications

Industrial Electronics

Biomedical Instrumentation

Dr. Anjan Chakravorty

PHD, IIT Kharagpur, India

Professor, Electrical Engineering

044-2257-4460; anjan@iitm.ac.in

http://www.ee.iitm.ac.in/~anjan/index.html

- SiGe Heterojunction Bipolar Transistors/ Modeling of Non-Quasi-Static Effects
- Laterally Diffused MOSFETs/ Modeling of Self-Heating & Snapback Effects
- Nano FETs/ Modeling of Charges and Non-Reciprocal Capacitances

Communication Circuits

Automotive Circuits

High-Speed Digital Switching

Dr. Arun Karuppaswamy B

Associate Professor, Electrical Engineering

044-2257-4449; akp@ee.iitm.ac.in

http://www.ee.iitm.ac.in/akp

Expertise: Power Electronics

sine LAB — An open design initiative

Broad Research Areas

Devices

Activities

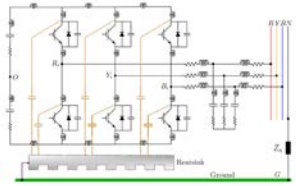
- Device Characterisation
- Gate Driver Development
- Device Protection
- Devices: Si-IGBT, SiC-MOSFET, GaN HEMT

Magnetics

Activities

- Exploring different types of cores
- Inductor design with different types of cores
- Materials: Amorphous, Powdered Iron, Nano Crystalline

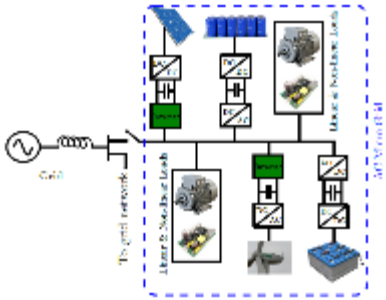
EMI/EMC



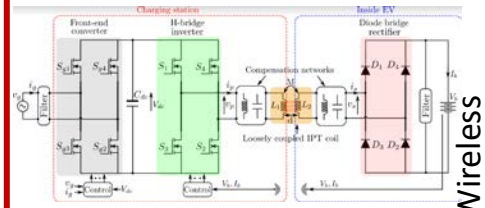
Activities

- Conducted EMI studies for grid-connected inverters
- Understanding EMI current flow paths through gate drivers

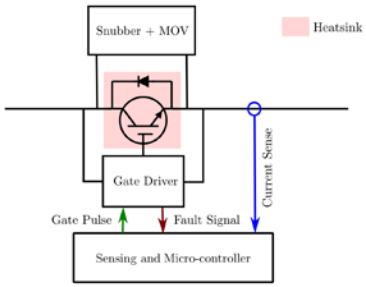
Focus Applications



- AC microgrids



- Wireless charging



- Solid State Circuit Breakers

Dr. Arun Karuppaswamy B

PhD, Indian Institute of Science, Bangalore

Associate Professor, Electrical Engineering

044-2257-4449; akp@ee.iitm.ac.in

http://www.ee.iitm.ac.in/akp

Major Areas of Research

- AC micro-grids
- Grid-connected inverters
- Switched Mode Power Supplies
- Power Electronics

Hardware Development

- Inverter Design
- DSP Board Design
- Converter Design
- Filter Design

Control, Comm. and UI

- Digital Control (DSP)
- CAN Communication
- Python Based UI

Some Project Areas

- Inv. Ct Mode Control
- Volt Mode Control
- Anti-Islanding
- EMI Filter Design
- Ultra-Cap Storage

Dr. Arun D Mahindrakar

PhD,IIT Bombay, India

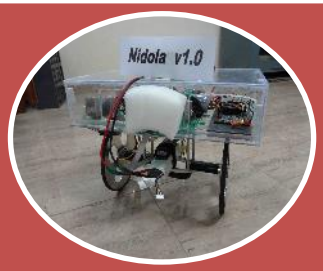
Professor, Electrical Engineering

044-2257-4445; arun_dm@iitm.ac.in

http://www.ee.iitm.ac.in/~arun_dm

- Nonlinear Control/Underactuated robots
- Experimental work /Mobile robots
- Formation control of multiple robots/Aerial vehicles

Underactuated robots



Mobile robots

Aerial Vehicles

Dr. Arun Pachai Kannu

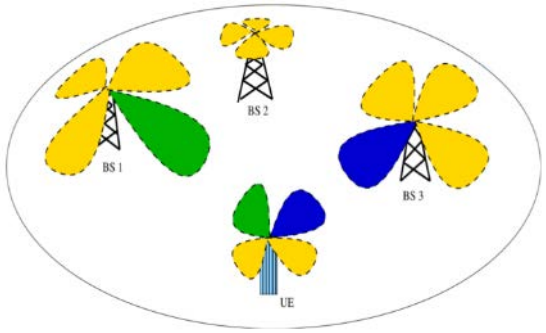
Professor, Electrical Engineering

044-2257-4463; arunpachai@ee.iitm.ac.in

http://www.ee.iitm.ac.in/~arunpachai

Major Areas of Research

- Signal Processing in Millimeter Wave Beam-forming Systems
- Massive Random Access and Media Based Modulation Techniques
- Theory and Applications of Sparse Signal Recovery



Detection and Estimation Problems in Wireless Communications

Dr. V. Arvind Rameshwar

PhD, IISc, Bangalore

Assistant Professor, Dept. of Electrical Engineering

044-2257-4496; arvind@iitm.ac.in

https://arvindrameshwar.github.io/

- Information theory and error-control coding: Design of low-complexity encoders/decoders
- Fundamental limits of DNA-based data storage: Code design and analysis for high-throughput DNA sequencers
- Data privacy: Differentially private release of statistics of real-world, non-public datasets

5G/6G Communications

Modern DNA-based data storage

Inference and learning with privacy

Fundamental limits of reliable communication, storage, and private data analysis

Dr. Avhishek Chatterjee

PhD, University of Texas at Austin, USA

Associate Professor, Electrical Engineering

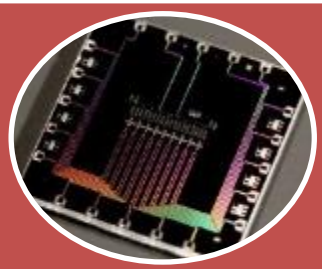
044-2257-4452; avhishek@iitm.ac.in

https://www.iitm.ac.in/info/fac/avhishek

- **Stochastic networks:** communication and social networks; crowdsourcing; fault tolerant computing; quantum information systems
- **Network inference:** inferring network phenomena; learning on networks; neural networks

Communication and social networks

Crowdsourcing



Stochastic information processing

Mathematical and data driven study of real life stochastic systems and networks

Dr. Balaji Srinivasan

PhD, University of New Mexico, USA

Professor, Electrical Engineering

044-2257-4426; balajis@ee.iitm.ac.in

http://www.ee.iitm.ac.in/facs_balajis

- High Power & Ultrashort Pulse Fiber Lasers
- Fiber Bragg Gratings
- Distributed Fiber Sensors

Laser-Based Material Processing

Structural Health Monitoring

Real-time Power Monitoring

Dr. Bharath Bhikkaji

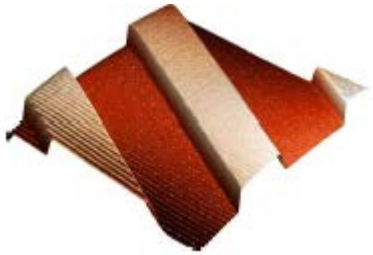
PhD, Uppsala University, Sweden

Associate Professor, Electrical Engineering

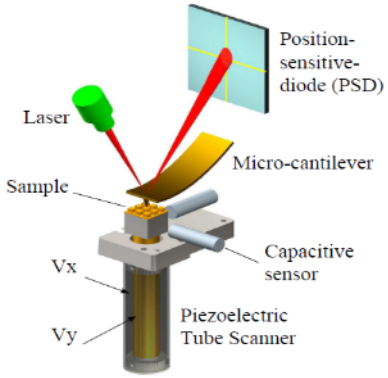
044-2257-4455; Bharath.Bhikkaji@iitm.ac.in

http://ee.iitm.ac.in/~Bharath

- Modeling and Control of Flexible Structures
- Vibration control of Smart Structures
- Portfolio Analysis and Selection



Atomic Force Microscopes



Nanopositioners

Finance

System Identification, Control Design & Statistical Signal Processing

Dr. Bharadwaj Satchidanandan

PhD., Texas A&M University, USA

Assistant Professor, Electrical Engineering

044-2257-4413; bsatchid@ee.iitm.ac.in

https://sites.google.com/view/bsatchidanandan/home

Major Areas of Research

- Security of Cyber-Physical Systems
- Resilient Control of Cyber-Physical-Social Systems
- Renewable Energy Systems
- Mechanism Design
- Millimeter-Wave Communication Networks
- Automated Traffic Management of Unmanned Aerial Systems

Source: Faculty website

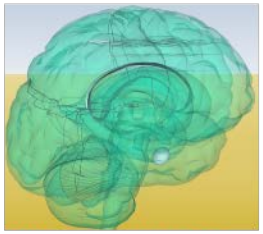
Dr. Bhaswar Chakrabarti

PhD, UTDallas, USA

Associate Professor, Electrical Engineering

044-2257-4413; bchakrabarti@iitm.ac.in

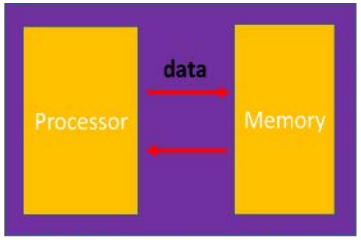
- Ultimate scalability of resistive memories with 2-dimensional heterostructures
- Design and development of 2-d RRAMs; performance evaluation; device model
- Develop neuromorphic circuit applications



Brain

10 W power consumption

Fault tolerant Massively parallel

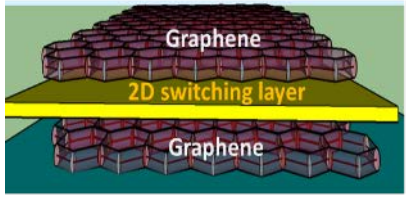


Von-Neumann Machine

100 W/cm^2 power consumption

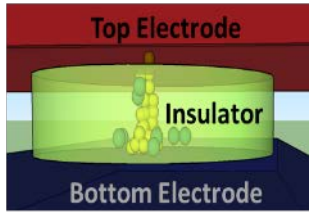
Very low defect tolerance Serial processing

2d RRAM

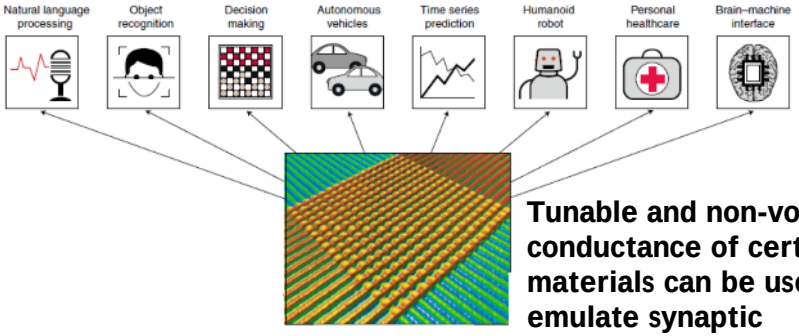


Low variability, switching power

Conventional RRAM



Higher variation, switching power



Tunable and non-volatile conductance of certain materials can be used to emulate synaptic connectivity in neural networks

Q. Xia and J. J. Yang, Nat. Mat., vol. 18, 309(2019)

Targets (3 year)

- ❑ Process development for all-2d resistive memory fabrication
- ❑ 2d-resistive memory prototype fabrication
- ❑ Electrical and physical characterization of developed device
- ❑ Development of device models

Dr. Bijoy Krishna Das

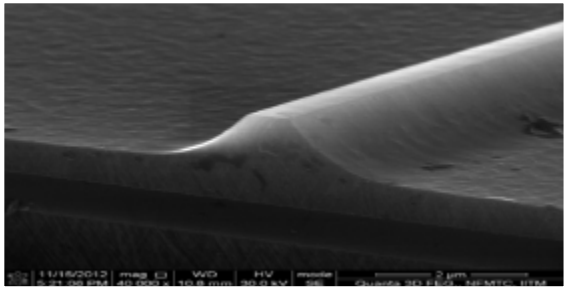
PhD, University of Paderborn, Germany

Professor, Electrical Engineering

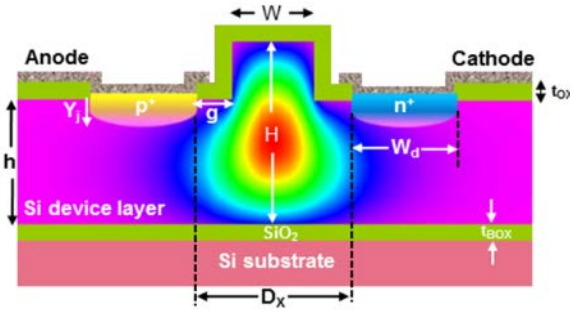
044-2257-4459; bkdas@iitm.ac.in

http://www.ee.iitm.ac.in/~bkdas

- Silicon Photonics & Optical Interconnect for Communications
- Integrated Optoelectronics for Sensor Devices
- Nonlinear Integrated Optics



Low-loss Trimmed Waveguide Structure in SOI (0.06 dB/mm)



Waveguide PIN Phase-Shifter in SOI (Modeling & Fabrication)

Fiber Pigtailed & Packaged DWDM Channel Interleaver (100 GHz)

Dr. Debdutta Ray

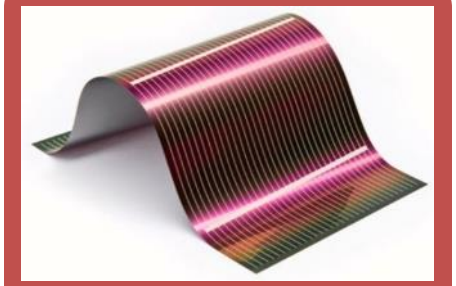
PHD, TIFR, Mumbai, India

Associate Professor, Electrical Engineering

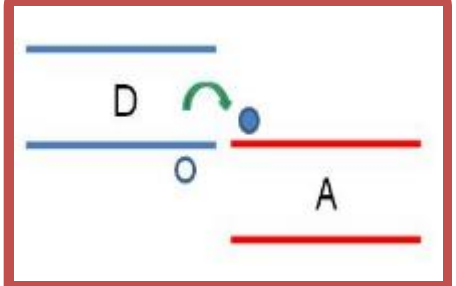
044-2257-4479; dray@ee.iitm.ac.in

Major Areas of Research

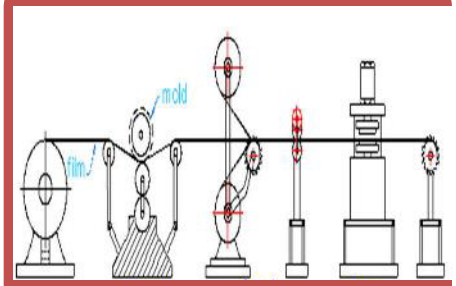
- Organic Solar Cells (OSOL)
- Novel organic devices
- Study of material for roll-to-roll processing
- Large area devices
- Organic field effect transistors (OFET)
- Organic doping
- Engineering thin film morphology



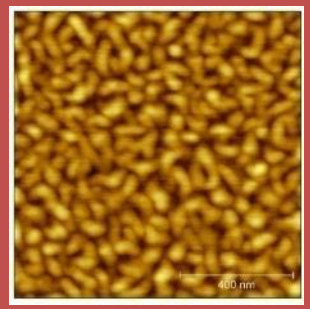
Organic solar cells



Organic doping



Roll-to-roll processing



Engineering morphology

Dr. Deepa Venkitesh

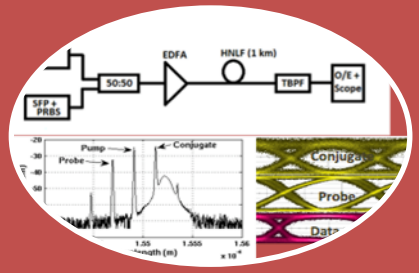
PhD, IIT Bombay, India

Professor, Electrical Engineering

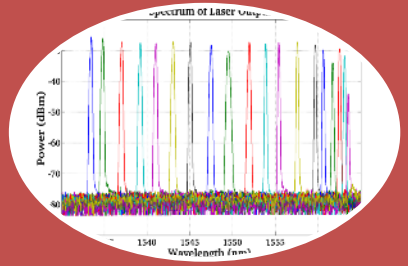
044-2257-4466; deepav@iitm.ac.in

http://www.ee.iitm.ac.in/facs_deepa

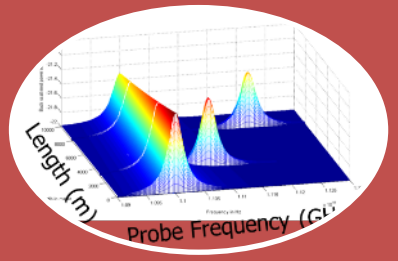
- All-optical signal processing in high-speed communication systems
- Development of fiber lasers for specific applications in different wavelength ranges
- Distributed temperature and strain sensors using nonlinear optics



Optical Wavelength Conversion



Tunable fiber laser



Distributed Temperature and Strain sensors

Applications of nonlinear optics

Dr. Deleep R Nair

Professor, Electrical Engineering

044-2257-4471; deleep@iitm.ac.in

http://www.ee.iitm.ac.in/user/deleep/

Major Areas of Research

- Semiconductor devices: Device Design, Fabrication, Characterization and Numerical modeling
- RF MEMS
- Circuit - Device interactions

Source: Faculty website

Dr. Devendra Jalihal

Professor, Electrical Engineering

Coordinator, RuTAG-IITM & Indian Language SMS taskforce

044-2257-4471; deleep@iitm.ac.in

http://www.ee.iitm.ac.in/user/deleep/

Research Areas

- Wireless Communication
- DSP for Communications
- MIMO Receiver Techniques

Research projects

- Indo-UK Cross Layer Energy Efficiency
- DISANET – Emergency Communications
- Tata Power – Battalion Communication System
- Project Guidance: M.Tech (30+), DD (10) B.Tech (30+)

Awards & Publications

- *Journals (15), Conferences (60)*
- *Sponsored Research projects as PI (total value ~ 680 Lakhs)*

Research Scholars (over last 5 years)

	Ph.D.	MS
Completed	1	5
In Progress	2	1
Project Staff	8	

	Since 2008
Citations	150
h-index	6
i10-index	7

Dr. Gaurav Raina

PhD, University of Cambridge

Professor, Electrical Engineering

Tel: 044-2257-4453; gaurav@ee.iitm.ac.in

http://www.ee.iitm.ac.in/facs_gaurav

Research Areas

- Control and Nonlinear Systems
- Performance Modelling of Communication & Transport Networks
- Mobile Payments, Security, Commerce

Source: Faculty website

Dr. K Giridhar

PhD (Univ. of California, Santa Barbara, 1993)

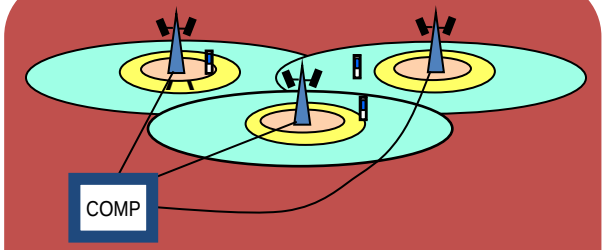
Professor, Electrical Engineering

+91 44 2257 4420; giri@ee.iitm.ac.in

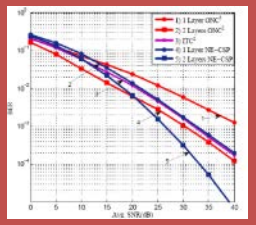
http://www.iitm.ac.in/ee/~giri

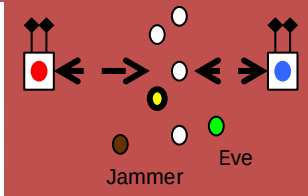
- Adaptive Signal Processing for Broadband Wireless Communications
- Interference Aware Estimation, Detection, Scheduling, and Rate Adaptation
- Wireless Standards, Future Het-Nets, Strategic Comm., and Performance Analysis

LTE/4G+/WiFi Wireless Hardware Design & Proof of Concept Test-Bed Development



Performance Analysis of MIMO-OFDM Mobile Broadband Access Networks





Advanced Transceiver Algorithms for Interference Limited Systems and for Strategic Communications

Wireless Communications for Civilian and Strategic Use – Research, Design, Analysis

Dr. Janakiraman Viraraghavan

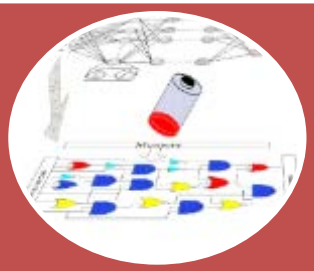
PhD, IISc Bangalore, India

Associate Professor, Electrical Engineering

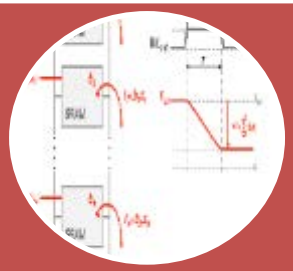
044-2257-4485; janakiraman@iitm.ac.in

http://www.ee.iitm.ac.in/janakiraman

- Low Power Circuit Design Techniques for Machine Learning Hardware
- In Memory Computing
- Statistical Analysis in VLSI



Machine Learning Accelerators



Computing in SRAM

Statistical Compact Model Extraction

Enabling energy efficient AI inference on the edge of the communication network

Dr. Jayaraj Joseph

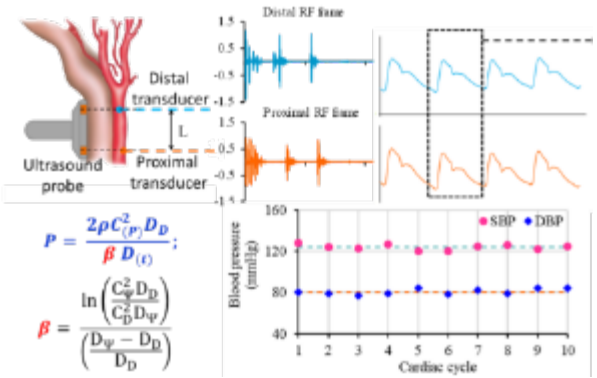
PhD, IIT Madras, India

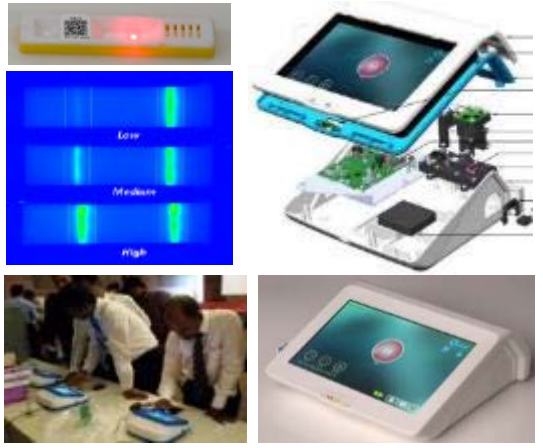
Associate Professor, Electrical Engineering

044-2257-5439; jayaraj@iitm.ac.in

https://scholar.google.com/citations?user=jkACmbEAAAAJ&hl=en

- Medical Devices and Healthcare Technology
  - Image free ultrasound for vascular health diagnosis & early screening
  - Point of care diagnostics
  - Unobtrusive physiological monitoring
- Sensors and Instrumentation





Vascular Ageing

ARTSENS® : Image-free ultrasound tech. for early vascular diagnosis

Cuff-less Central Blood Pressure

Modelling, Sensors and Devices

Clinically reliable cuff less BP

Point of care diagnostics

Quantitative fluorescent imaging

Rapid immunoassay kits

Dr. B Kalyan Kumar

PhD, IIT Kanpur, India

Professor, Electrical Engineering,

044-2257-4446; bkalyan@iitm.ac.in

http://www.iitm.ac.in/component/faculty/72/bkalyan/

Major Areas of Research

- Power System Stability
- Flexible AC Transmission Systems (FACTS)
- Power Quality
- Power System Optimization

Source: Faculty website

Dr. Kamalesh Hatua

PhD, Indian Institute of Science, Bangalore

Associate Professor, Electrical Engineering

044-2257-4475; kamalesh@ee.iitm.ac.in

http://www.ee.iitm.ac.in/user/kamalesh/

Major Areas of Research

- Medium Voltage Electric Drives
- Poly phase Induction motor drive
- Split phase induction motor
- Slip ring induction motor
- Active reactive Induction motor
- Solid state transformer
- Power electronics application in Power system
- Design of high efficient power converters using upcoming SiC power switches
- SP and FPGA based controller design for Power Electronics application.

Source: Faculty website

Dr. Kaushik Mitra

PhD, University of Maryland, College Park, USA

Associate Professor, Electrical Engineering

044-2257-4411; kmitra@iitm.ac.in

http://www.ee.iitm.ac.in/kmitra/

- Research Area/Focus 1: Computational Imaging (CI)
- Research Area/Focus 2: Image Processing and Computer Vision
- Research Area/Focus 3: Machine/Deep learning for CI

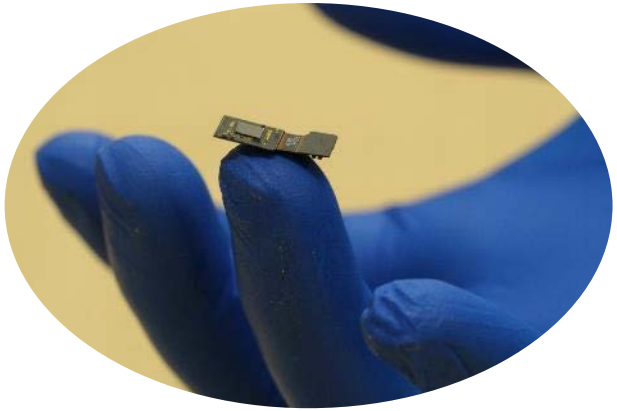
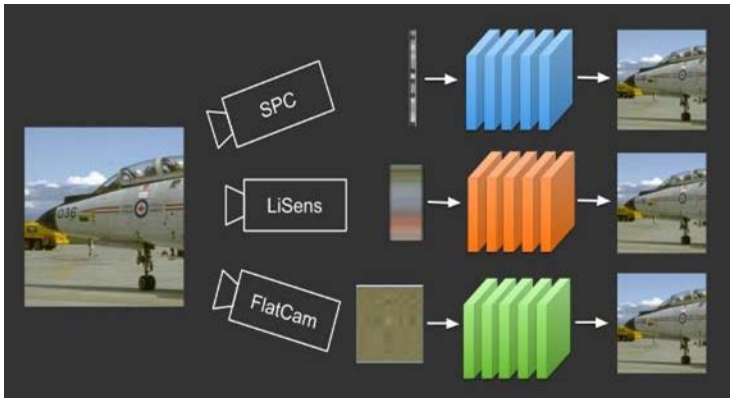


Image reconstruction and inference for Lensless Cameras



Solving inverse problems in CI

Light field acquisition and processing

Dr. S Krishna

PhD, Indian Institute of Science, India

Associate Professor, Electrical Engineering

044-2257-4448; krishnas@iitm.ac.in

http://www.ee.iitm.ac.in/~krishnas

- **Power System Stability Analysis and Control**

Problems I have worked on:

- Under frequency load shedding scheme
- Detection of voltage collapse and corrective action
- Strategy for transient stability improvement using braking resistor and excitation system
- On-line dynamic security assessment: computational aspects

Source: Faculty website

Dr. Krishna Jagannathan

PhD., Massachusetts Institute of Technology

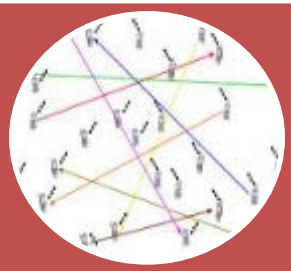
Professor, Electrical Engineering

044-2257-4469; krishnaj@ee.iitm.ac.in

http://www.ee.iitm.ac.in/~krishnaj/

- Wireless Networks: Resource Allocation, Cross Layer Control
- Distributed Control and Optimization of Complex Networks
- Stochastic Modelling and Performance Analysis

LTE Resource Allocation



Large Wireless Networks & Distributed Operation

Real-Time Road Traffic Control

NETWORK CONTROL AND OPTIMIZATION

Dr. Krishna Vasudevan

PhD, IIT Madras, India

Professor, Electrical Engineering

044-2257-4428; krishna.vasudevan@iitm.ac.in

http://www.ee.iitm.ac.in/facs_krishna

- PMSM/BLDC Motor drives
- Power Electronics for Renewables
- Grid Integration of Renewables

Motor control , Electric vehicles, Electromagnetic Actuators

Power Converters for solar, battery applications

Power Converters and control for grid integration

Dr. Lakshminarasamma

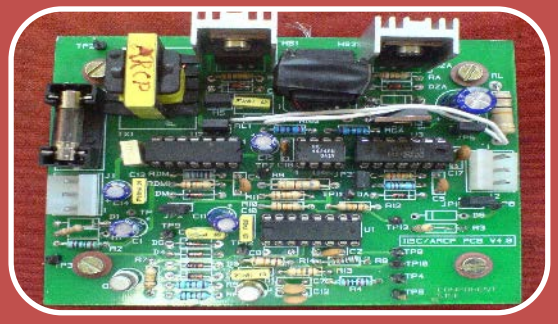
PhD, IIsc Bangalore, India

Professor, Electrical Engineering

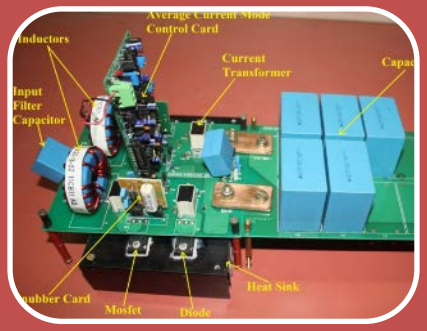
044-2257-4462; lakshmin@iitm.ac.in

http://www.ee.iitm.ac.in/facs_lakshmin

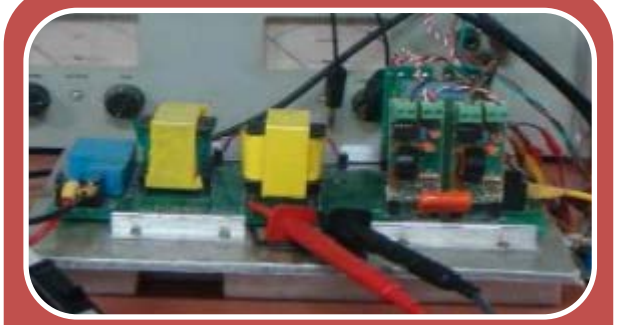
- DC DC Power Converters, Modeling, Analysis and Design
- High Frequency Converters and Inverters for Renewable Energy Applications



33 W 500 kHz DC DC Converter Designed and Implemented for space craft Applications.



2 kW Interleaved Boost DC DC Converter High Power Applications, Operated in Interleaved and Paralleling



A 500 W 100 kHz 48 – 400 V Soft switching DC DC Bridge converter

Finds Applications for Aircraft, solar/Fuel cell fed power supplies

Dr. Lakshmi Narasimhan Theagarajan

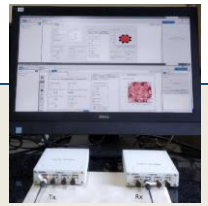
PhD, IISc Bangalore

Assistant Professor, Electrical Engineering

044-2257-4495; lnt@iitm.ac.in

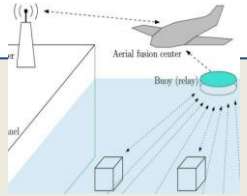
https://sites.google.com/view/lakshminarasimhan/bio

- Wireless communication - physical layer algorithms and analysis
- Statistical signal processing - distributed detection and estimation
- Machine learning for wireless communication and statistical learning



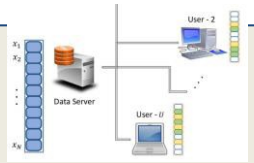
5G, 6G, WiFI

- Integrated sensing and communication
- Waveform design
- Low-complexity transceiver design
- Visible light communication



Sensor Networks

- Multimodal data fusion and federated learning
- Target tracking
- Radar & Sonar design
- Change detection



Big data processing

- Sparse/structured data compression and reconstruction
- Causal inference
- Time series data analytics

Statistical learning and inference algorithms; Wireless communications

Dr. Mahesh Kumar

PhD, IIT Kanpur, India

Professor, Electrical Engineering

044-2257-4429; maheshk@iitm.ac.in

http://www.ee.iitm.ac.in/facs_mahesh

- Power Quality Monitoring, Analysis and Interpretation
- Application of Power Electronics in Power Systems: Custom Power Devices
- Renewable Energy Grid Interactive and Grid OFF Systems

Based on monitored data of industrial plants, their detailed performance evaluations are carried out. Also, based on the study of analyzed data, interpretation can be made to avoid serious consequences of power quality problems.

Custom Power Devices are used to eliminate power quality related problems such as unbalance, reactive power, harmonics etc., in power distribution systems. Control, Design and development of these devices are the core issues which are being addressed.

Custom power devices are basically power electronic based controllers and find numerous applications in renewable energy systems. Efficient grid interactive inverters, their design and control for optimal power sharing with the local grid and loads are important aspects which are explored and investigated.

Dr. R Manivasakan

PhD, IIT Bombay

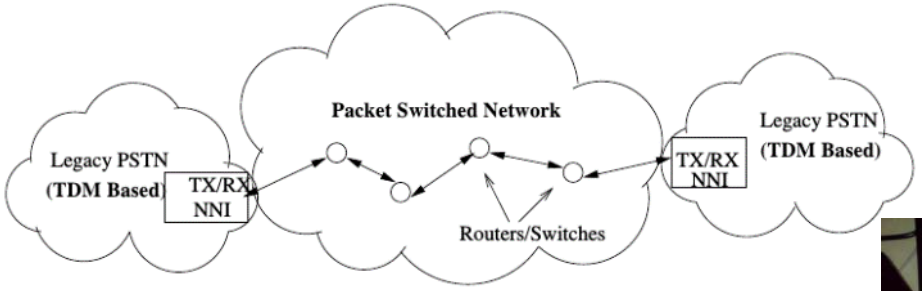
Associate Professor, Electrical Engineering

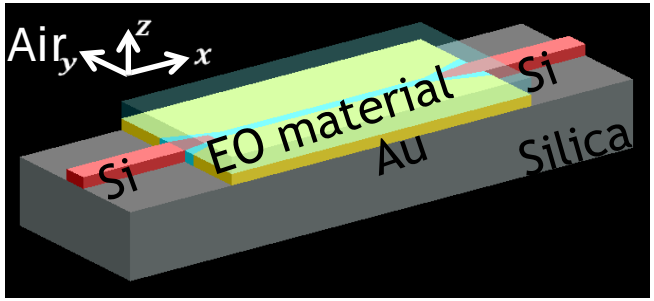
044-2257-4330; rmani@ee.iitm.ac.in

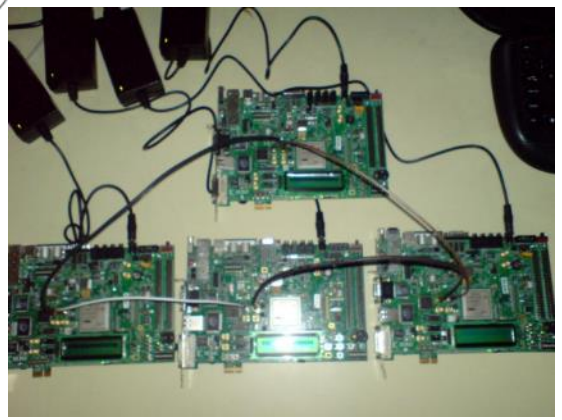
http://www.ee.iitm.ac.in/~rmani/

Major Areas of Research

- Optical Networks: PHY and Layer 2
- Queueing Theory and its Applications to Communication networks
- TDM over PSI







Performance Analysis of Communication Networks (Optical and Wireless)

Dr. C Mathiazhagan

Assistant Professor, Electrical Engineering

044-2257-4431; mathi@ee.iitm.ac.in

Major Areas of Research

- Analog and digital circuits, Instrumentation

Source: Faculty website

Dr. Mohanasankar Sivaprakasam

PhD - University of California Santa Cruz, USA

Professor, Electrical Engineering

+91-9884511692; mohan@ee.iitm.ac.in

- Healthcare technologies
- Biomedical devices and instrumentation
- Medical signal/image processing

Screening

Diagnosis

Therapeutic

Dr. Nagendra Krishnapura

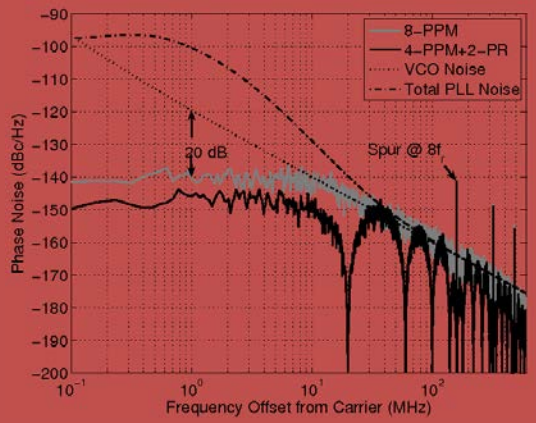
PhD, Columbia University, USA

Professor, Electrical Engineering

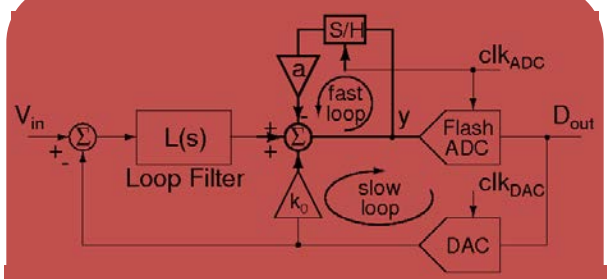
044-2257-4444; nagendra@iitm.ac.in

http://www.iitm.ac.in/~nagendra

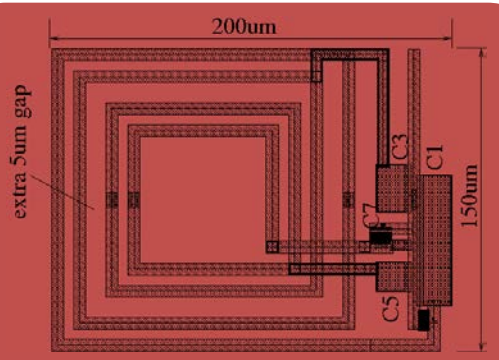
- Analog integrated circuit design
- RF integrated circuit design
- Circuits and systems education



Randomization reduces PLL spurs



Additional fast loop overcomes speed limit of DS ADC



Multi-tap inductor enables compact filters

Increase speed and precision, and reduce power and area of ICs

Dr. Nandita DasGupta

PhD, IIT Madras, India

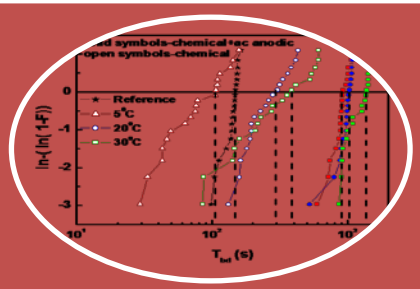
Professor, Electrical Engineering

044-2257-4422; nand@ee.iitm.ac.in

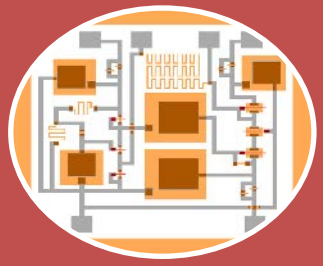
http://www.ee.iitm.ac.in/~nand/

- Research Area/Focus 1: Thin oxides and High-k Dielectrics
- Research Area/Focus 2 : III-V Semiconductor Devices
- Research Area/Focus 3 : Micromachining for MEMs & photonic devices

Pigtailed InGaAs/InP p-i-n Photodetector with micromachining for fibre coupling



Improvement in the reliability of thin oxides with ac anodization



GaAs MESFET-based Transimpedance preamplifier

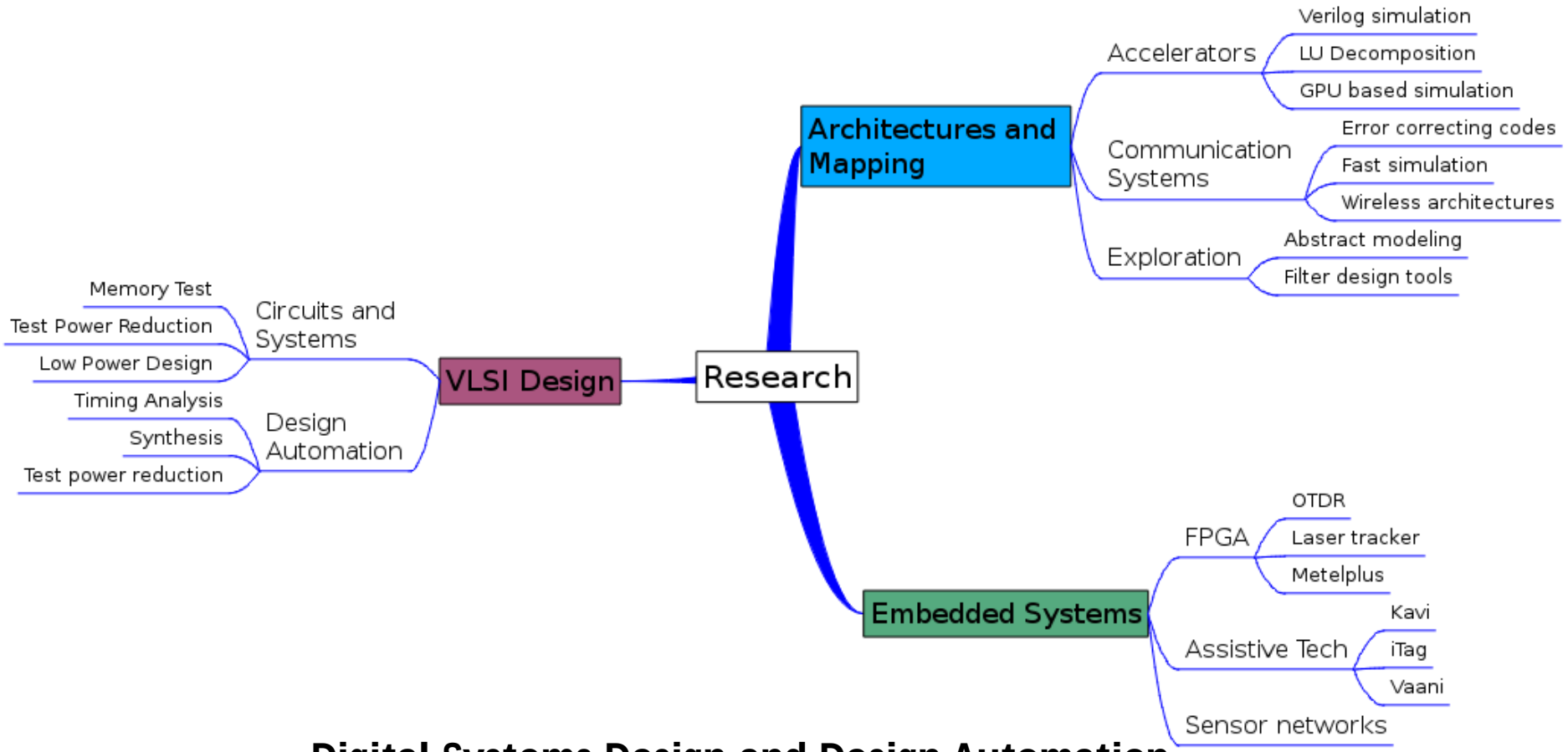
Dr. Nitin Chandrachoodan

PhD, Univ. of Maryland, College Park, USA

Professor, Electrical Engineering

044-2257-4432; nitin@iitm.ac.in

http://www.ee.iitm.ac.in/~nitin/



Digital Systems Design and Design Automation

Dr. Pravin Nair

PhD, Indian Institute of Science, Bengaluru

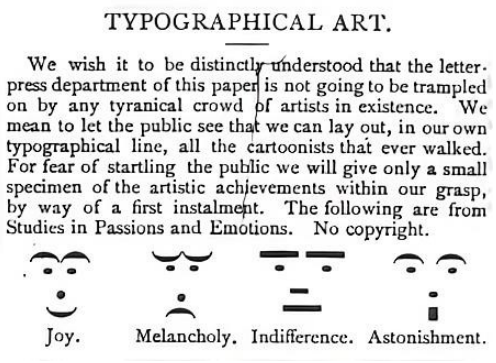
Assistant Professor, Electrical Engineering

044-2257-4498; pravinnair@iitm.ac.in

- Constructing 1-Lipschitz neural networks for image regularization.
- Development of high-quality algorithms for image and video restoration.
- Formulation of real-time, power-efficient computer vision solutions.

Applications in smartphones, satellite imaging, medical imaging, defence applications

Deblurring



Video Stabilization

Inpainting

Dr. Pradeep Kiran Sarvepalli

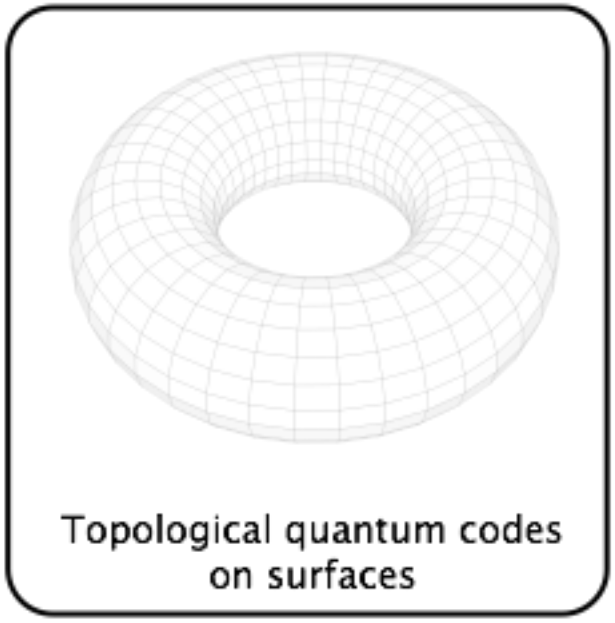
PhD, Texas A&M University, USA

Professor, Electrical Engineering

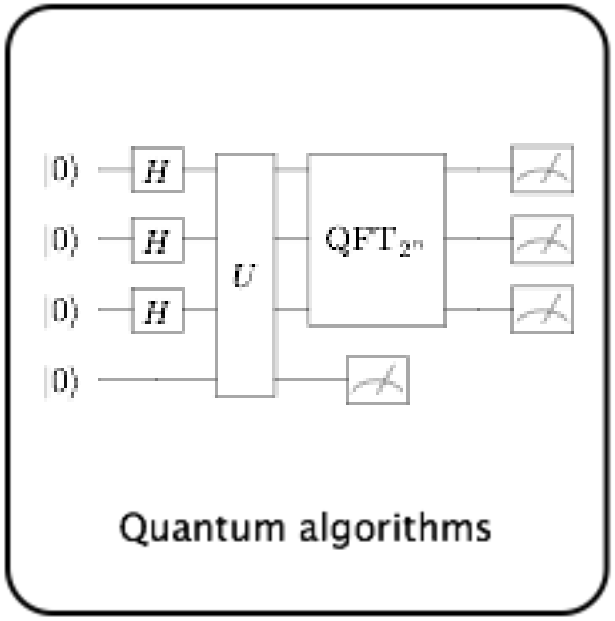
044-2257-4473; sarvepalli@iitm.ac.in

http://www.ee.iitm.ac.in/~pradeep

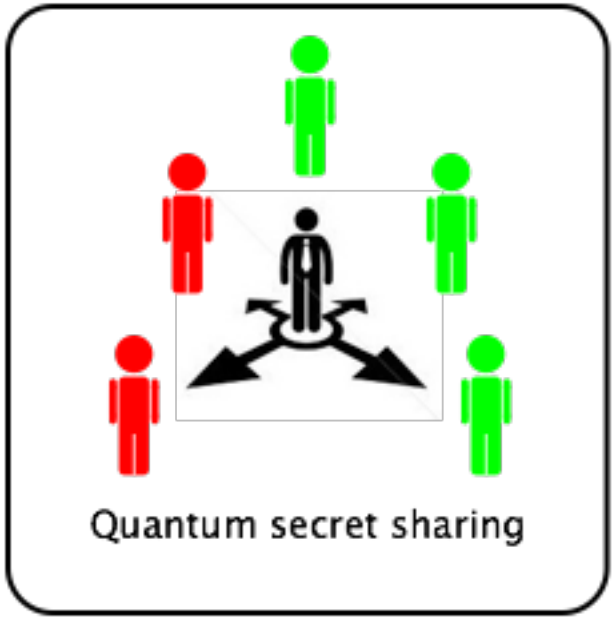
- Classical and quantum error correction
- Quantum algorithms
- Quantum cryptography



Topological quantum codes on surfaces



Quantum algorithms



Quantum secret sharing

Quantum information processing

Dr. Puduru Viswanadha Reddy

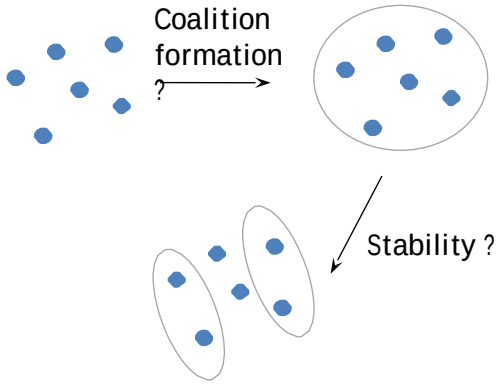
Associate Professor, Electrical Engineering

044-2257-4486; vishwa@iitm.ac.in

Major Areas of Research

- Control systems
- Game theory
- Optimal control
- Operations research

Game theory



Multi-agent control systems

Dr. Rachel Kalaimani

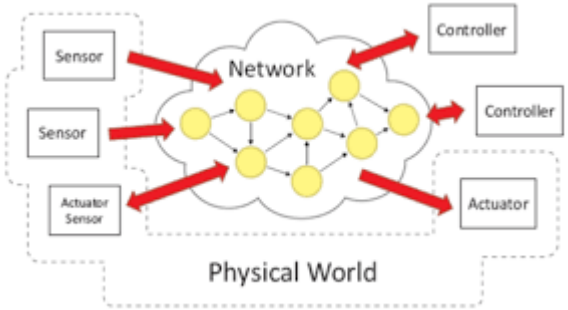
Associate Professor, Electrical Engineering

044-2257-4487; rachel@ee.iitm.ac.in

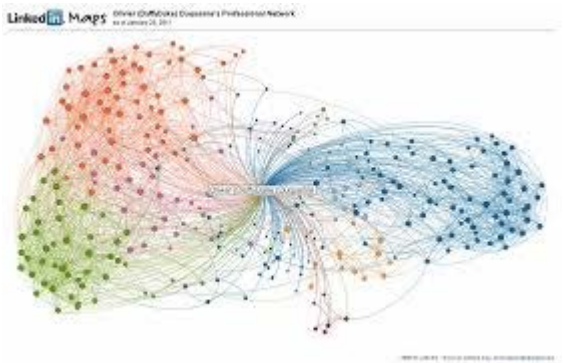
http://www.ee.iitm.ac.in/rachel

Major Areas of Research

- Optimization and control of complex dynamical systems
- Networked control systems
- Learning based control



Stabilizing NCS subject to SNR constraints on channel along with scheduling



Optimizing the control energy in complex dynamical systems by modifying the network topology

Dr. Radha Krishna Ganti

PHD, University of NotreDame

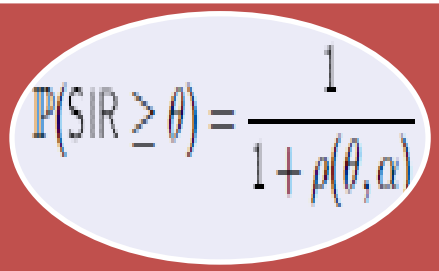
Professor, Electrical Engineering

044-2257-4467; rganti@ee.iitm.ac.in

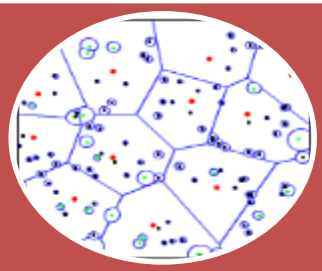
http://www.ee.iitm.ac.in/~rganti/

- Wireless Networks
- Stochastic Geometry
- Information Theory

Implementation of superposition coding on SDR



Probability, Stochastic Geometry, Information Theory



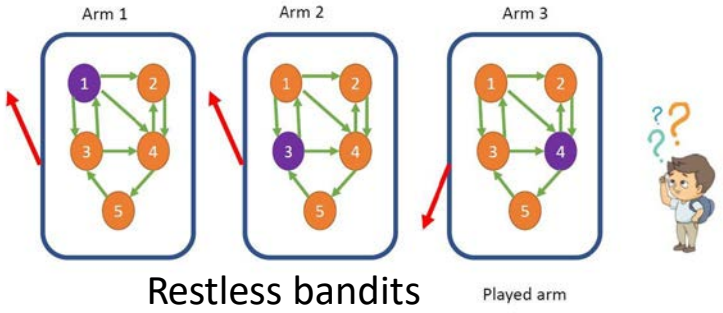
HetNets, Cellular Networks, Adhoc Networks

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

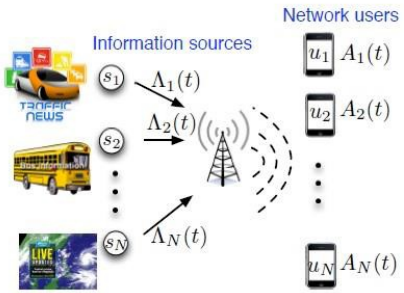
Dr. Rahul Meshram

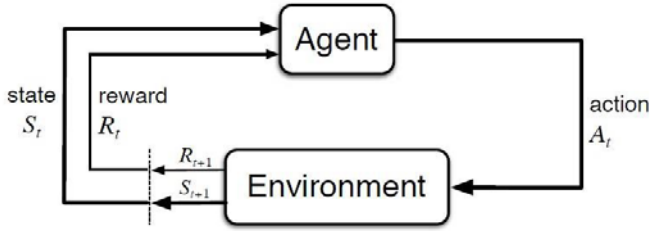
PhD. IIT Bombay, India
Assistant Professor, Electrical Engineering
044-2257-4414; rahulmeshram@iitm.ac.in

- Restless multi-armed bandits
- Reinforcement learning for restless bandits
- Multi-agent reinforcement learning for restless bandits



Restless bandits





Dr. A N Rajagopalan

PhD, IIT Bombay, India

Professor, Electrical Engineering

044-2257-4433; raju@ee.iitm.ac.in

http://www.iitm.ac.in/~raju

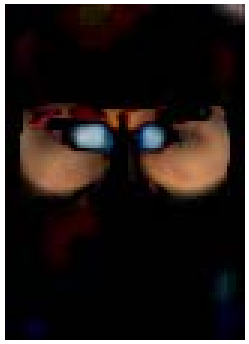
Shape from Motion Blur

Digital Heritage Reconstruction

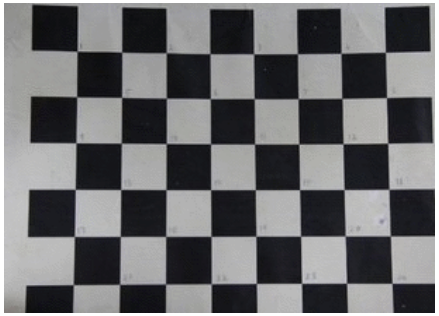
Non-Uniform De-blurring n HDR

Super-resolution Matting

Face Recognition in Occlusion and Blur



Underwater Imaging



Dr. Ramalingam C S

PhD., University of Rhode Island, USA

Associate Professor, Electrical Engineering

044-2257-4475; csr@ee.iitm.ac.in

http://www.ee.iitm.ac.in/~csr/

Major Areas of Research

- Signal Processing
- Speech Recognition
- Speech Coding
- Speech Synthesis

Source: Faculty website

Dr. Ramkrishna Pasumarthy

PHD, University of Twente, The Netherlands

Professor, Electrical Engineering

044-2257-4470; ramkrishna@iitm.ac.in

http://www.ee.iitm.ac.in/~ramkrishna

- Mathematical Modeling
- Control of physical systems
- Simulations of Large scale infrastructures

Cloud Computing

Industrial Automation

Computational mechanics

Dr. S Ramprasath

PhD, Indian Institute of Technology Madras

Assistant Professor, Electrical Engineering

044-2257-4482; ramprasath@ee.iitm.ac.in

- Automated layout generation for analog/mixed-signal circuits
- Design rule checkers and fixers for advanced process nodes
- Solving NP-hard/complete problems using Ising machines

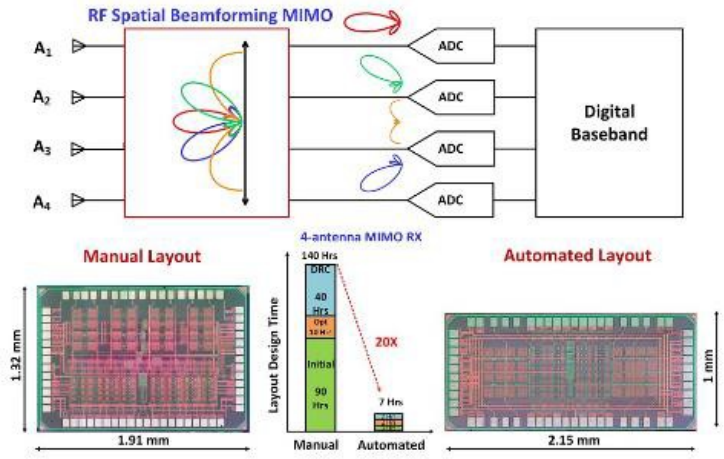


Fig. 1. MIMO design used to illustrate the process. Chip micrographs for manual and automatic layouts and productivity improvement using the tools.

MIMO layout generated automatically
Fabricated. tested and, compared against manual layout

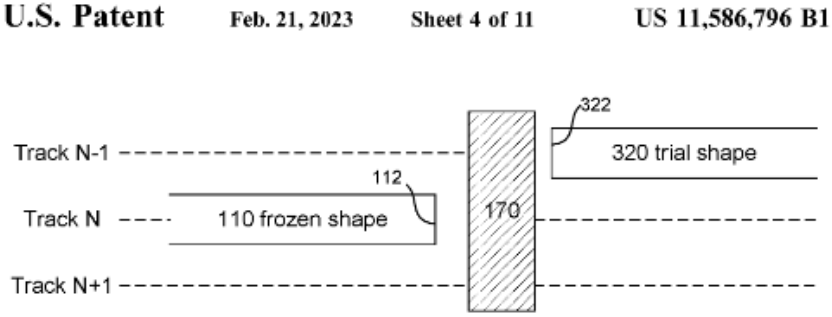


FIG. 3A

Keep-through regions for handling end-of-line rules in FinFET technologies

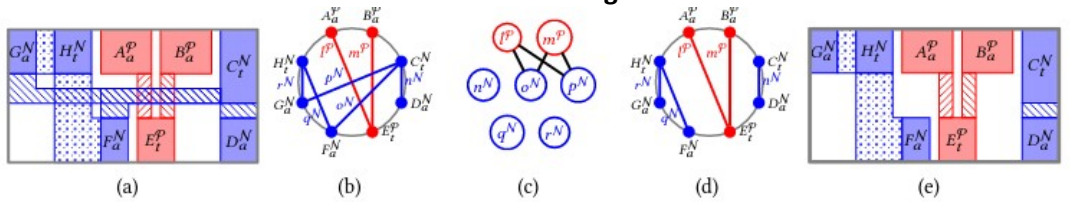


Fig. 6. (a) Layout with overlapping well islands; (b) Jordan curve corresponding to layout in (a); (c) Circle graph corresponding to the curve in (b); (d) Optimal nonoverlapping edges; (e) Optimal non-overlapping well islands.

Automated well-island generation and well-tap insertion in AMS circuits

Dr. Ravinder David Koilpillai

PhD., California Institute of Technology, USA

Professor, Electrical Engineering

044-2257-4405; davidk@iitm.ac.in

Major Areas of Research

- **Cellular evolution - 5G and beyond**
- **DSP for High Speed Coherent optical communications**
- **IITMSAT Student Satellite project**

Dr. R Sarathi

PhD, IISc, Bangalore, India

Professor, Electrical Engineering

044-2257-4436; rsarathi@iitm.ac.in

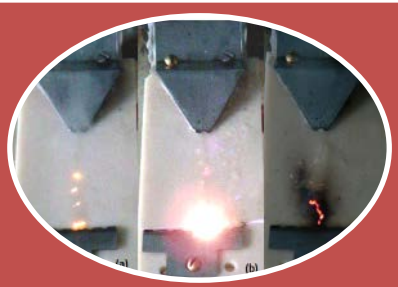
http://www.iitm.ac.in/info/fac/rsarathi

- Condition monitoring of power apparatus adopting Multi sensor fusion Technique
- Pulsed power technique for nano particle production and sterilisation of liquid foods
- Development of high performance nanocomposites for electrical insulation

Theoretical and experimental studies to identify the location of discharges in power apparatus especially in transformers by measuring UHF signals generated by discharges and by triangulation process

Facility for generation of nano particles by wire explosion process and for use of nano aluminium for Rocket propellant.

Pulsed power technique for sterilisation of liquid foods.



Optimisation of nano fillers in nano composites for obtaining good electrical, thermal and mechanical properties for various electrical insulation applications.

Dr. Saurabh Saxena

PhD., University of Illinois

Associate Professor, Electrical Engineering

044-2257-4457; saurabh.saxena@ee.iitm.ac.in

Major Areas of Research

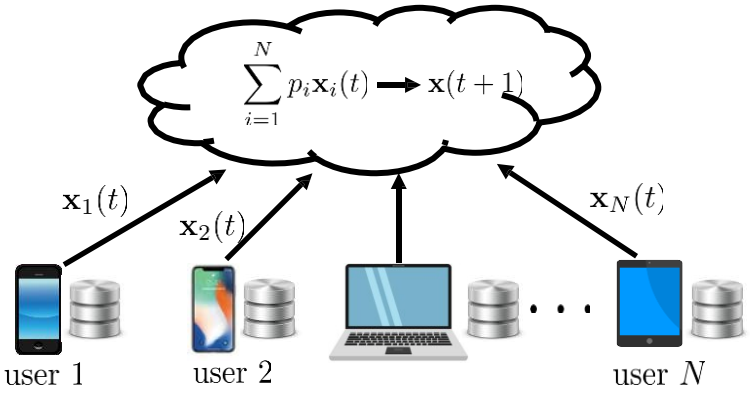
- **Analog and mixed signal circuits**
- **Data converters**
- **Serial links**
- **Phase-locked loops**

Source: Faculty website

Dr. Saurav Prakash

PhD, University of Southern California, USA
Assistant Professor, Dept. of Electrical Engineering
044-2257-4427; saurav@iitm.ac.in

- Enhancing Federated Learning: Efficiency, Security, and Fault-Tolerance
- Unveiling the Potential of FL: Training Large Models on Weak Clients
- Making AI Forget You: Machine Unlearning of FL Models



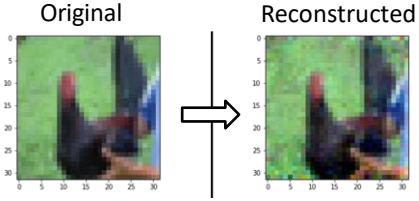
Federated Learning Paradigm

Resource constraints and heterogeneity

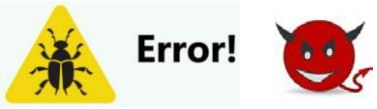
Challenges

Data leakage through models

Model Inversion



Errors and malicious clients



Vision: **Transformative** and **Foundational** Framework for **Large-Scale** and **Privacy-Preserving** Federated Learninng

Dr. Sayak Dutta Gupta

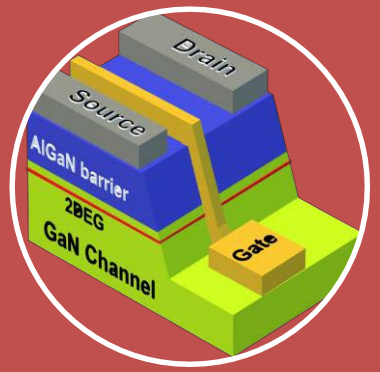
PhD, Indian Institute of Science, Bangalore, India

Assistant Professor, Electrical Engineering

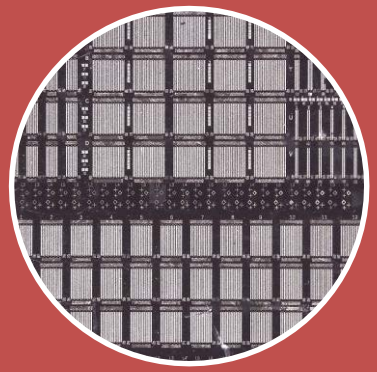
044-2257-4483; sayak@zmail.iitm.ac.in, sayak@ee.iitm.ac.in

https://www.ee.iitm.ac.in/faculty/profile/sayak

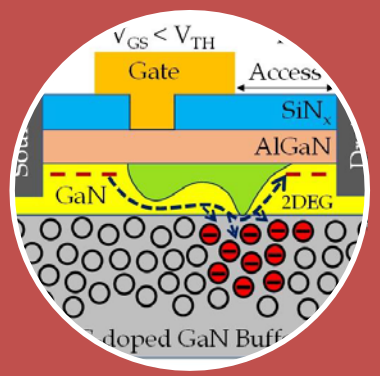
- Power Semiconductor Device development
- Technology Development for Wide Band-gap Semiconductor based devices
- Reliability Physics Investigations on Next-generation semiconductor devices



Device development



Technology Development



Reliability Analysis

Reliable Wide Band-gap Semiconductor based Device Development

Dr. Shanthi Pavan

PhD, Columbia University New York, USA

Professor, Electrical Engineering

044-22574437; shanthi@ee.iitm.ac.in

http://www.ee.iitm.ac.in/~shanthi/faculty.html

- Analog Mixed Signal Design : A/D and D/A conversion, filters
- Microwave IC Design : Broadband equalization and beamforming
- Sensor Interfaces : Bio and inertial sensor read electronics

Data Converters & Filters

High Speed Data Links & Beamforming

MEMS Accelerometers and Gyroscopes, Biosensors

Dr. Shanti Bhattacharya

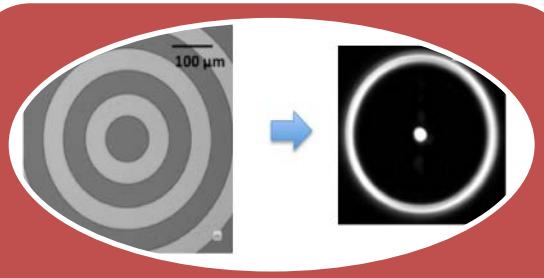
Professor, Electrical Engineering

044-2257-4438; shantib@iitm.ac.in

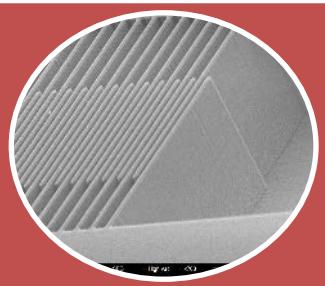
https://sites.google.com/site/appliedopticsgroup/

Major Areas of Research

- Design and fabrication of diffractive optical elements
- Design and fabrication of Optical MEMS
- Fibre and free space-based Optical Metrology systems (eg OCT, spectroscopy)



Diffractive optics for Beam Shaping. Converting a Gaussian beam into a focused ring



Comb drive for actuation of micro-optics

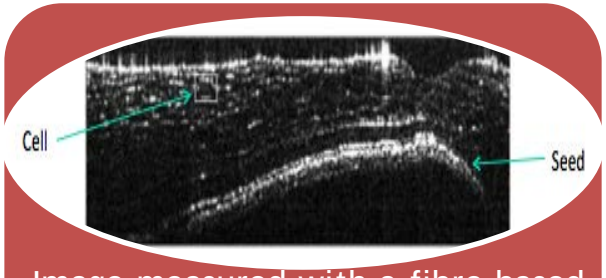


Image measured with a fibre based OCT system working at 1550nm. Cucumber Slice - Depth: 1.4 mm in air; Width: 8 mm

Devices, Systems, Components to control light, extract information, make measurements.

Dr. Sheetal Kalyani

PHD, IIT Madras, INDIA

Professor, Electrical Engineering

044-2257-4474; skalyani@iitm.ac.in

- Robust statistics based estimation/detection approaches and outlier detection.
- Applications of extreme value theory to problems in wireless networks/systems.
- Statistical learning theory and its applications.

Receiver algorithms and link abstraction for OFDM/OFDMA based systems

Analysis of model misspecification and robust solutions

Cross layer optimization across MAC and PHY layers in wireless systems

Dr. Shivananju B N

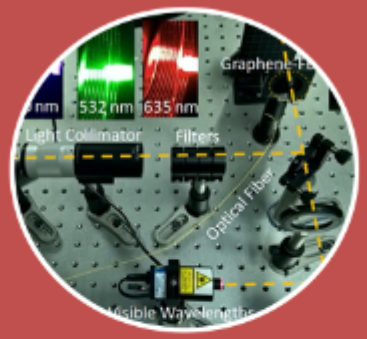
PhD, Indian Institute of Science, India

Assistant Professor, Electrical Engineering

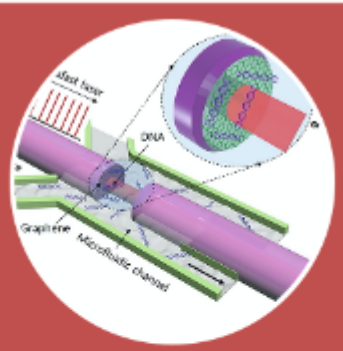
044-2257-5408; shivananju@iitm.ac.in

http://www.ee.iitm.ac.in/user/shivananju/

- Two-dimensional Materials Based Photonics and Optoelectronics Applications
- Biochemical Photon Fingerprints for Healthcare Applications
- Polaritons and Excitons Technologies for Industrial Applications



Photonics & Optoelectronics



Biochemical Fingerprints

Polaritons and Excitons

Future Nano-Bio-Photonics Technologies for Healthcare Applications

Dr. Shreepad Karmalkar

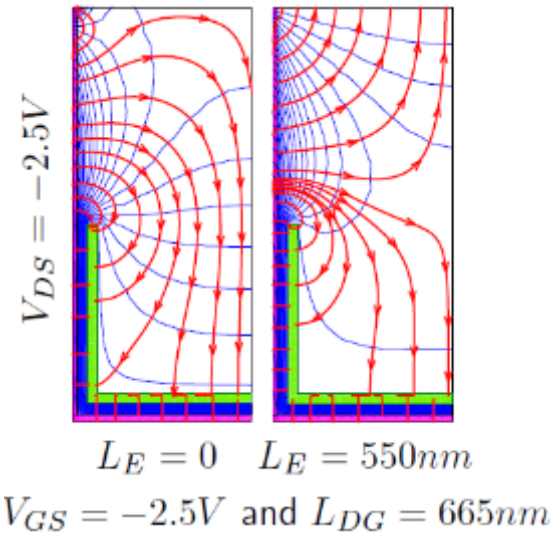
PHD, IIT Madras, India

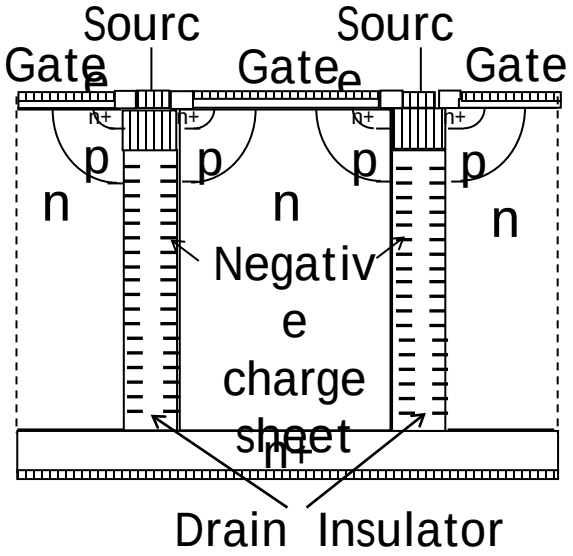
Professor, Electrical Engineering

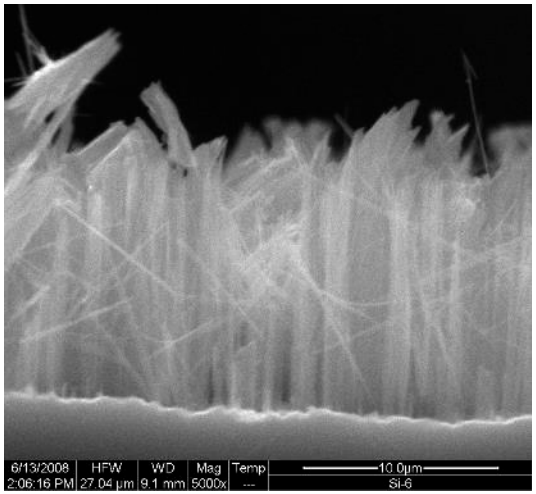
044-2257-4409; karml@ee.iitm.ac.in

http://www.ee.iitm.ac.in/~karmal/

- Semiconductor Device Modeling and Fabrication
- Nanotechnology
- Education







Nanowire devices
Electroless processing

Power MOSFET (SiC, Si, Superjunction), GaN HEMT

Dr. Soumya Datta

PhD, JNCASR, Bangalore

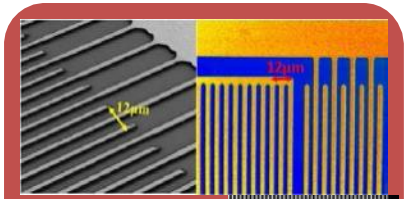
Professor, Electrical Engineering

044-2257-4472; s.dutta@ee.iitm.ac.in

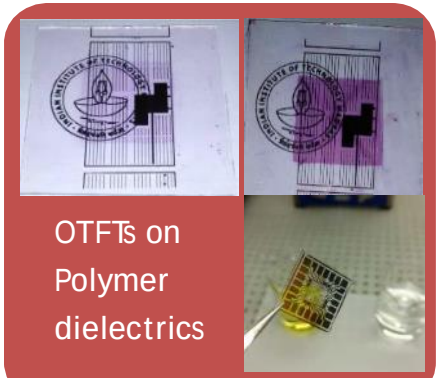
http://www.ee.iitm.ac.in/user/s.dutta/

Major Areas of Research

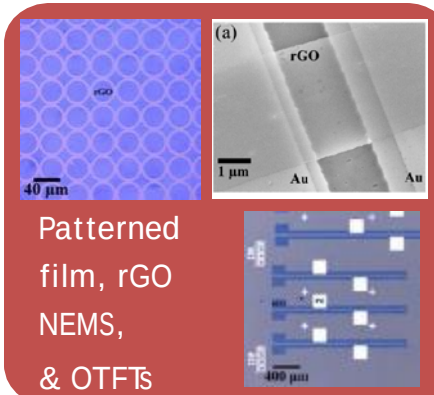
- Organic Solar Cell (OSC) /Perovskite Solar Cells
- Organic Thin Film Transistors (OTFTs) and Circuits
- Reduced Graphene Oxide (rGO) based NEMS and Microelectronic Devices
- Ferroelectric Polymer based Surface Acoustic Wave (SAW) Devices
- Organic LED and AMOLED Display



Polymer SAW Devices & Sensors



OTFTs on Polymer dielectrics



Patterned film, rGO NEMS, & OTFTs

Printed Film OSC & State-of-the-art Facility

Dr. K Sridharan

Ph.D, RPI, New York

Professor, Electrical Engineering

044-2257-4423; sridhara@iitm.ac.in

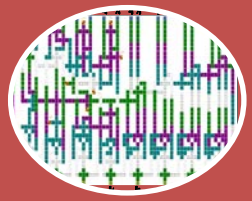
http://www.ee.iitm.ac.in/~sridhara

Major Areas of Research

- VLSI Architectures for autonomous systems and DSP; FPGA-based design and implementation
- Sensor-based planning and control for mobile robots, cooperative robot navigation and rendezvous
- Video stabilization and stitching – Algorithms and VLSI architectures
- Design of digital circuits in emerging device technologies, reliability studies

FPGA-based Robotics

Cooperative Robotics



Digital Nano-circuits

Dr. Srikrishna Bhashyam

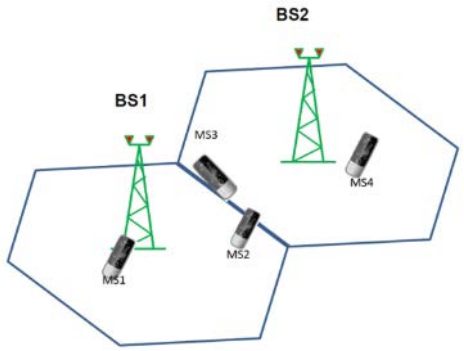
PhD, Rice University, USA

Professor, Electrical Engineering

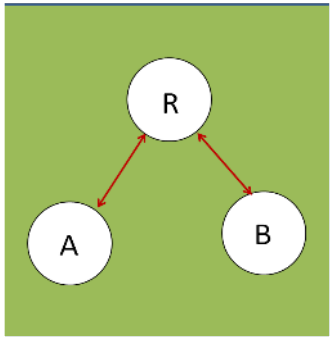
044-2257-4439; skrishna@iitm.ac.in

http://www.ee.iitm.ac.in/~skrishna/

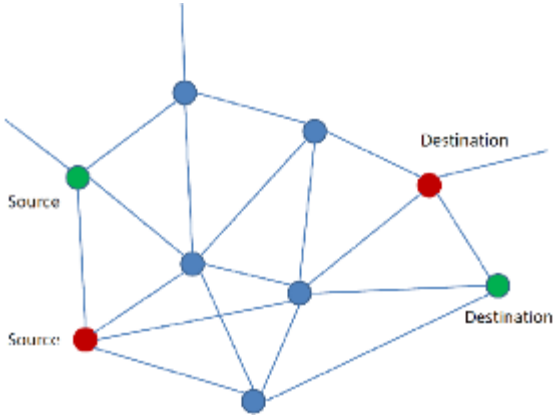
- Multi-hop multi-flow wireless communication: Capacity, protocols and codes
- Network resource allocation: Centralized and distributed optimization
- Statistical signal processing methods



Cellular Networks



Wireless LANs



Sensor Networks

COMMUNICATION AND INFORMATION THEORY

Dr. Srirama Srinivas

PHD, NIT Warangal, India

Professor, Electrical Engineering

044-2257-4447; srsrini12@iitm.ac.in

- Multilevel Inverters, PWM control & diagnostics
- Integration of distributed energy systems with utility grid
- Control algorithms for DC-DC and DC-AC Converters

Electrical machines & Drives

Microgrids

Renewable Energy

Dr. K S Swarup

PhD, IISc Bangalore, India

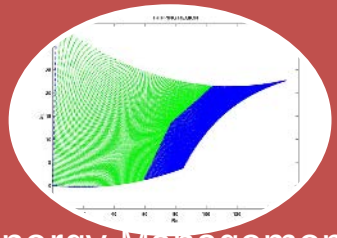
Professor, Electrical Engineering

044-2257-4440; ksswarup@iitm.ac.in

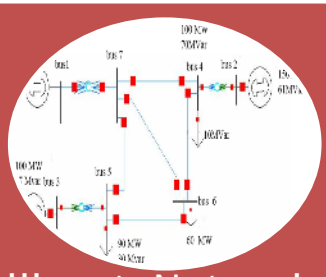
http://www.ee.iitm.ac.in/facs_swarup

- Power Systems, Operation, Optimization, Planning, Deregulation and Control
- Energy Management Systems / SCADA, Smart Grid, Automation and Protection
- Soft Computing, Intelligent Systems, Evolutionary Computational Intelligence

Power System Operation, Optimization and Planning



Energy Management Systems, Automation and Protection



Intelligent Networks for Power Grids

ENERGY MANAGEMENT SYSTEM APPLICATIONS FOR POWER GIRDS OF THE FUTURE

Dr. Sudharsanan Srinivasan

PhD., University of California, USA

Assistant Professor, Electrical Engineering

044-2257-4491; sudharsanan@ee.iitm.ac.in

Major Areas of Research

- High Performance lasers and optical amplifiers on silicon
- Heterogeneous integration of lasers, detectors and modulators on silicon
- Co-packaging electronic photonic chips for communication and sensing

Source: Faculty website

Dr. Uday Khankhoje

PhD, Caltech, USA

Associate Professor, Electrical Engineering

044-2257 4450; uday@ee.iitm.ac.in

www.ee.iitm.ac.in/uday

- RF electromagnetics
- Active and passive electromagnetic metasurfaces
- RF inverse scattering
- Inverse design of electromagnetic devices

Breast cancer detection using microwave + machine learning

Soil moisture detection on Earth

Ice detection on Moon & analysis of Chandrayaan data

Physics based WiFi propagation and source placement studies

⇐ EXAMPLES OF RESEARCH APPLICATIONS ⇒

Dr. Umesh S

PhD., University of Rhode Island, USA

Professor, Electrical Engineering

044-2257-4461; umeshs@ee.iitm.ac.in

http://www.ee.iitm.ac.in/~umeshs/

Major Areas of Research

- **Automatic Speech Recognition**
- **Speaker Normalization & Adaptation**
- **Self Supervised Learning**
- **Deep Learning and Machine Learning**
- **Speaker Recognition & Diarisation**

Dr. Venkatesh T G

PhD., Indian Institute of Science, Bangalore

Professor, Electrical Engineering

044-2257-5448; tgvenky@ee.iitm.ac.in

http://www.ee.iitm.ac.in/tgvenky/

Major Areas of Research

- **Stochastic Modeling**
- **Computer Networks**
- **Computer Architecture**
- **Design and performance evaluation of medium access layer protocol in wireless network.**

Source: Faculty website

Dr. Venkatesh Ramaiyan

PhD, Indian Institute of Science, Bengaluru

Associate Professor, Electrical Engineering

044-2257-4464; rvenkat@iitm.ac.in

http://www.iitm.ac.in/~rvenkat

- Distributed Medium Access in Ad hoc Wireless Networks
- Cross-layer Resource Allocation and QoS Provisioning in Cellular Networks
- High Rate Communication Networks for Control Applications

WiFi Hot Spots

3G/4G Browsing

Sensor Networks

Provisioning and Performance Evaluation in Wireless Networks

Dr. Vinita Vasudevan

PhD, IIT Bombay, India

Professor, Electrical Engineering

044-22574442; vinita@iitm.ac.in

http://www.ee.iitm.ac.in/~vinita

- Circuit Noise, Timing, Power, leakage analysis
- Reduced order modelling
- System simulation and optimization

Some problems I have worked on:

- Fast and accurate statistical timing analysis of digital circuits
- Analysis of clock jitter in sigma-delta converters
- Optimum scheduling of data parallel tasks in partially reconfigurable systems

INDIVIDUAL FACULTY PROFILE

DEPARTMENT OF ENGINEERING DESIGN

LIST OF FACULTY

- Asokan Thondiyath
- Atriyas Biswas
- Balkrishna C Rao
- Bijo Sebastian
- Deepak Ronanki
- Jayaganthan R
- Kavitha Arunachalam
- Naresh Kumar R
- Nilesh Jayantilal Vasa
- Niravkumar Amrutlal Patel
- Palaniappan Ramu
- Ramanathan M
- Sandipan Bandyopadhyay
- Saravana Kumar G
- Shankar Ram C S
- Srikanthan Sridharan
- Tuhin Subhra Santra
- Venkatesh Balasubramanian

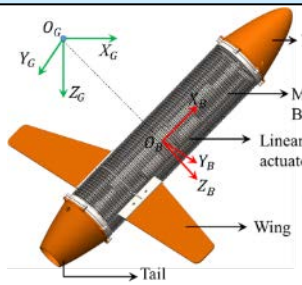
Dr. Asokan Thondiyath

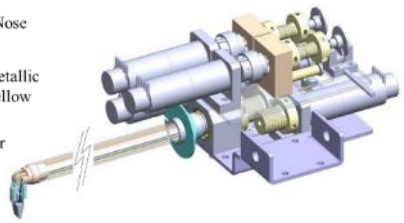
Professor, Engineering Design

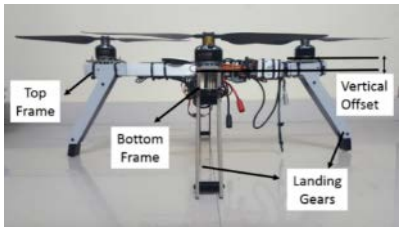
044-2257-4707; asok@iitm.ac.in

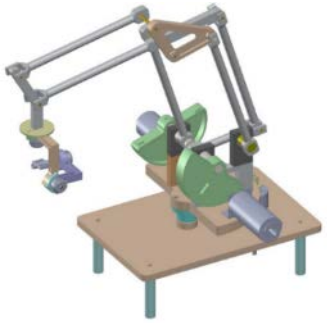
http://ed.iitm.ac.in/~balkrish/

- Robotics
- Mechatronics
- Automation
- Medical Devices









Design

- Autonomous underwater robots
- Surgical robots
- Variable buoyancy systems
- Medical / rehabilitation devices
- Aerial robots
- Multimodal robots
- New Product Development

Dynamics

- Mathematical modelling and Simulation
- Analysis of 6dof motion dynamics
- Dynamic path planning and obstacle avoidance
- Localisation and Mapping

Control

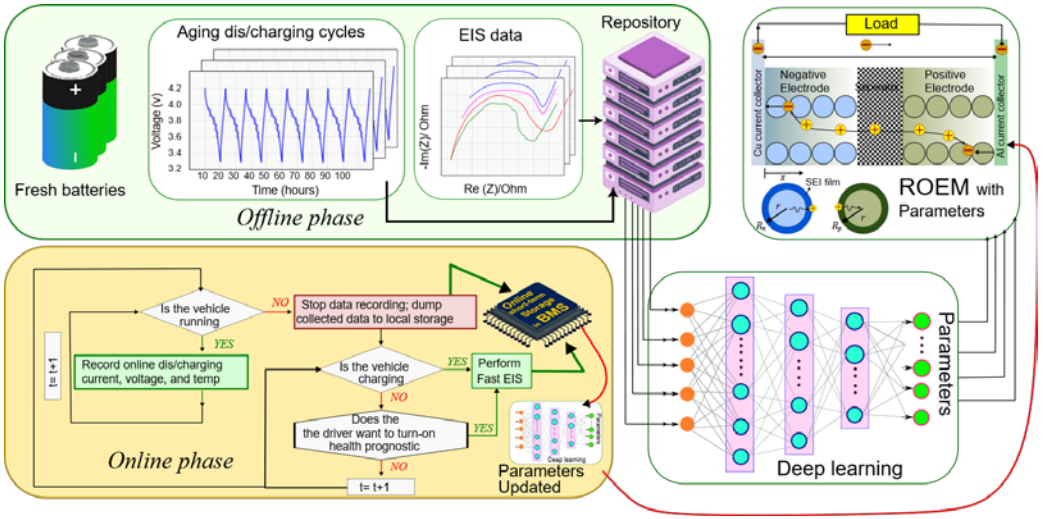
- Guidance, Navigation and Control for Autonomous operation
- Control algorithms for improved performance
- Hybrid Control architectures for robot control

Dr. Atriya Biswas PhD,

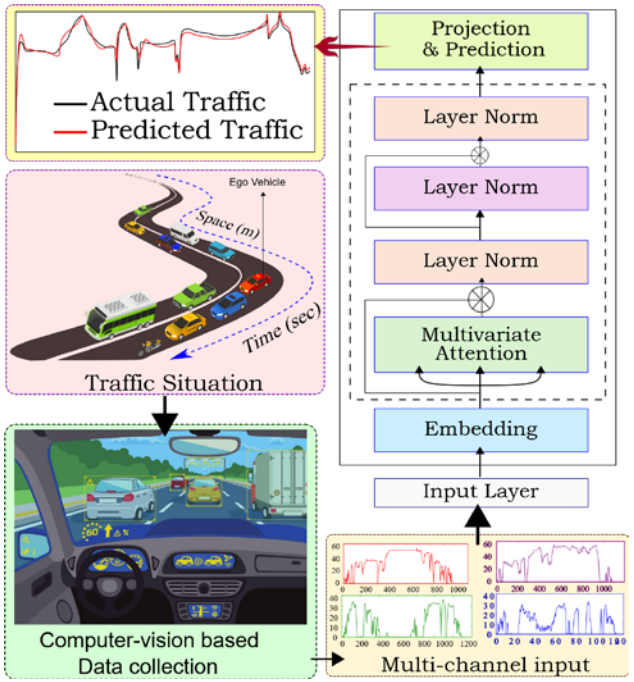
Assistant Professor, Dept. of Engineering Design

044-2257-4744; abiswas@iitm.ac.in

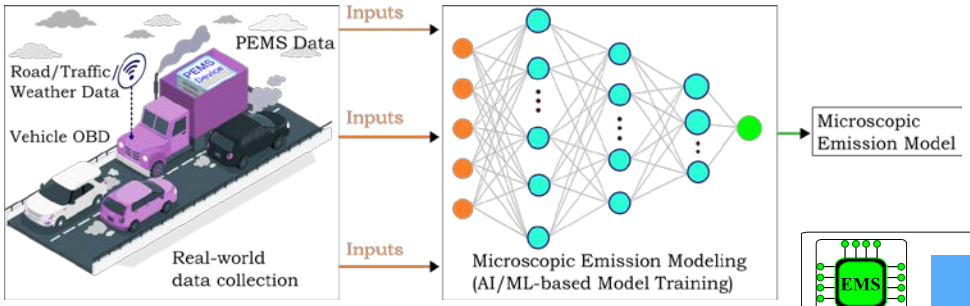
Current research focus: AI-based Battery SOH Estimation for electric vehicles (EVs), Computer vision-based Energy efficiency improvement for EVs, Reinforcement learning-based optimal control, Eco-driving algorithms For high-way Freights for Lowering Emissions and Electric Trucks, Optimal Routing for Last-mile Drones



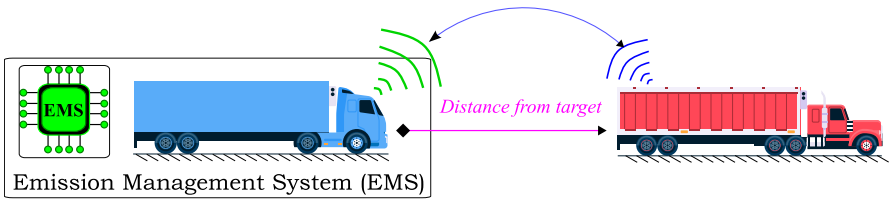
Online Accurate SOH estimation of Li-ion battery packs for BEVs



Computer vision-based Energy efficiency improvement for BEVs in different traffic scenario



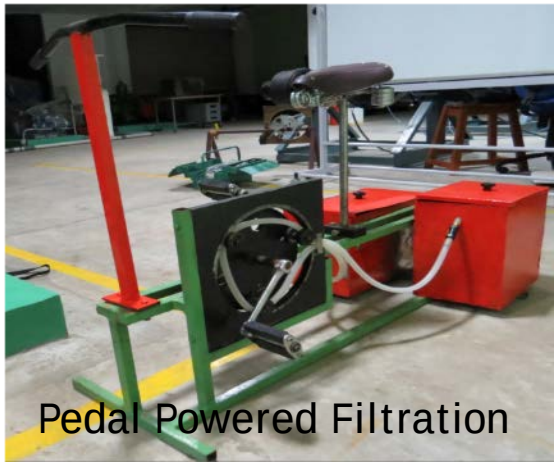
Eco-driving freight on Indian highways



Dr. Balkrishna C Rao
Professor, Engineering Design
044-2257-4660; balkrish@iitm.ac.in
http://ed.iitm.ac.in/~balkrish/

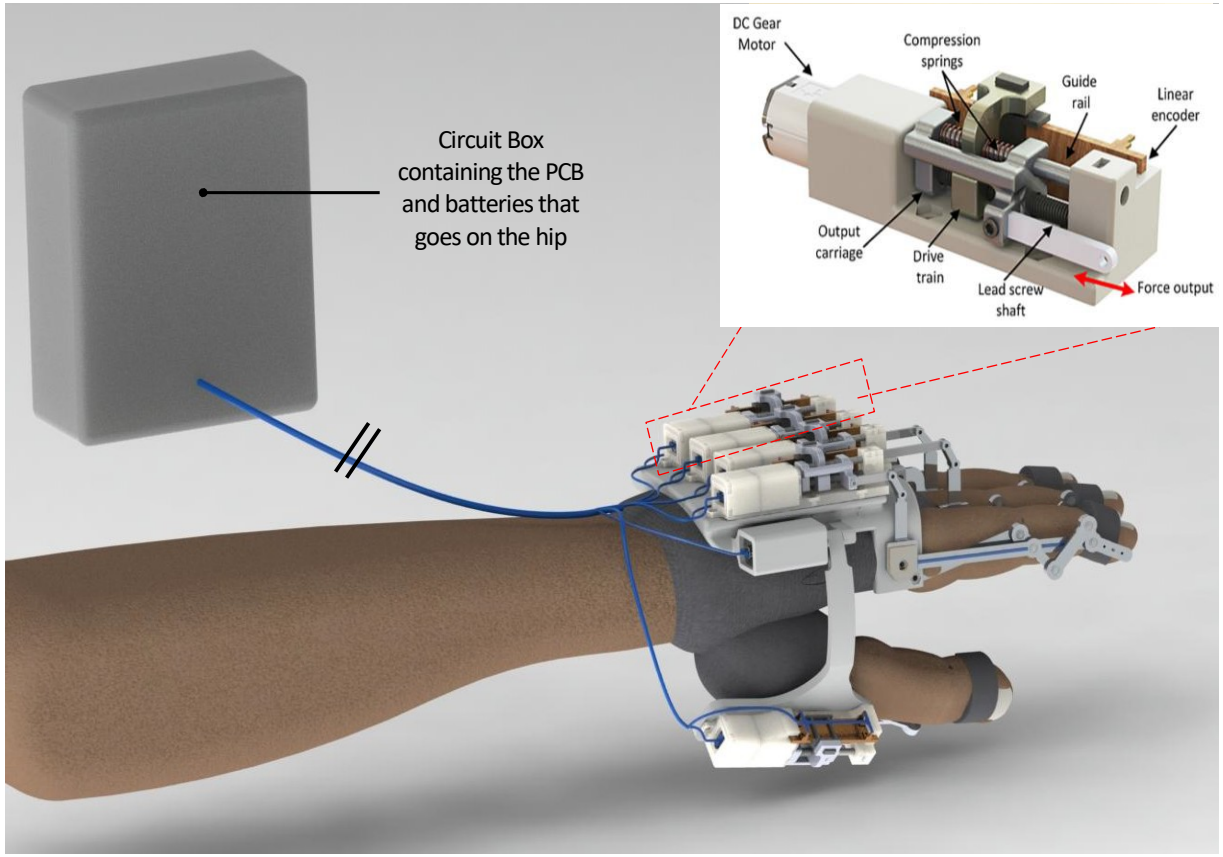
Major Areas of Research

- Severe Plastic Deformation (SPD) for creating nanocrystalline metals and alloys
- Sustainable manufacturing and additive manufacturing of metals
- Innovations for a sustainable future

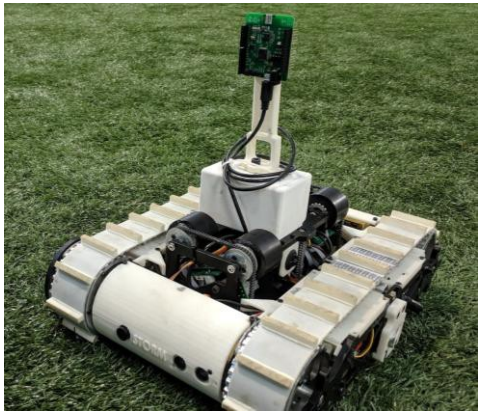


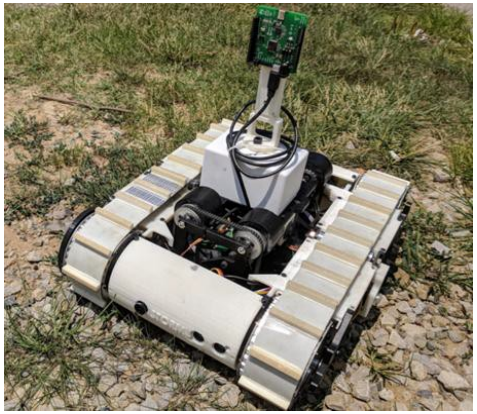
Dr. Bijo Sebastian
PhD, Virginia Tech, USA
Assistant Professor, Engineering Design
044-2257-4749; bijo.sebastian@iitm.ac.in

Exoskeleton systems for Rehabilitation
Autonomous navigation in Structured and Unstructured terrain



Full hand exoskeleton glove system: See Refour, E. M., Sebastian, B., Chauhan, R. J., and Ben-Tzvi, P. "A General Purpose Robotic Hand Exoskeleton With Series Elastic Actuation." Journal of Mechanisms and Robotics. December 2019; 11(6): 060902. DOI: 10.1115/1.4044543





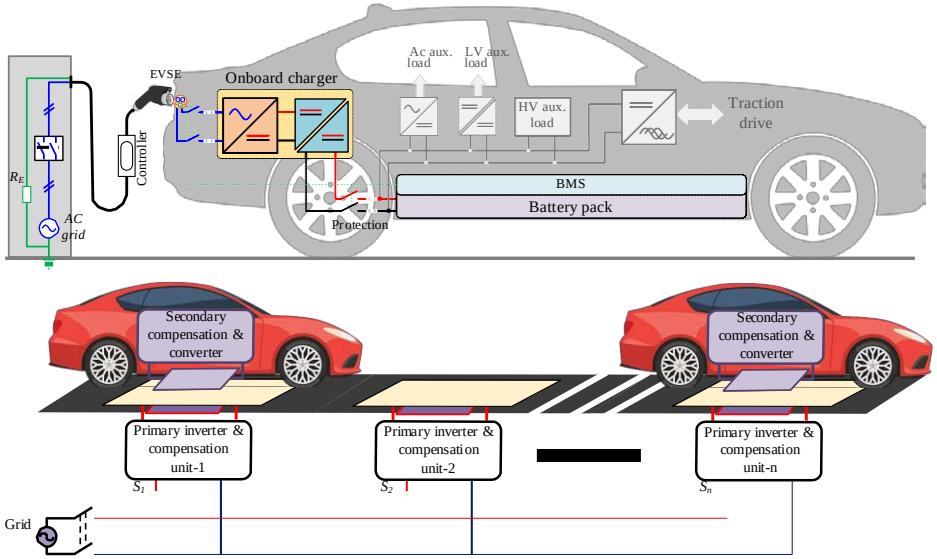
Tracked robot locomotion on varying terrain: Sebastian, B., Ben-Tzvi, P., "Support Vector Machine Based Real-time Terrain Estimation for Tracked Robots", Mechatronics, Elsevier, August 2019, Vol.62, pp:102260, Doi: 10.1016/j.mechatronics.2019.102260

Dr. Deepak Ronanki

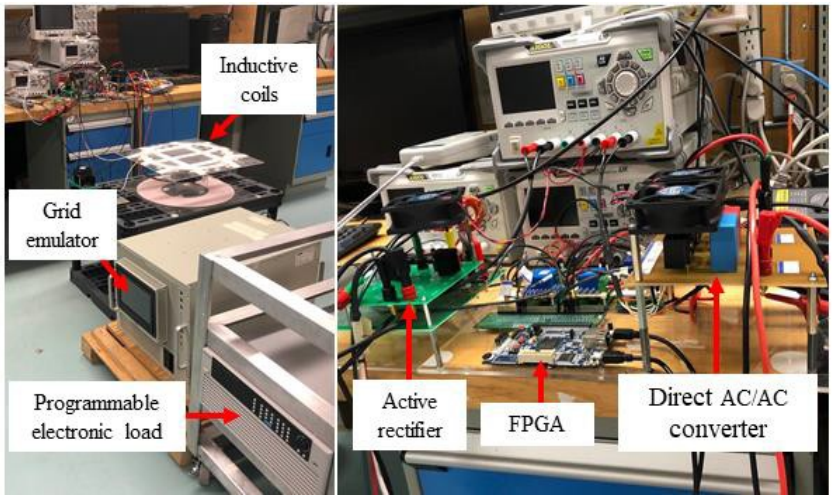
Ph.D., Ontario Tech University, Canada
Assistant Professor, Engineering Design
044-2257-4746; dronanki@iitm.ac.in

Research Areas:

- Power Electronics and Traction Motor Drives for Electrified Vehicles
- Electric Vehicle Battery Charging Infrastructure
  - Conductive (Onboard and Offboard) Battery Chargers
  - Wireless Battery Chargers (Inductive and Capacitive)
- Grid-Integration of Energy Storage and Green Energy Sources



Dynamic (in-motion) wireless charging



Wireless electric vehicle battery charger

Dr. R Jayaganthan

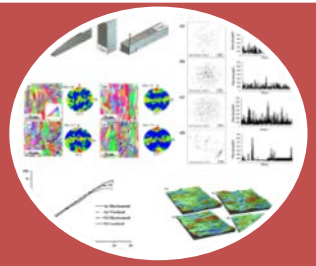
PhD, Indian Institute of Technology Madras, India

Professor, Engineering Design

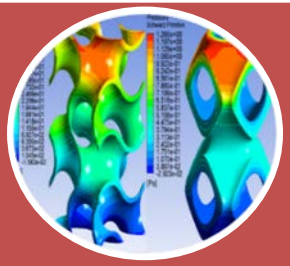
044-2257-4735; edjay@iitm.ac.in

https://ed.iitm.ac.in/team.html

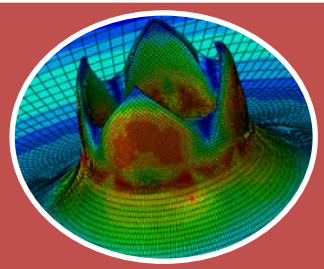
- Additive Manufacturing of Automotive, Aerospace, and Biomedical Structural Materials
- Fatigue, Fracture & Impact Mechanics
- Finite Element Modeling & Simulation of Deformable Solids
- Machine Learning for Life Time Prediction of Structural Materials



Materials' Microstructural Design for Environmental Protection



Materials Design for Automotive, Aerospace and Biomedical Applications



Finite Element Analysis of Deformable Solids for Crash worth Structures

Materials Design for Aerospace, Automotive and Bio-medical Applications

Dr. Kavitha Arunachalam

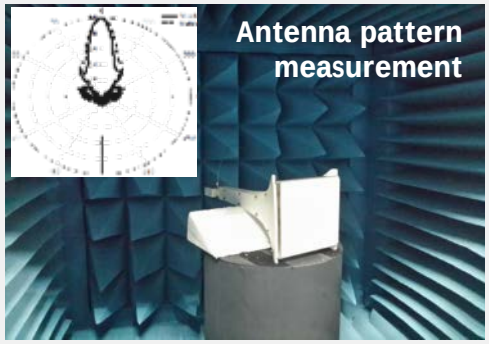
Indian Institute of Technology Madras, India

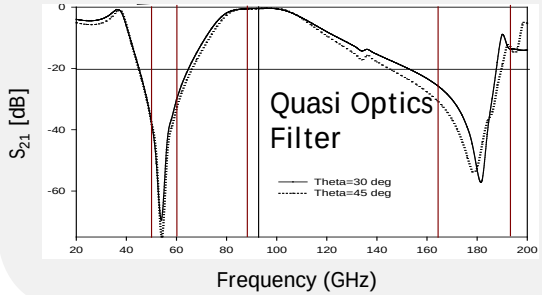
Professor, Engineering Design

http://ed.iitm.ac.in/~akavitha/index.html

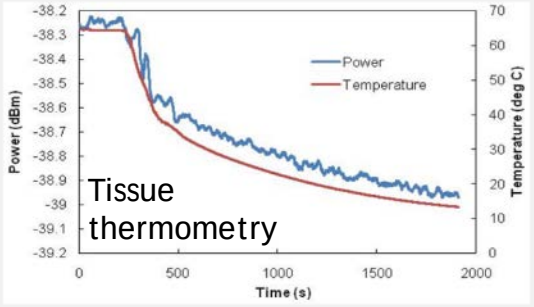
- Antennas, Filters, Microwave Circuits
- EM Medical Devices – Thermal therapy, Diagnostic
- EM Nondestructive Evaluation (NDE) – Microwave, Eddy Current Inspection

Antenna, Filter Design



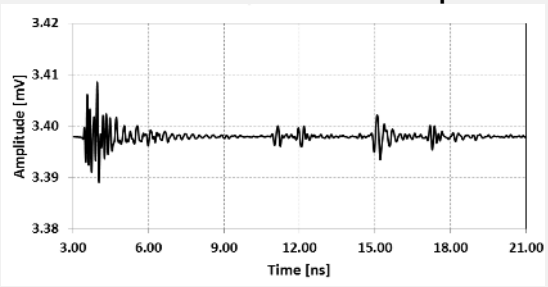


EM Medical Devices

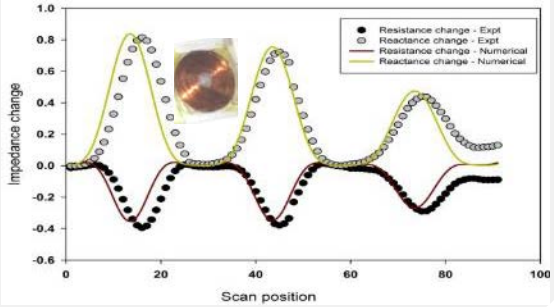


EM NDE

Microwave remote inspection



Eddy current inspection



Dr. Naresh Kumar Ravichandran

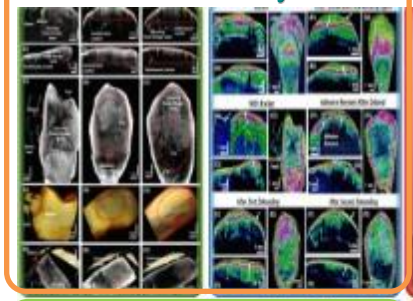
PhD, Kyungpook National University, South Korea

Assistant Professor (Grade-I), Engineering Design

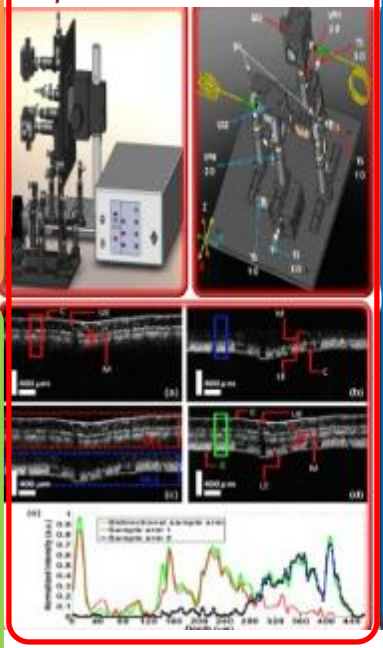
044-2257-4759; nareshr@iitm.ac.in

LiGHT **L**ight **i**n **G**uided-wave **H**ealthcare & **T**esting *(Illuminating Science, Innovative Diagnostics & Inspection)*

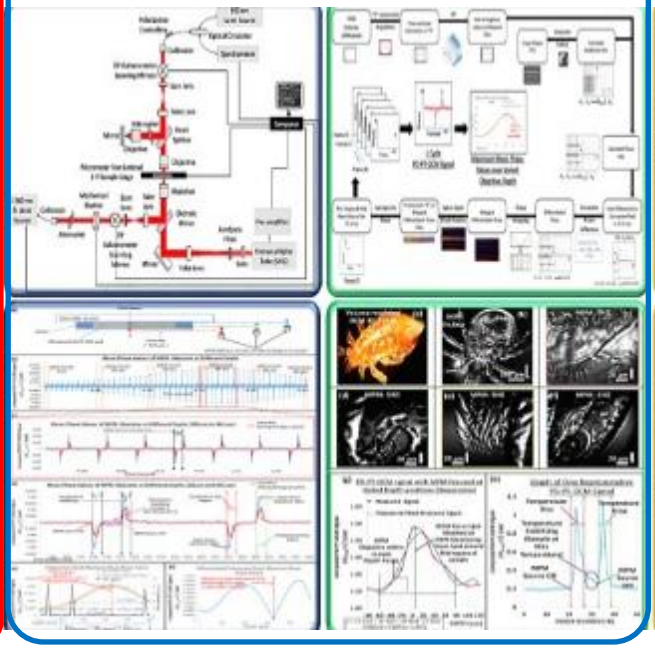
OCT in Dentistry (Link)



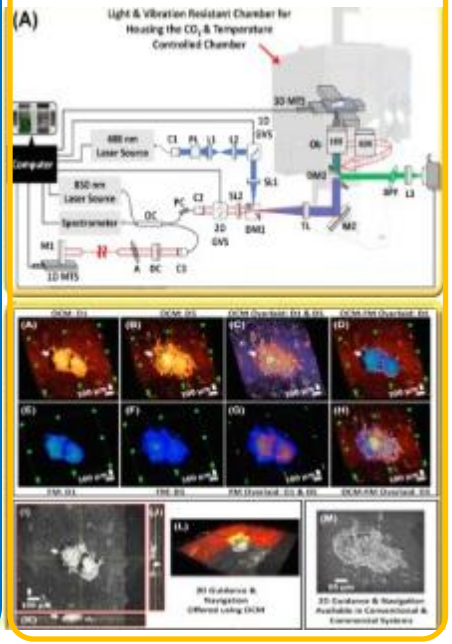
Depth Enhanced OCT (Link)



Photothermal OCT for MPM (Link)



OCT + cFM for Cancer (Link)



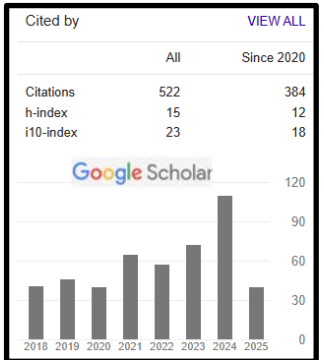
OCT in Agri (Link)

OCT in Entomology (Link)

Website *(Link)*

Research Bio:

- Researcher with >10 yrs. of experience in design, build, & optimization of Advanced Optical Metrology & Imaging Systems.
- Specialized in Optical Coherence Tomography (OCT), Line-Confocal Fluorescence Microscopy (LC-FM), and Multiphoton Microscopy (MPM).
- Awarded Young Faculty Fellowship, Best Ph.D. thesis, and won multiple research competition awards.
- Published 45+ research articles garnering 500+ citations.



Dr. Nilesh J Vasa

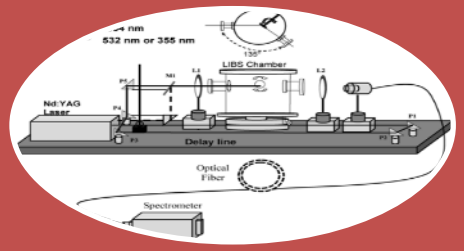
Dr. Eng., Kyushu University, Japan

Professor, Engineering Design

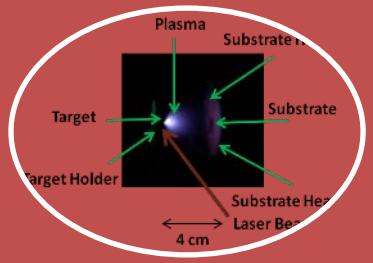
+91-44-2257-4706; njvasa@iitm.ac.in

http://ed.iitm.ac.in/~vasa/

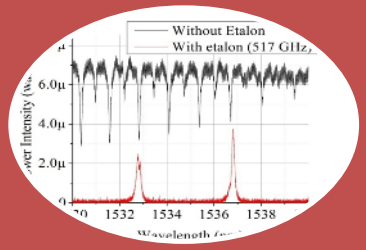
- Laser assisted sensing, Laser induced breakdown spectroscopy (LIBS) based sensing
- Laser assisted micro-manufacturing, annealing, texturing of thin films
- Optical coherent tomography technique for biomedical applications



LIBS for elemental analysis



Laser assisted micro-manufacturing



Laser assisted sensing

Opto-Mechatronics Laboratory : Application of Lasers in Engineering

Dr. Niravkumar Patel

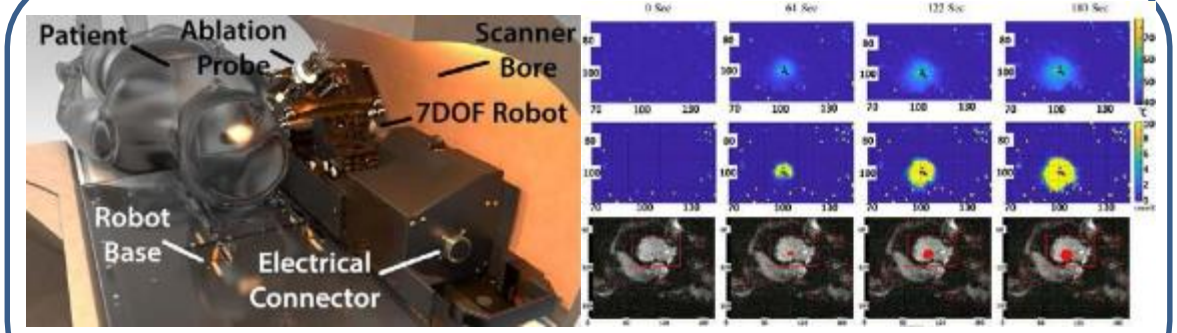
PhD, Worcester Polytechnic Institute, USA

Associate Professor, Engineering Design

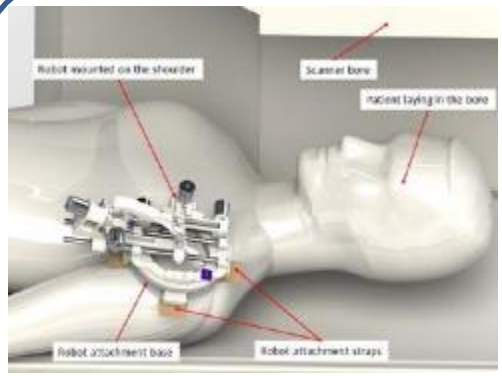
044-2257-4737; niravpatel@iitm.ac.in

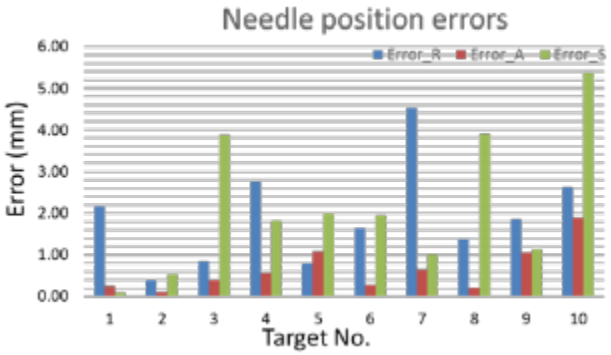
nirav.robotics@gmail.com

- Image guided, robot assisted minimally invasive interventions
- Autonomy in robot assisted minimally invasive surgeries

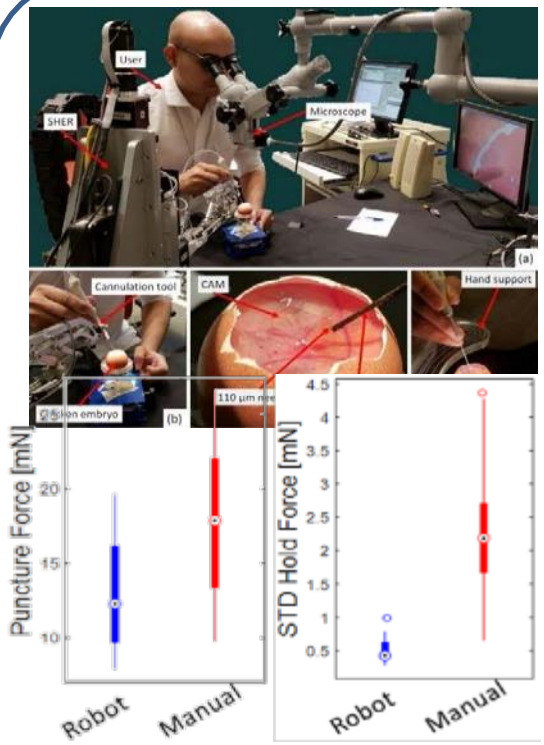


MRI guided robotic systems for brain tumor ablation and results from *in vivo* porcine studies





MRI guided robotic systems for shoulder arthrography and results from human cadaver studies



Robot assisted retinal vein cannulation and results from wet phantom studies using CAM

Dr. Palaniappan Ramu

PhD, University of Florida, Gainesville, USA

Professor, Engineering Design

044-2257-4738; palramu@iitm.ac.in

http://www.ed.iitm.ac.in/~palramu/

- Treatment of uncertainties in engineering design
- Design space exploration and surrogate enabled optimization
- Engineering analytics and decision sciences

Core area

- Uncertainty quantification, propagation and analysis
- Applied statistics

Methods

- DoE
- Optimization
- Adaptive sampling
- Surrogates/ metamodels
- Model calibration
- Engineering analytics

Application

- Aerospace DSS
- Design for reliability robustness, quality and sustainability
- Wind turbines
- Material characterization

Probabilistic process and product design and development

Dr. M Ramanathan

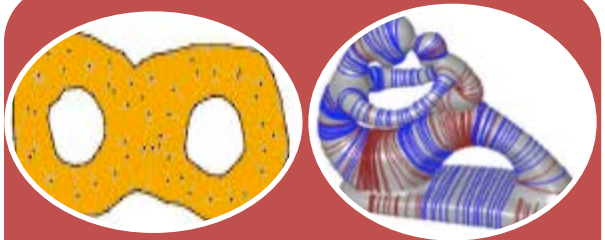
PhD, Indian Institute of Science, India

Professor, Engineering Design

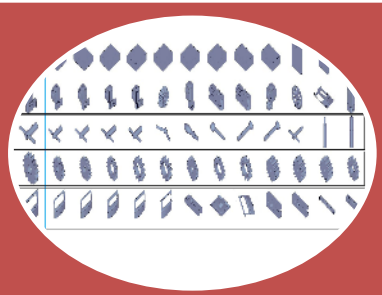
044-2257-4734; mraman@iitm.ac.in

http://ed.iitm.ac.in/~raman

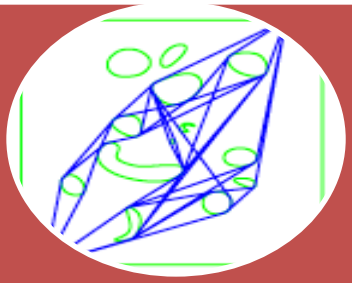
- Geometric and solid modeling /Analysis of Mesh Models and Point-sets
- Image processing (including biomedical)/Primitvie extraction from images
- Computational geometry in curved world/Shortest path, Voronoi diagram



Shape Animation Reconstruction,



Content-based Shape/Image retrieval, Image reconstruction



Path Planning / Mould separation/Protein structural analysis

Geometric computing

Dr. Sandipan Bandyopadhyay

PhD, Indian Institute of Science, Bangalore

Professor, Engineering Design

044-2257-4733; sandipan@iitm.ac.in

http://www.ed.iitm.ac.in/~sandipan

- Computational kinematics
- Mechanics, control, and design of parallel robots
- Design of mechanisms and products

Singular manifold of the general hexagonal Stewart platform manipulator

MaPaMan: a 3-DoF spatial parallel robot

An improved hand-driven tricycle with suspensions

From equations to embodiment

Dr. G Saravana Kumar

PhD, IIT Kanpur, India

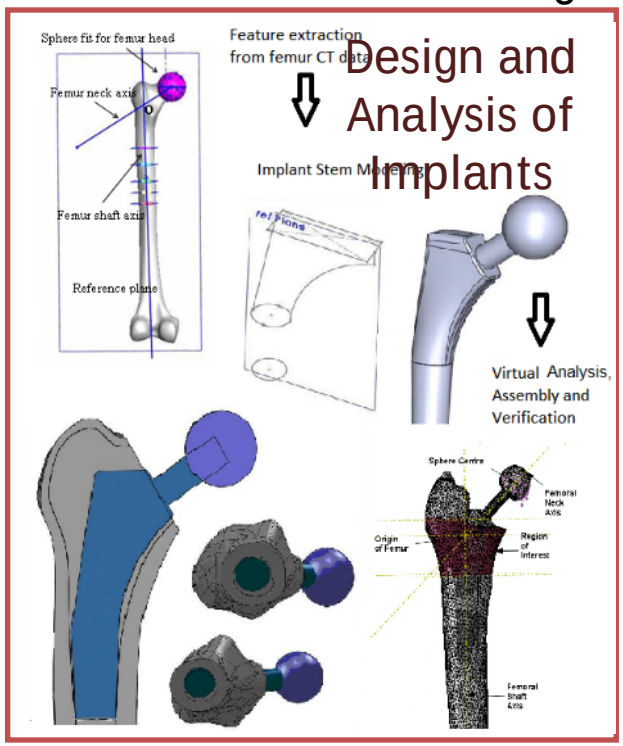
Professor, Engineering Design

044-2257-4736; gsaravana@iitm.ac.in

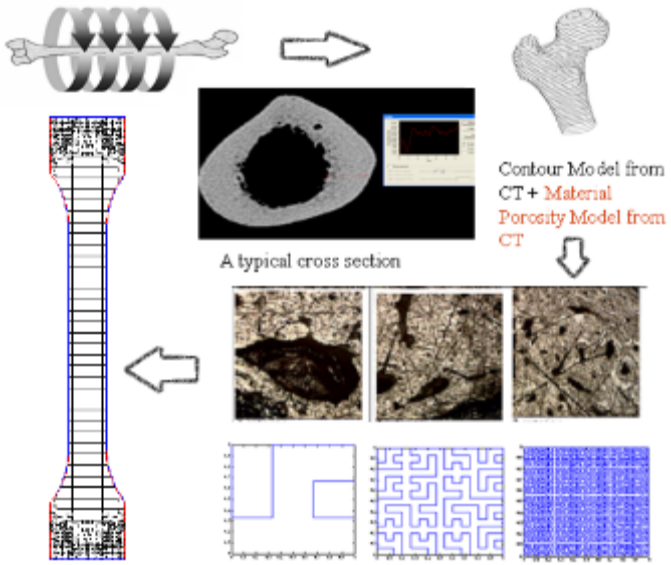
http://ed.iitm.ac.in/~gsaravana

Development of representational and computational tools for virtual and physical prototyping applied to arrive at solutions to design problems.

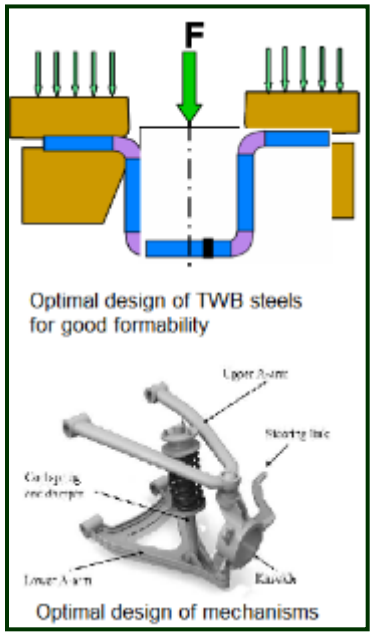
- CAD/CAE/CAM
- Additive Manufacturing
- Engineering Optimization
- Nature Inspired Computing



Design and Analysis of Implants



Composition / Porosity controlled Object CAD and Layered Manufacturing



Optimal Design

Dr. C. S. Shankar Ram

PhD, Texas A&M University, USA

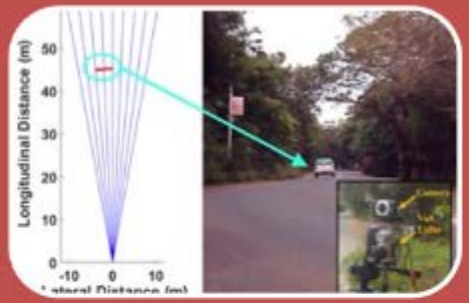
Professor and V. Ramamurti Faculty Fellow, Engineering Design

+91-44-22574705; shankarram@iitm.ac.in

https://ed.iitm.ac.in/~shankarram

- Active Vehicle Safety and Advanced Driver Assistance Systems.
- Vehicle Modelling and Monitoring for Predictive Maintenance.
- Electric and Hybrid Vehicles: Brake Blending and Control, Powertrain Optimization.
- Sustainable Road Transportation, Technologies for Decarbonisation.

Active Vehicle Safety



Advanced Driver Assistance Systems

Vehicle Prognostics for Predictive Maintenance

VEHICLE DYNAMICS AND CONTROL

Dr. Srikanthan Sridharan

PhD, Univ. of Illinois at Urbana-Champaign, USA

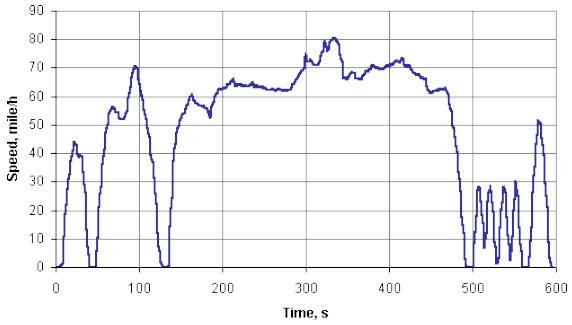
Assistant Professor, Engineering Design

+91-44-22574748, srikanthan@iitm.ac.in

https://home.iitm.ac.in/srikanthan/

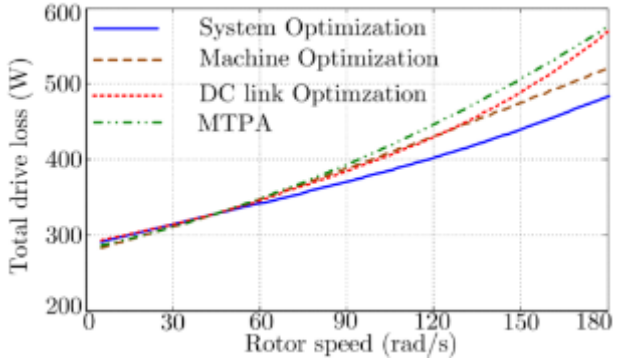
- Modeling and control of e-drive systems for electrified vehicles (EV)
- Component-level design /sizing of e-drive system
- EV battery modeling and characterization

Drive-cycle based control techniques



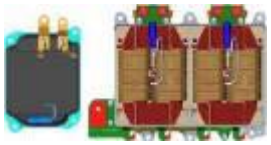
Vehicle speed profile in an example drive cycle

E-drive loss comparison among different control methods



Design of passive components of e-drive system

Capacitors



Inductors

Source: Presentation at SAE World Congress Experience 2017

Dr. Tuhin Subhra Santra

Ph.D, National Tsing Hua University, Taiwan

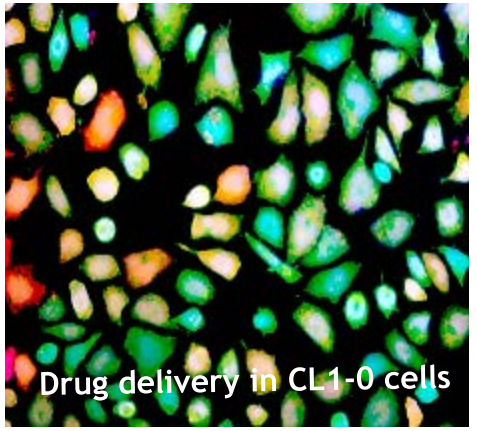
Associate Professor, Engineering Design

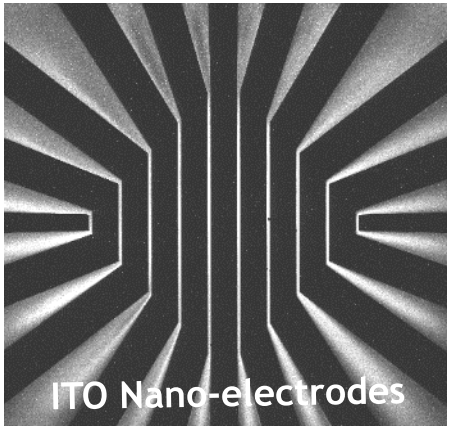
044-2257-4747; tuhin@iitm.ac.in

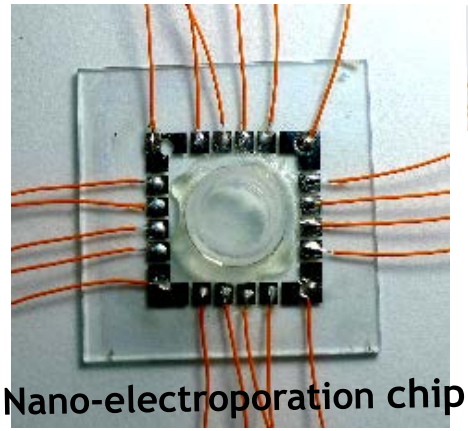
https://ed.iitm.ac.in/~tuhin/

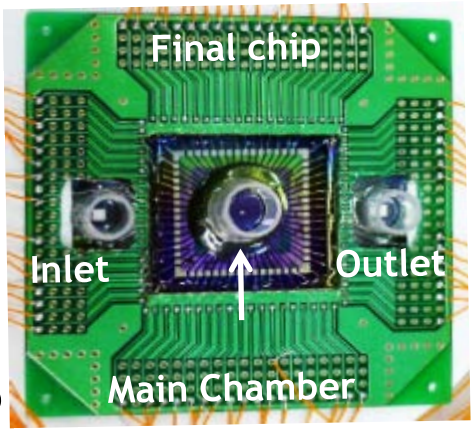
- Bio-Micro/Nano Electro Mechanical Systems (Bio-MEMS/NEMS)
- Biomedical Micro/Nano Devices
- Biofabrication
- Cell Chip/Lab on a Chip
- Nanomedicine
- Bionanomaterials

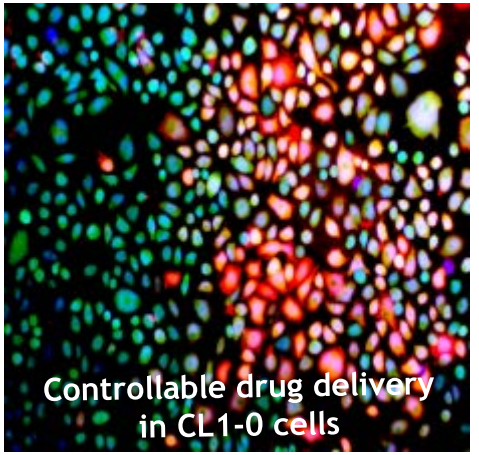
"We are developing micro/nano fabricated chips for massively parallel high throughput single cell therapy and diagnostics using different physical mechanisms such as electrotherapy, laser therapy, mechanotherapy etc."











Dr. Venkatesh Balasubramanian

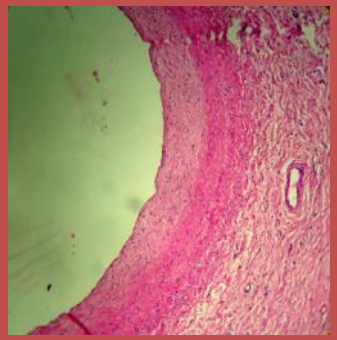
PhD, Louisiana Tech University, USA

Professor, Engineering Design

044-2257-4117; chanakya@iitm.ac.in

http://www.ed.iitm.ac.in/~vb/

- Medical Devices and Implants
- Human Factors and Ergonomics
- Innovation and Manufacturing Strategy



- Tissue Engineering
- Biomaterial Development
- Electro-mechanical Devices/ Ortho Devices

- Driver Fatigue
- Occupant Safety
- Occupational Biomechanics duct & Process Design

- RBG Risk Scaling
- RBG Innovation Ladder
- Sustainable Manufacturing
- Manufacturing Strategies

INDIVIDUAL FACULTY PROFILE

DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCE

LIST OF FACULTY

- Aditya Sriram Kolachana
- Anindita Sahoo
- Anup Kumar Bhandari
- Avishek Parui
- Aysha Visvamohan
- Binitha V. Thampi
- Dhanavel S P
- Deepak Paramashivan
- Divya A
- Hemachandran Karah
- Joe Thomas Karackattu
- John Bosco Lourdusamy
- Jyotirmaya Tripathy
- Kalpana K
- Krishna Malakar
- Mathangi Krishnamoorthy
- Merin Simi Raj
- Milind Brahme
- Paras Sachdeva
- Pramod Kumar Naik
- Rajesh Kumar
- Sabuj Kumar Mandal
- Sandeep Kumar Kujur
- Santhosh Abraham
- Santhosh R
- Santosh Kumar Sahu
- Satya Sundar Sethy
- Solomon J Benjamin
- Sonika Gupta
- Sreekumar N
- Sreenath V S
- Subash S
- Sudarsan Padmanabhan
- Sudhir Chella Rajan
- Suresh Babu M
- Swarnalatha R
- Tabraz S S
- Thanggoulen Kipgen
- Umakant Dash
- Umasankar Patra

Dr. Aditya Kolachana

PhD, IIT Bombay

Assistant Professor, Humanities and Social Sciences

044-2257-4544; aditya@iitm.ac.in

https://hss.iitm.ac.in/team-members/aditya-k/

Major Areas of Research - History of Science and Technology in India

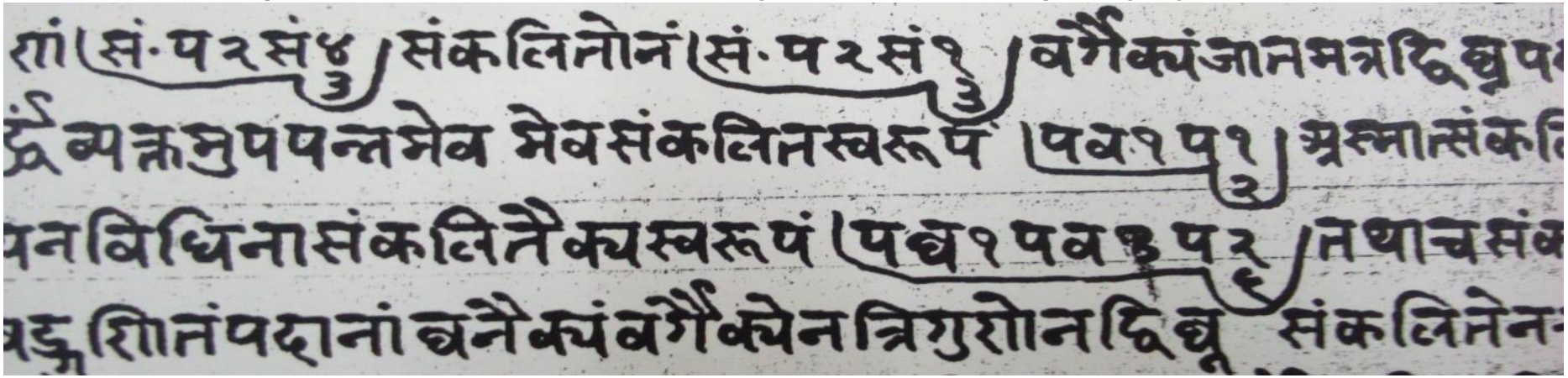
Focus:

- History of exact sciences in India
- Scientific literature in Sanskrit
- Manuscriptology

Outcomes:

- Authentic history of the development of science in India
- Publication of important scientific literature in Sanskrit
- Development of alternative pedagogical techniques

Below: A manuscript of the mathematical commentary *Nisṛṣṭārthadūtī* depicting algebraic notation in Sanskrit



Dr. Anindita Sahoo

Assistant Professor, Humanities and Social Sciences

044-2257-4534, anindita@iitm.ac.in/sahoo.anindita@gmail.com

https://hss.iitm.ac.in/team-members/anindita-sahoo/

Theories of Natural Language, Cognition and Computation — A

- Issues related to Faculty of Language
- Evolution of Language
- Comparative studies of Language

Linguistic Typology, Syntax-morphology Interface Variation Studies — B

- Syntactic Typology of South Asian Languages
- Grammatics of Indian English
- Diachronic studies of grammaticalization

- Technique development.
- Nonlinear electrochemical Impedance Spectroscopy (NLEIS)

Pragmatics and Discourse Analysis Computational Sociolinguistics NLP — C

- Effects of Social context on Language
- Data Mining and Content Analysis
- Language and Identity

Dr. Anup Kumar Bhandari

PhD (in Quantitative Economics), Indian Statistical Institute

Professor, Humanities and Social Sciences

044-2257-4531, anup@iitm.ac.in

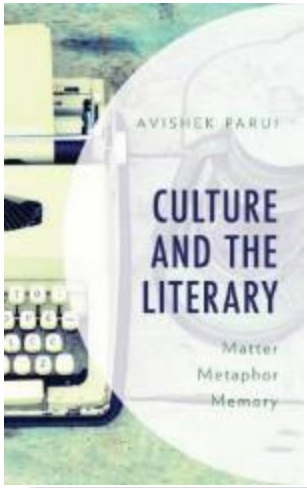
http://www.hss.iitm.ac.in/anup/index.html

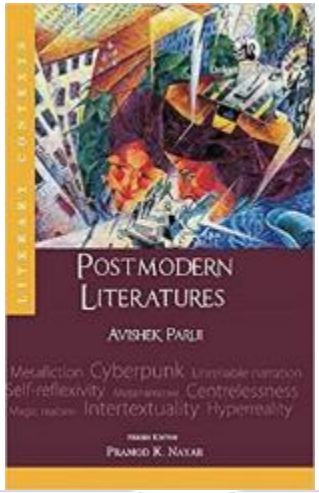
Major Areas of Research

- Production Economics, with special emphasis on Productivity and Efficiency Analysis
- Applied Industrial Economics
- Issues related to Indian Banking and Indian Financial Markets

Dr. Avishek Parui (PhD, Durham University, UK)
Associate Fellow, UK Higher Education Academy
Founding Chairperson, Indian Network for Memory Studies (INMS)
Associate Professor, Humanities and Social Sciences
044-2257-4535 avishekparui@iitm.ac.in
https://hss.iitm.ac.in/team-members/avishek-parui/

- Memory Studies
- Mind-Machine Interface
- Medical Humanities





Sponsored Projects
International and
Interdisciplinary

Neuroscience and Embodiment
Affect, Literature, Technology
Empathy, Event, Encoding

Cognitive Humanities and Machine Studies
Culture, History, Storytelling
Heritage, Preservation, Representation

Contagion and Consumption
Sleep Studies
Spatiotemporality
Philosophy and Brain Science

Memory Studies Research Initiative (IoE Project)

https://ioe.iitm.ac.in/project/memory-studies/

Dr. Aysha Iqbal Viswamohan

Professor, Humanities and Social Sciences

044-2257-4521; draysha@iitm.ac.in

http://www.hss.iitm.ac.in/aysha/index.html

Major Areas of Research

- Film Studies
- Drama and Contemporary Fiction
- Popular Culture

Film Studies

Drama

Popular Culture

Literature, Media, Culture

Dr. Binitha V Thampi
PhD, Institute for Social and Economic Change, Bangalore
Professor, Humanities and Social Sciences
044-2257-4528;binithathampi@iitm.ac.in

- Gender and Development
- Decentralised Planning and Governance
- ICTs for Development

Gender critique of public policies and engendering of development

Analysis of governance reform initiatives and decentralized planning

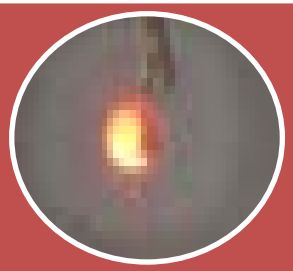
Digital divide and the inclusion

Dr S P Dhanavel

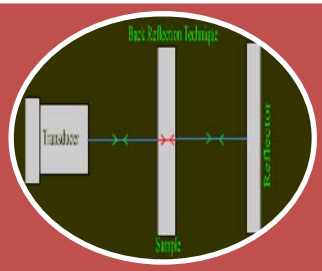
PhD, Tripura University, India
Professor, Humanities and Social Sciences
044-2257-4522; dhanavelsp@iitm.ac.in
http://www.iitm.ac.in/team-members/dhanavel-sp/

- Poetry
- English Language Teaching, Communication, and Soft Skills
- Semiotics

Creativity



Personality Development



Cultural Communication

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

Dr. Deepak Paramashivan
PhD, Indian Institute of Science
Assistant Professor; Humanities and Social Sciences
044-2257-4500; deepak@iitm.ac.in @iitm.ac.in
https://hss.iitm.ac.in/deepak-paramashivan/

- Music Information Retrieval/Generative AI for music composition
- Ethnomusicology /Sanskrit treatises on Music, World Music Theories, Indian Theatre, Biography
- Sanskrit and Yoga
- Energy, Climate and Sustainability/Biomass energy, Carbon sequestration, Renewable Energy Technologies

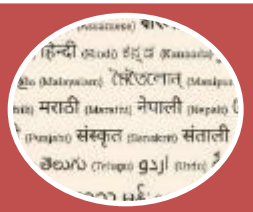
Dr. Divya A

PhD, Nanyang Technological University, Singapore
Associate Professor, Humanities and Social Sciences
044-2257-4542; divya@iitm.ac.in
https://hss.iitm.ac.in/team-members/divya/

- Genre and Tamil Cinema
- Gender in Literature and Popular Culture
- Indian Literature and Regional Indian Literatures in English Translation

Neo Noir, Mise-en-scène, Masculine Anxieties, and Plotting in Tamil Cinema

Narrative and spatial analyses of gender and racial discourses in literatures.



Representations of identities in Indian and Regional Indian literatures: the rural and the urban; and gender

Cultural and Literary constructions of Gender Narratives

Dr. Hemachandran Karah

PhD, University of Cambridge, UK

Associate Professor, Humanities and Social Sciences

044-2257-4529; hkarah@iitm.ac.in

Major Areas of Research

- **Disability Studies**
- **Aesthetics**
- **Literary criticism**
- **Comparative musicology**

Source: Faculty website

Dr. Joe Thomas Karackattu

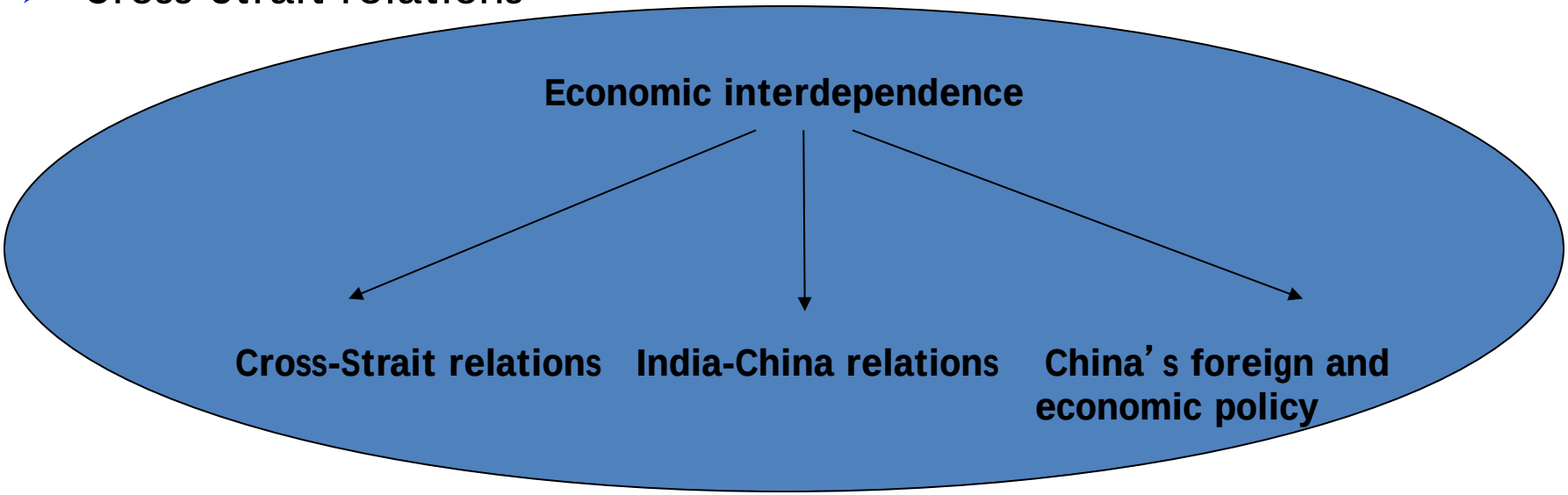
Associate Professor, Humanities and Social Sciences

044-2257 4511 ; joe@iitm.ac.in

http://www.hss.iitm.ac.in/joethomas/index.html

Major Areas of Research

- Economic interdependence and conflict
- India-China relations
- Cross-Strait relations



How conflict stands to be deterred, informed, or transformed by the value of economic linkages at the inter-state level

Dr. John Bosco Lourdusamy

D.Phil [University of Oxford, UK]

Associate Professor, Humanities and Social Sciences

044-2257 4511; 94440 18510; jbl@iitm.ac.in; jbl.hss@gmail.com

Fax: 044-2257 4502

https://hss.iitm.ac.in/team-members/john-bosco-lourdusamy/

Areas of expertise: History of Science, Technology and Medicine in colonial India.

Current specific areas of focus:

- Global circulation of crops
- Flows of botanical knowledges
- Rise of plantations

Dr. Jyotirmaya Tripathy

PhD, IIT Kharagpur, India

Professor, Humanities and Social Sciences

044-2257 6581; jyotirmaya@iitm.ac.in

https://hss.iitm.ac.in/team-members/jyotirmaya-tripathy/

- Cultural Studies
- Culture and Development
- Contemporary India

Questions around culture and identity; cultural criticism; postcolonial cultures	How culture mediates development thought and practice; development as a process; development narratives	Indian cultural expressions; Indian thought on nation and nationalism; Indian development Cultures

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

Dr. K Kalpana

PHD, Madras Institute of Development Studies nai

Associate Professor, Humanities and Social Sciences

044-2257-4520; kkalpana@iitm.ac.in

http://www.iitm.ac.in/component/faculty/75/kkalpana/

- Gender and Development / Women's Studies
- Shifting Paradigms of State-Civil Society Relationships

Understanding how the socio-political dynamics of gender, class and caste mediate and shape Indian women's experience of development in post-Independence India

Critical analysis of the shifting relationships between the Indian state and civil society actors in the delivery of public and social services

Dr. Krishna Malakar

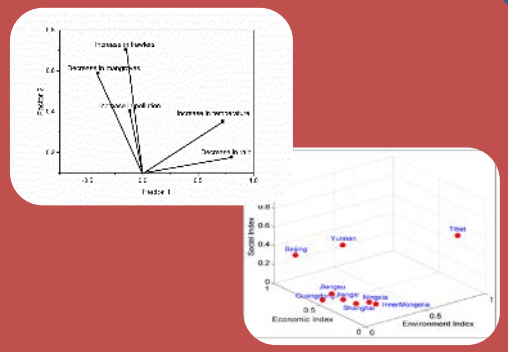
PhD, IIT Bombay, India

Assistant Professor (Climate Policy), Humanities and Social Science

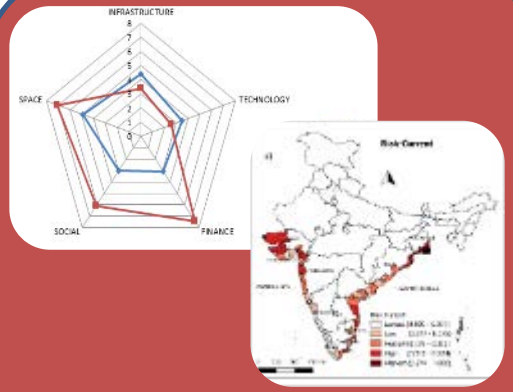
044-2257-4510; krishnamalakar@iitm.ac.in

- Vulnerability, risk and adaptation of communities to environmental/climate change
- Resilience, response and recovery of communities from extreme weather events
- Social barriers to adoption of technology by communities
- Livelihood and environmental sustainability

Designing primary socio-economic surveys and Focus Group Discussions



Quantitative analyses of socio-economic data



Building quantitative indices to measure vulnerability, risk an

Techniques to analyze human dimensions of environmental/climate change and inform policy

https://scholar.google.com/citations?user=Yc-tKKgAAAAJ&hl=en&oi=ao

Dr. Mathangi Krishnamurthy

PhD, The University of Texas at Austin, USA

Associate Professor, Humanities and Social Sciences

044-2257-4530; mathangi@iitm.ac.in

https://hss.iitm.ac.in/team-members/mathangi-krishnamurthy/

- Anthropology of Work (Cultural Anthropology)
- Gender and Sexuality (Medical Anthropology and Gender Studies)
- Popular Culture and Representation (Cultural Studies)

Future of Work

New Service Economies

Anthropology of Body

Biopolitics

Genetic Diagnostics and Biopower

Everyday life and Popular Culture

Worlding and Affect

ANTHROPOLOGY OF WORK, BODY AND GENDER

Dr. Merin Simi Raj

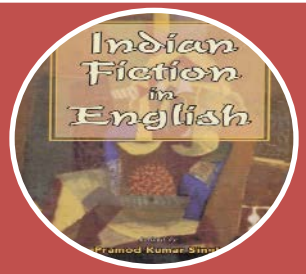
PhD, IIT Bombay, India

Associate Professor, Humanities and Social Sciences

044-2257-4524; merinsimiraj@gmail.com

Major Areas of Research

- Indian English fiction – historicizing texts and textualizing history; nation-writing; secularism and Indianness debate; visibility from marginalized locations – gender, caste and region
- Literary Historiography Studies – the writing of literary histories in India; questioning the foundations and frameworks; Nationalism and the politics of inclusion/exclusion
- Caste studies and Dalit writing – caste and secular nationalist imaginings; discourse of denial and castelessness; construction of new knowledge subjects



Opening up Indian English fiction as a ground for insurrections, possibilities and destablizations

How the recovery/inclusion of certain texts/traditions/events change the 'story' of a particular literature/genre/nation

How other frames of references affect the dominant meaning making processes

Examining the conditions/terms of production and reception of knowledge and its institutionalization

Dr. Milind Brahme

PhD (JNU, India)

Professor, Humanities and Social Sciences

044-2257-4508; brahme@iitm.ac.in

http://www.hss.iitm.ac.in/milind/index.html

- Research Area – Modern German and Comparative Literature
- Research Area – Education – School and Higher Education in India
- Teaching Area – Literary Theory, Literary Criticism, German Language and Literature

Areas of Application of Research

German Language and Literature:

- **My research in this area does not have any direct application. Indirectly it informs my teaching as well as research guidance in English and German Literary Studies.**

Education:

- **Research Guidance**
- **Research based Consultancy in the form of Monitoring the Sarva Shiksha Abhiyan in Tamil Nadu for the MHRD since 2008**
- **Evaluation of Pedagogical Interventions and Innovations in School Education – for the Tamil Nadu Government as well as private non-profit institutions**

Dr. Pramod Kumar Naik
PhD, IIT Bombay
Assistant Professor, Humanities and Social Sciences
044-2257 4503; pramod@iitm.ac.in
https://hss.iitm.ac.in/team-members/pramod-kumar-naik/

Major Areas of Research

- **Stock Market Volatility and Real Economic Activities**
- **Behavioral Finance: Investment Sentiment and Stock Returns**
- **Corporate Finance, Credit Risks**
- **Eco-Efficiency and Stock Return Volatility**

Source: Faculty website

Dr. Paras Sachdeva

PhD, Indian Institute of Technology Kanpur

Assistant Professor, Humanities and Social Sciences

parassachdeva@iitm.ac.in

Major Areas of Research

- **Fiscal Policy Monetary Policy**
- **Business Cycle Phases**
- **Inflation and Growth Dynamics**
- **Public Debt Sustainability**

Source: Faculty website

Dr. Rajesh Kumar

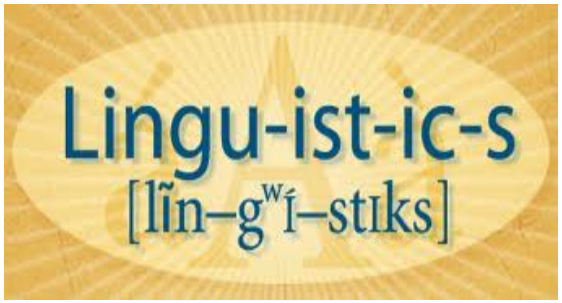
PhD, University of Illinois at Urbana-Champaign, USA

Professor, Humanities and Social Sciences

Phone: 044-2257-4537; Email: rajesh@iitm.ac.in

https://hss.iitm.ac.in/team-members/rajesh-kumar/

- Language in Education/Teaching of English
- Language and Mind (Cognition)
- Structure of South Asian Languages (Linguistic Theory)
- Sociolinguistics



Organization of language at the levels of sounds, words, and sentences with reference to human mind.

Linguistic competence and performance, relationship between language and society, and relationship between language and human mind.

Applications of the fundamental ideas of language learning/acquisition and teaching in general and teaching of English language in particular.

Understanding nature and structure of natural language and its applications

Dr. Sabuj Kumar Mandal

Associate Professor, Humanities and Social Sciences

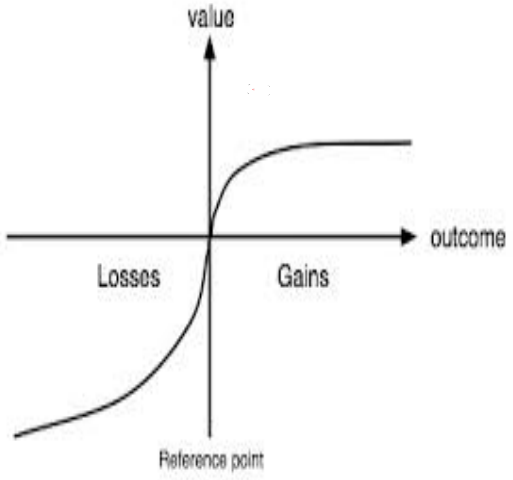
044-2257-4532; sabuj@iitm.ac.in

http://www.hss.iitm.ac.in/sabuj/index.html

Major Areas of Research

- Energy and Environmental Economics
- Efficiency and Productivity Analysis(frontier approach)
- Industrial Economics & Applied Econometrics
- Behavioral Economics

Industrial Energy Efficiency



Dr. Sandeep Kumar Kujur

PhD, Jawaharlal Nehru University, New Delhi

Assistant Professor, Humanities and Social Sciences

044-2257-4500; sandeep@iitm.ac.in

https://hss.iitm.ac.in/team-members/sandeep-kumar-kujur/

Major Areas of Research

- **Industrial Economics**
- **Economics of Technology and Innovation**
- **Labour and Development Economics**

Source: Faculty website

Dr. Santhosh Abraham

Associate Professor, Humanities and Social Sciences

044-2257-4536; abraham@iitm.ac.in

http://www.hss.iitm.ac.in/abraham/index.html

Major Areas of Research

- Colonial Courts, Legal Pluralism, Customary Laws, Conflicts
- Mental Asylums and Legal Norms in Colonial South India
- Territorial Logics of Malabar and South Canara: History and Land in the Social Construction of Law

Colonial Courts, Native Laws, Conflicts

Colonialism, Psychiatry, Mental Asylums

History and Land in the Social Construction of Law

Colonialism, Courts, Law, Land, Medical Institutions

Dr. R Santhosh

PhD, ISEC Bangalore, India

Associate Professor, Humanities and Social Sciences

044-2257-4517; rsantho@iitm.ac.in

www.hss.iitm.ac.in/santhosh/index.html

- Research Area: Sociology of Religion, Islam
- Research Area: Development Studies and globalization
- Research Area: Social Movements and state

Changing articulation of religion in the contemporary world.

Role of Islamic activism and charity in the fields of social welfare and public health in Kerala.

New Social movements and identity question

Dr. Santosh Kumar Sahu

PhD, IIT Bombay, India

Associate Professor, Humanities and Social Sciences

044-2257-4512 | santosh@iitm.ac.in

https://hss.iitm.ac.in/team-members/santosh-kumar-sahu/

- Applied Energy Economics and Climate Change
- Industrial Ecology and Policy
- Applied Industrial Economics

Energy Efficiency

Industry-Environment

Innovation-Industrial Ecology

Microeconometrics

https://sites.google.com/view/sksahuiitm/home

Dr. Satya Sundar Sethy

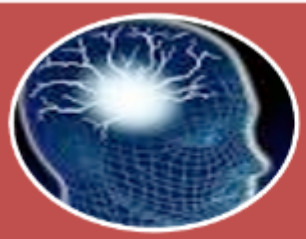
PhD, Central University of Hyderabad, India

Professor, Humanities and Social Sciences

044-2257-4509; satyasundar@iitm.ac.in

https://hss.iitm.ac.in/team-members/satya-sundar-sethy/

- Research Area: Professional Ethics (Engineering Ethics and Academic Ethics)
- Research Area: Engineering Education, Assessment & Evaluation in Higher Education
- Research Area: Consciousness Studies, Logic, Indian Philosophy, and Analytic Philosophy



Professional Ethics (Engineering Ethics and Academic Ethics)

Engineering Education, Assessment & Evaluation in Higher Education

Consciousness Studies, Logic, Indian Philosophy, Analytic Philosophy

Dr. Solomon Benjamin

Ph.D. Massachusetts Institute of Technology

Professor, Humanities and Social Sciences

044-2257-4538; solly.benj@iitm.ac.in

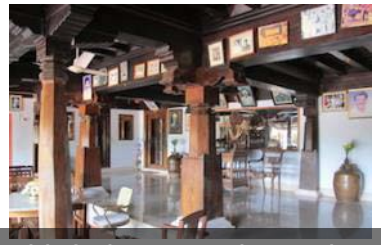
Major Research Areas

- **Trans-National Urbans: Indian and Chinese Urbanism as a 'South' Theory:** Co-producing Indian and Chinese Urbanisms: With researchers at the Hong Kong Baptist University, Chinese University of HK, CRIT Mumbai, this networks works on the idea of 'Co-produced Urbanism to re-think the urban not as bounded but inter-connected ideas and practices. Preliminary funding from the Indian Council of Social Science Research.

- **Logics of Non-Metro Urbanization:** SUBURBIN (Subaltern Urbanisation in India) funded by the 'ANR' French National Research Agency http://suburbin.hypotheses.org/701 With more than 30 collaborators in India and France, coordinated with the CHS Delhi, CPR Delhi, IFP Pondicherry, the project analyses the logics of small town large village urban agglomerations.

- **Spatialzing Peri-Urban Claims: Land, Politics, and Economy:** Research network focusing on metro-peripheries as part of *Global Suburbanisms: Governance, Land, and Infrastructure in 21st Century*: With fifteen 'co-applicants' more than 40 collaborators in a long term international research collaborative funded under the Major Collaborative Research Initiatives (MCRI), Social Science and Humanities Research Council (SSHRC), Canada) http://www.yorku.ca/city/?page_id=222

'Repair' or 'Reconstitution' in Indian China Bazaars: An issue of conceptual and empirical significance



'Chieftain' House in South Canara and it's Chinese Vase: Mediations via 'customary' claims underpin non-metro urbanisation, with trans-national trade links

Dr. Sonika Gupta

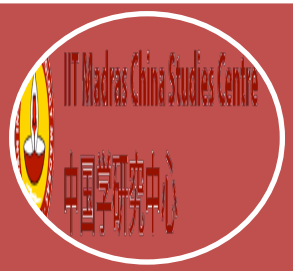
Mphil & PhD: JNU, India

Professor, Humanities and Social Sciences

044-2257-4523: sonika@iitm.ac.in

- International Relations & Chinese Politics
- Tibet Studies & Himalayan Borderlands
- Chinese Foreign Policy

Tibetan exile community, Indo-Tibetan Borderlands



China's Ethnic Policy, Cross Relations, China's Territorial Disputes, Internet in China

IR Theory, Cosmopolitanism, Citizenship

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

Dr. Sreekumar Nellickapilly

PhD, Hyderabad Central University

Professor, Humanities and Social Sciences

044-22574514, srkumar@iitm.ac.in

http://www.hss.iitm.ac.in/sreekumar/index.html

- Bioethics and the History of Healthcare in South India (Focus on Patient Autonomy, Institutional history and the role of technology in health care); Dr John Lourdusamy and Prof. V.r.Muraleedharan are co-researchers.
- Traditional/Indegenous Medicine (Focus on Scientific and Ethicsal aspects) supported by INSA, New Delhi.
- Philosophical, phenomenological, scientific and hermeneutical dimensions of human reality and human wellbeing.
- Research Area/Focus 2
- Research Area/Focus 3

Philosophical, Phenomenological and Scientific Conceptions of Human Wellbeing

This project is funded by the Wellcome Trust UK for three years upto 2015, coordinated by Dr John Lourdusamy and Prof. V.R.Muraleedharan. I focus on the problem of Patient Autonomy and Wellbeing with

This project is funded by the Indian National Science Academy, New Delhi and it tries to understand the history, ethical outlook and cultural aspects related to the traditional Ayurveda practitioners of Kerala who are known as Parambarya Vaidyas.

The phenomenological and philosophical conceptions of human being. This is a broad area of my research where I take insights from both the western and Indian philosophical traditions.

Dr. Sreenath V S

PhD, IIT Kanpur

Assistant Professor, Humanities and Social Sciences

044-2257-4549; sreenath@iitm.ac.in

Major Areas of Research

Source: Faculty website

Dr. Subash S

PhD, IIT Bombay

Professor, Humanities and Social Sciences

044-2257-4507; subash@iitm.ac.in

http://www.hss.iitm.ac.in/subash/index.html

Major Areas of Research

- MSME's and Industrial Development
- Foreign Direct Investment
- Innovation and Technological Change
- International Trade

Source: Faculty website

Dr. Sudarsan Padmanabhan

PhD (Pondicherry Univ & Univ of South Florida)

Professor, Humanities and Social Sciences

044-22574526, sudarsanp@iitm.ac.in

http://www.hss.iitm.ac.in/sudarsan/index.html

- Social and Political Philosophy (Focus on Social, Political and Cultural Theories and Institutions): Dr. JyotirmayaTripathy is my research partner. India EU Study Centre Project (IESCP) – 2010-2011 – www.iescp.net - Result of India – EU Joint Action Plan – Strong emphasis on EU studies, teaching, research and student exchange

- Erasmus Mundus Consortium (IBI*ES*) with Aarhus University, Denmark - Collaborative teaching, student exchange and research partnerships with 19 national and international universities funded by the European Union. (www.erasmus.iescp.net) - 2013-2016

- Erasmus Mundus Asia Lot – MAE – Erasmus Mundus Consortium with Aarhus University (http://www.mae-erasmus.iescp.net/) - Proposal stage

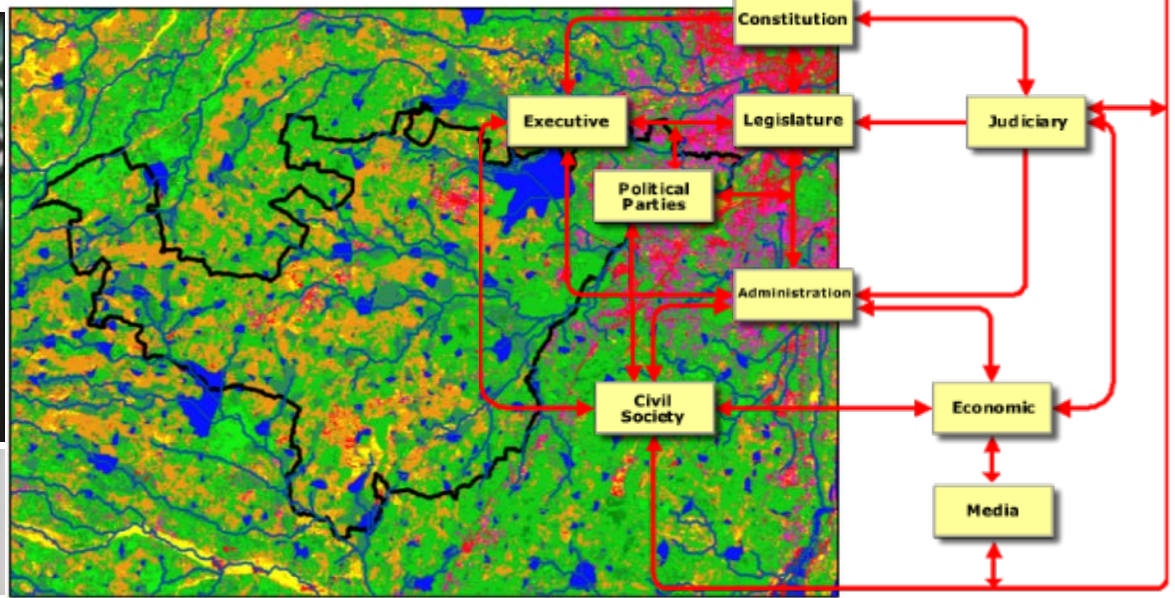
My area of current research is the construction of Indian social imaginary. I am interested in the pre-colonial, colonial and post-colonial social, political and economic institutions that influenced the formation of Indian nation and state. An attempt to create an Indian social imaginary is simultaneously an endeavour to create a moral order. The Constitution of India best exemplifies an attempt to institutionalize India's post-colonial, non-hierarchical, and democratic moral order.

The India EU Study Centre Programme funded by the EU was envisioned by the EU-India Joint Declaration to increase mutual cooperation in Higher Education. The research group at IIT Madras was called the Centre for Comparative EU Studies (CCEUS). The broad areas covered by the Centre were philosophy, political sciences, literature, culture studies, and international relations. More specifically, social and political theory, postcolonial, poststructural and postmodern cultural debates, contemporary debates in international relations, especially, problematizing nation-state and cosmopolitanism.

The EU Study Centre has conducted several international workshops, seminars and conferences with its European and Indian partners. The outcome of this partnership is two edited volumes published by Routledge, India. ***The Democratic Predicament: Cultural Diversity in Europe and India*** (2013) is edited by Dr. Jyotirmaya Tripathy and Dr. Sudarsan Padmanabhan and the second volume titled politics in the ***Global Age: Critical Reflections on Sovereignty, Citizenship, Territory and Nationalism*** edited by Dr. Sonika Gupta and Dr. Sudarsan Padmanabhan by Routledge Publishers is forthcoming.

Dr. Sudhir Chella Rajan
Denv, University of California, Los Angeles
Professor, Dept. of Humanities and Social Sciences
044-2257-4525; scrajan@iitm.ac.in
https://hss.iitm.ac.in/team-members/sudhir-chella-rajan/

- Political theory and the environment: automobility; climate change; resource curse; transport and urban policy
- Periurban initiative: armatures and enclaves; bypasses and youth; community gardening; repair cultures
- Corruption studies: big histories; grand corruption; social theories of elite networks and emergence



Dr. M Suresh Babu

PhD (JNU, New Delhi)

Professor, Humanities and Social Sciences

044-2257-4527; sureshbabum@iitm.ac.in

http://www.hss.iitm.ac.in/sureshbabu/index.html

Major Areas of Research

- Industrial Economics
- Trade and Development
- Education and Human Capital

My research has been on Competition, Entry Barriers and Productivity Growth in Indian Manufacturing Industries

I am currently interested in the issues related to unorganized manufacturing sector in India, especially innovations and growth

I have been associated with the monitoring of Sarva Sikha Abhayan in Tamil Nadu and the implementation of ICT in schools

Industrial Performance/Applied Macroeconomics/Innovations and Human Capital

Dr. Swarnalatha Rangarajan

PHD, University of Madras, India

Professor, Humanities and Social Sciences

044-2257-4519, swarna@iitm.ac.in

http://www.hss.iitm.ac.in/swarnalatha/index.html

- Ecocriticism
- American Literature
- Early Modern English Literature

Representation of environmental debates in cultural spaces- ecofeminism, econarratives from the Global South, bioregionalism,ecophilosophy

place studies

The diverse genres of 18th, 19th and 20th American Literature- with a special focus on the writings of Thomas Wolfe

Shakespearean drama – the greening of Shakespeare studies

Dr. S S Tabraz

Assistant Professor, Humanities and Social Sciences

044-2257-4533; tabraz@iitm.ac.in

Major Research Areas

- Politics of West and South Asia
- Theories of International Relations
- US mediation in conflicts in West Asia especially Israeli-Palestinian Conflict

Dr. Thanggoulen Kipgen

PhD, North-Eastern Hill University, Shillong

Assistant Professor, Humanities and Social Sciences

044-2257-4519; kipgen@iitm.ac.in

http://www.hss.iitm.ac.in/swarnalatha/index.html

Area of Research Interest:

- sociology of migration
- tribal migration
- urban ethnography

Proposed Topic of Research: “Migration, Food Preferences and Adaptations: A Study of the Northeast Migrants in Delhi”

Dr. Umakant Dash

PhD (IIT Kanpur)

Professor, Humanities and Social Sciences

044-22574516, dash@iitm.ac.in

http://www.hss.iitm.ac.in/umakant/index.html

- Healthcare Economics (Equity, Efficiency and Governance)
- Efficiency Analaysis (Data Envelopment Analysis)
- Financial Economics (Fixed Income Securities, Derivatives Market)

Part of an International Consortium of 10 Research Institutions, **RESYST, the focus is on generating evidences which would enhance the resilience and responsiveness of health systems in promoting health and health equity**. This project is funded by the Department for International Development, UK.http://resyst.lshtm.ac.uk

Efficiency Analysis of Sectors: the Banking Sector and Health Systems

Healthcare Purchasing Arrangements: intend to work on governance issues pertaining to purchasing of health care services in India, where access to basic care remains one of the challenge in achieving Universal Health Care.

Healthcare Economics/Efficiency Analysis/Derivative Market

Dr. Umasankar Patra

PhD, University of Delhi, New Delhi

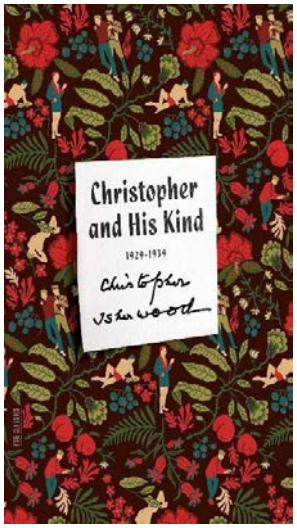
Assistant Professor, Humanities and Social Sciences

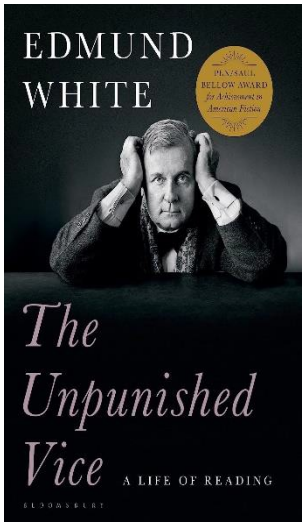
umasankar@iitm.ac.in

https://hss.iitm.ac.in/team-members/umasankar/

Research Interests:

- Anglo-American Modernism
- Life Writing
- Modernism and Modernity





Proposed Research Project: <u>Autobibliography: Acts of Reading and Ways of Belonging</u>

Research Questions:

- Why does an author produces *only* autobiographical writings one after the other?
- Does redramatization of events complicating the temporal scheme of past-present-future politicize memory?
- What happens to the questions of textuality, authorship and subjectivity as books assume centrality in one's lifestory?

Research Objectives:

- This project will explore the role of books in the construction of such a *renewable and renewed* selfhood vis-à-vis the works of Christopher Isherwood (1904-1986) and Edmund White (1940).
- It will study books as characters, agents, sites, mediators, and generators of discourses in their autobiographical works.
- This project will examine the interrelations of Anglo-American Modernism, Autobiography Studies, Visual Culture and Author Studies.

INDIVIDUAL FACULTY PROFILE

DEPARTMENT OF MANAGEMENT STUDIES

LIST OF FACULTY

- Amit R K
- Arshinder Kaur
- Arun Kumar G
- Imon Chakraborty
- Krishna Prasanna
- Lata Dyaram
- Madhumathi Rajendran
- Nargis Pervin
- Pinosh Kumar Hajoary
- Prakash Sai L
- Prathamesh Vivek Kittur
- Rahul R. Marathe
- Richa Agrawal
- Rupashree Baral
- Saji K Mathew (Profile yet to be uploaded)
- Srinivasan G
- Srinivasan S
- Sundarraj R P
- Thenmozhi M
- Thillai Rajan A
- Usha Mohan
- Vaibhav Chawla
- Varisha Rehman
- Vijayalakshmi V
- Vipin B

Dr. R K Amit

PhD, IISc Bangalore, India

Professor, Management Studies

044-2257-4575; rkamit@iitm.ac.in

http://www.doms.iitm.ac.in/amit.htm

- Game Theory
- Decision Theory
- Operations Research

Relational Contracts in Supply Chains

Inventory Games

Combinatorial Auctions

Dr. Arshinder Kaur

PhD, IIT Delhi, INDIA

Professor, Management Studies

044-2257-4553; arshinder@iitm.ac.in

http://www.iitm.ac.in/arshinder

- Supply Chain (SC) Management/ SC Coordination, SC contracts, Closed-loop SC
- Inventory Management/ Newsboy model and Operations Research Applications
- Strategic Sourcing/Evaluation and selection of suppliers

Automobile and auto components

Castings

Agro food products

Operations and Supply Chain Management

Dr. Arun Kumar G

PhD, IISc. Bangalore, India

Professor, Mechanical Engineering

044-2257-4563; garun@iitm.ac.in

https://doms.iitm.ac.in/index.php/arun-kumar-g

Major Areas of Research

- Corporate Governance
- Development Finance
- High frequency Finance
- Joint Ventures & Alliances

Source: Faculty website

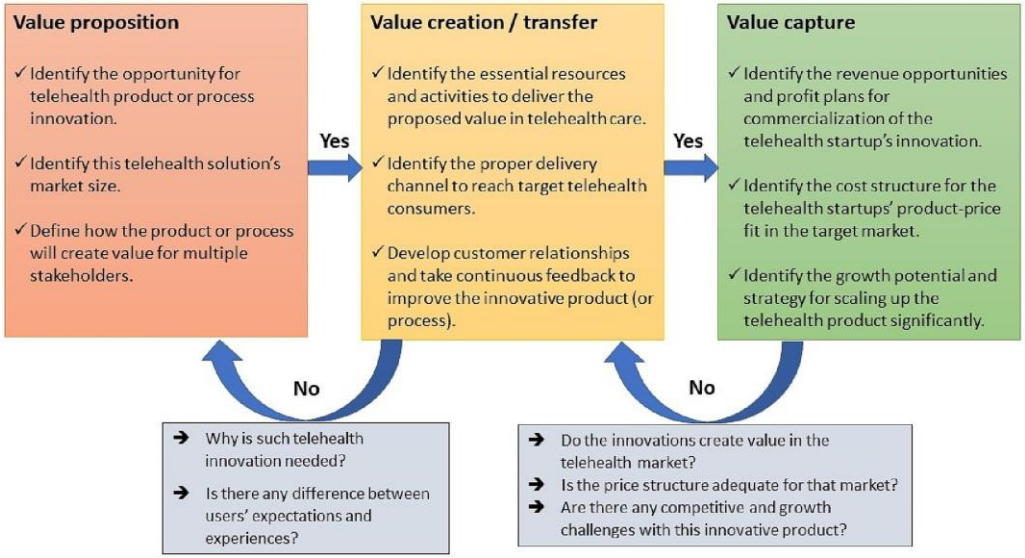
Dr.Imon Chakraborty

PhD, IIT Delhi & The University of Queensland Australia

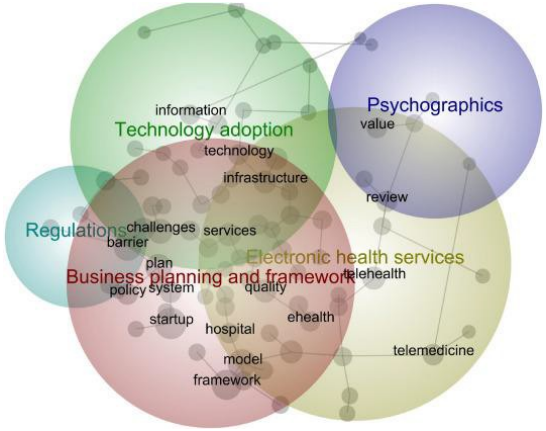
Assistant Professor, Management Studies

044-2257-4590; imon@iitm.ac.in

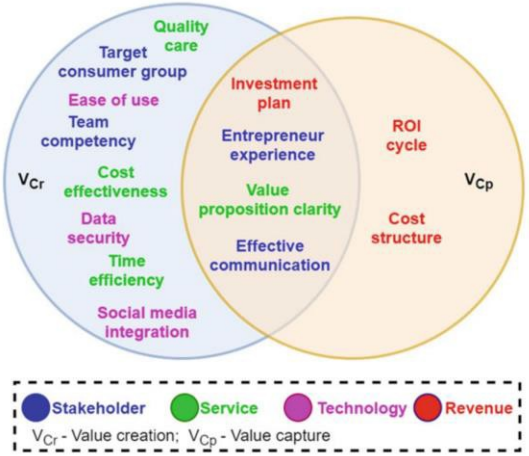
- Digital Transformation
- Critical Success Factors & Value Creation
- Information Systems in Healthcare



Framework of telehealth startups' sustainable innovation.



Role of Health-tech startups in healthcare.



Success factors for value creation.

Dr. Krishna Prasanna

PhD, University of Madras, India

Professor, Management Studies

044-2257-4571; pkp@iitm.ac.in

http://www.doms.iitm.ac.in/pkp.html

- Fixed Income Markets
- Financial Risk Management
- Corporate Governance

Fixed Income Markets

Financiacial Risk Governance models

Liquidity Risk in Financial Markets

Dr. Lata Dyaram

Ph.D (Indian Institute of Technology Madras)

Professor, Management Studies

044-2257-4567; lata.dyaram@iitm.ac.in

Major Areas of Research

- Organizational Behavior, Leadership and Organization Development (L&OD), Human Resource Management
- Cognition, spontaneous mental states and goal directed behavior across contexts
- Behaviorism combining elements of philosophy, methodology, and psychological theory

Perception, reasoning, sense making, learning

Emotions intertwined with personality, dispositions & motivation

Biological Drives, Learned motives, Needs, goals a

Spectrum of Cognition, Emotion and motivational processes to study human behavior

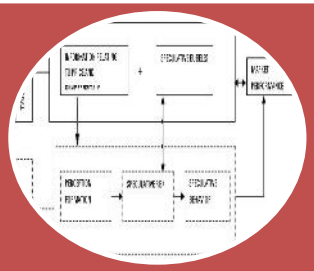
Dr. Madhumathi Rajendran

PhD, Madras University, India

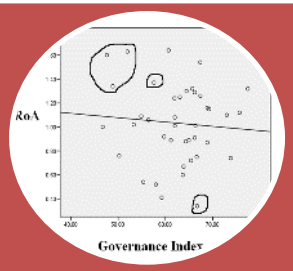
Professor, Management Studies

044-2257-4565; rmm@iitm.ac.in

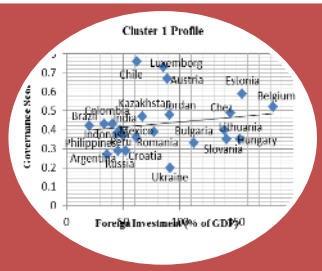
- Capital Markets
- Corporate Governance
- International Finance



Valuation of Financial Assets



Governance and Firm Performance



Evaluation of Financial Risk

Corporate Finance

Dr. Nargis Pervin

PhD, National University of Singapore, Singapore

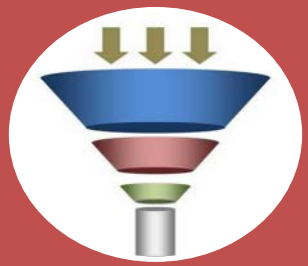
Associate Professor, Management Studies

044-2257-4574; nargisp@iitm.ac.in

http://www.doms.iitm.ac.in/domsnew/index.php/nargis-pervin

- Social Network Mining
- Recommender System
- Mobile App Analytics
- Big Data Analytics

Social Network Analytics

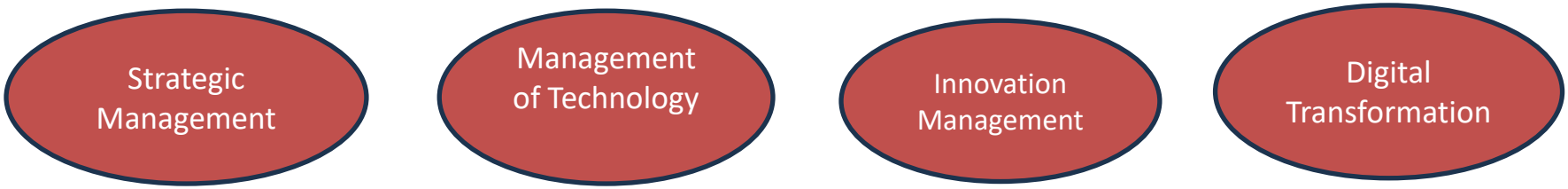


Recommender Systems

Mobile App Analytics

Dr. Pinosh Kumar Hajoary
PhD, Indian Institute of Science Bengaluru
Assistant Professor, Management Science
044-2257-4586; pinoshh@iitm.ac.in
http://www.doms.iitm.ac.in

- Strategic Management, Management of Technology
- Innovation Management, Industry 4.0
- Digital Transformation, Technology policy



Dr. L Prakash Sai

PhD, IIT Madras, INDIA

Professor, Management Studies

+91-44-2257-4568; lps@iitm.ac.in

- Strategy and Policy Studies
- Technology Foresight and Innovation
- Competitiveness and Business Excellence

Manufacturing

Information Technology

Education

Healthcare

AREAS OF APPLICATION

Dr. Prathamesh Kittur

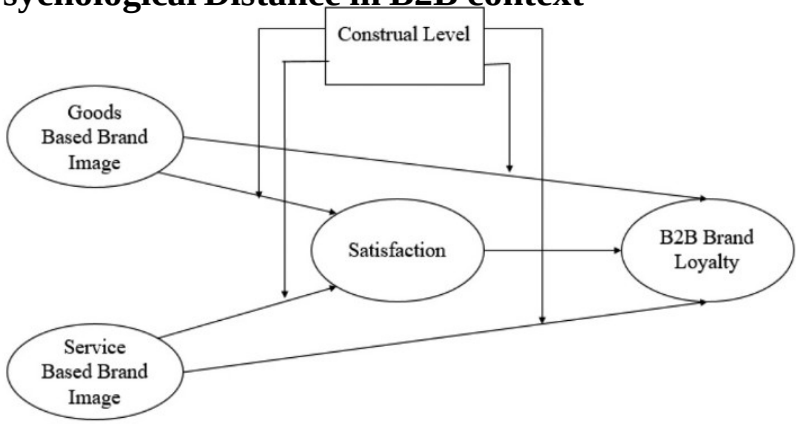
PhD, IIT Kharagpur

Assistant Professor, Management Studies

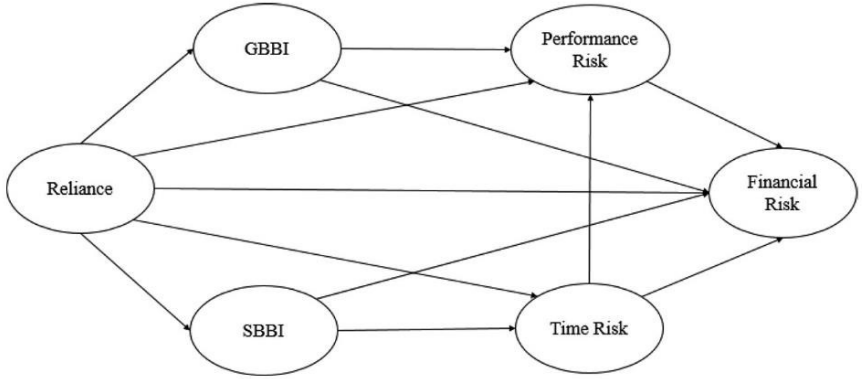
+91 44 2257 4588; prathamesh.kittur@iitm.ac.in

Previous Research Works

Psychological Distance in B2B context



Reliance in reducing risk perceptions



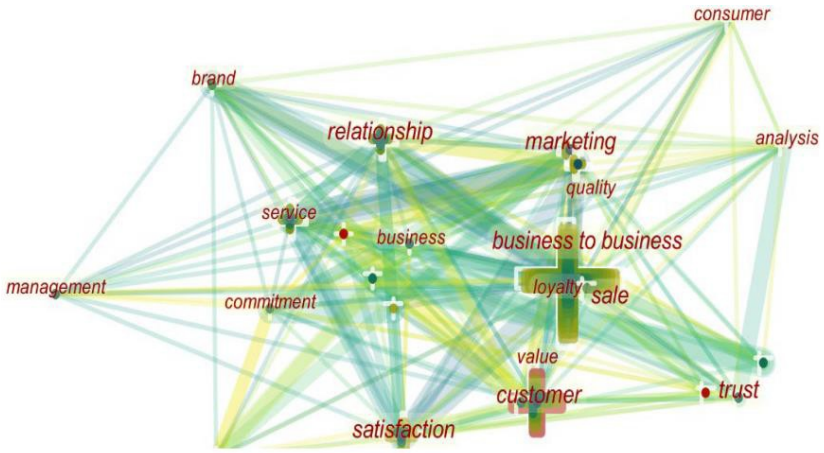
Research Methods

- Regression
- PLS-SEM
- ANOVA
- Interviews
- Quantitative data analysis.
- Experimental studies

Research Interests

- B2B Marketing
- Service failure and recovery
- Tourism and Hospitality
- B2B Healthcare

Keywords co-occurrence in B2B relationships



Dr. Rahul R Marathe

PHD, Iowa State University, USA

Professor, Management Studies

044-2257-4579; rrmarathe@iitm.ac.in

http://www.doms.iitm.ac.in/rahul.htm

- Mathematical and statistical modeling
- Stochastic processes
- Optimization

Manufacturing

Analytics

Uncertainty modeling

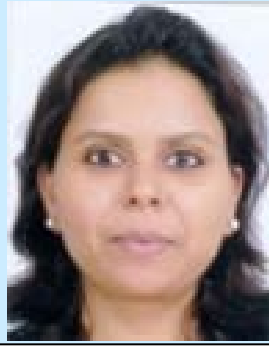
Dr. Richa Agrawal

Ph D, IIT Bombay, India

Associate Professor, Management Studies

044-2257-4564; richa@iitm.ac.in

http://www.doms.iitm.ac.in/richaagrawal



- Relationship Marketing - Relational Behaviour, Communities & Networks
- Scale Development
- Contemporary Marketing Areas: Green marketing, Luxury marketing, etc.

Customer Insights

Marketing Measures

Relationships, Communities and Behaviors

Dr. Rupashree Baral

PhD, IIT Bombay, India

Professor, Management Studies

044-2257-4561; rupashree@iitm.ac.in

http://www.iitm.ac.in/component/faculty/76/rupashree/

- Research Area 1: Work-Family Dynamics
- Research Area 2: Diversity/Generational Differences at the Workplace
- Research Area 3: Technology and Human Interface: Problems and Prospects

Work-Family Dynamics

Diversity/Generational Differences at the Workplace

Technology and Human Interface: Problems and Prospects

Dr. Saji K Mathew

PhD, IIT and Management Gwalior

Professor, Management Studies

044-2257-4573; saji@iitm.ac.in

http://doms.iitm.ac.in/index.php/skm

- Web Personalization, Information Privacy
- Business Analytics, Business Value
- Digital Platforms, Business Strategy

E-Government

Digital Enterprise

Healthcare

Research domains

Dr. G Srinivasan

PHD, IIT Madras

Associate Professor, Management Science

044-2257-4560; gsrini@iitm.ac.in

http://www.doms.iitm.ac.in

- Cellular Manufacturing
- Supply Chain Modeling
- Sequencing and Scheduling.

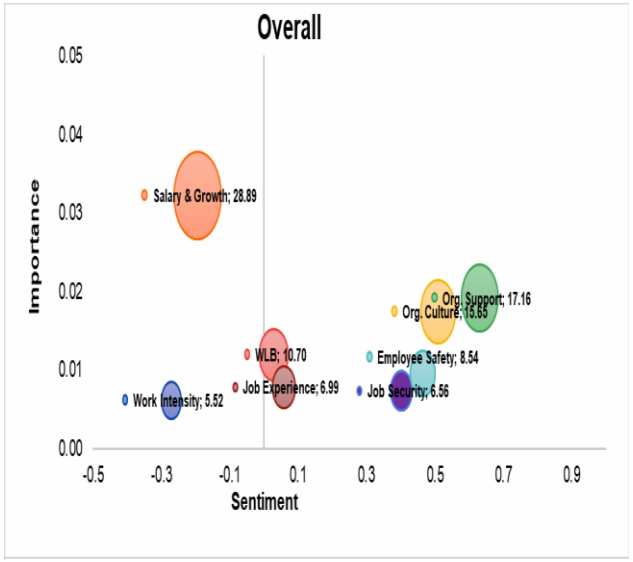
Operations Research Applications

Manufacturing Systems Management

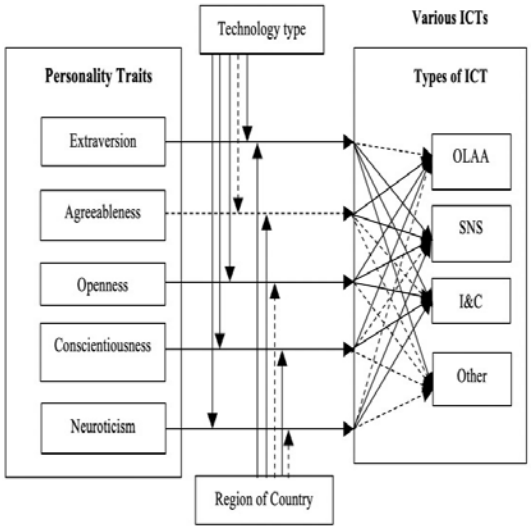
Supply Chain Management

Dr. S Srinivasan
PhD, IIT Madras, India
Associate Professor, Management Studies
044-2257-4583; srinivasan@iitm.ac.in

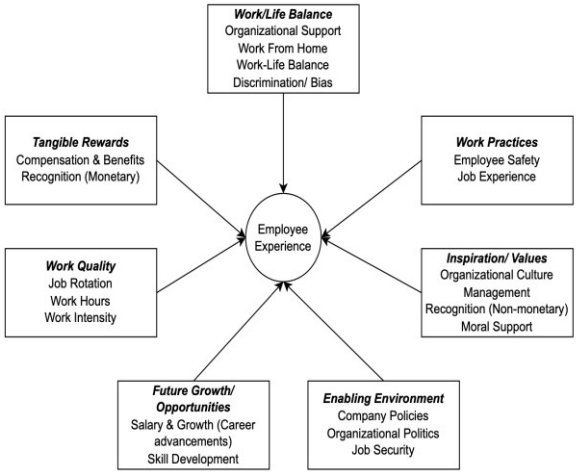
- Employee Experience
- Employee Engagement and Performance
- Technology Adoption and Workplace Performance



Sentiment and importance of the identified Employee Experience-factors



Integrated Theoretical Framework on Personality traits-ICT use



Framework for Enhanced Employee Experience

Dr. R P Sundarraj

PhD, University of Tennessee at Knoxville

Professor, Management Studies

044-2257-4558; rpsundarraj@iitm.ac.in

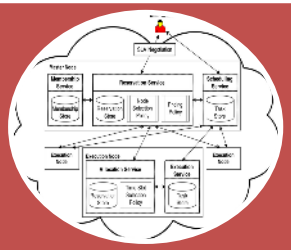
http://www.doms.iitm.ac.in/domsnew/index.php/sundarraj-rp

Major Areas of Research

- Electronic negotiation and applications
- Analytics
- Innovation management
- Supply chain management

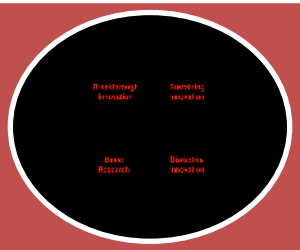
Prior experience

- Qatar University, Doha
- University of Waterloo, Canada
- Clark University, USA



Cloud computing negotiation, pricing, services

Analytics



Technology innovation in firms

Applying Operations research and behavioral models to technology design and adoption

Dr. Thenmozhi M

PhD, University of Madras, India

Professor, Management Studies

044-2257-4562; mtm@iitm.ac.in

http://www.doms.iitm.ac.in/thenmozhi.htm, http://ssrn.com/author=567794

Specialization: Corporate Finance and Strategy, Corporate Valuation, Financial Markets, Computational Finance, Forecasting and Time Series Modeling, Stock and Commodity Derivatives.

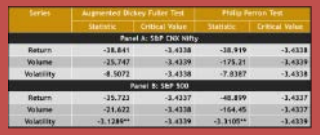
Courses: Financial accounting, Cost Management, Financial Management, Financial Institutions and Markets, Computational Finance, Fixed Income Securities :Trading and Strategy, Investment Management, Empirical Research in Finance, Options and Futures.

Current research: Cash holdings and Governance, CBHI scheme Performance, Intraday Price discovery and Volatility Spillover, India VIX and Risk Management, Liquidity in Currency Options, Crude Oil Pricing.

Fulbright-Nehru Visiting Lecturer Fellowship 2010-11

European Union Erasmus Mundus Scholarship 2009-10

Australian Government Endeavour Executive Award, 2007



Series	Augmented Dickey Fuller Test		Philip Perron Test	
	Statistic	Critical Value	Statistic	Critical Value
Panel A: S&P CNX Nifty				
Return	-18.841	-3.4338	-38.919	-3.4338
Volume	-25.747	-3.4339	-175.21	-3.4339
Volatility	-8.5072	-3.4338	-7.8387	-3.4338
Panel B: S&P 500				
Return	-25.723	-3.4337	-48.899	-3.4337
Volume	-21.672	-3.4338	-164.45	-3.4337
Volatility	-3.1286**	-3.4339	-3.3105**	-3.4339

Corporate Finance and Strategy

Impact of diversification Strategy on Firm Performance: Entropy Approach

Cross-border Mergers and Acquisitions involving emerging markets

Financial markets

Effect of macroeconomic variables on Bond market volatility in BRIC Countries

Volatility Spillover in Bullion and Energy futures and Spot Markets

Financial Modeling

Forecasting Stock Index Returns using ARIMA-SVM, ARIMA-ANN, and ARIMA-Random Forest Hybrid Models.

Multi-objective and Multi-strategy Optimization Stock Trading Model using Support Vector Machines and Ant Colony optimization

Dr. Thillai Rajan A

Fellow (PhD), Indian Institute of Management Bangalore, India

Professor, Management Studies

+91-044-2257-4569; thillair@iitm.ac.in

http://www.iitm.ac.in/thillai.htm

Private Equity and Venture Capital

- Annual India venture capital and private equity report series
- Value addition by venture investors
- Non-financial risk management by private equity investors

Infrastructure Finance

- Private equity in infrastructure
- Project finance in high risk environments
- Impact of PPP on costs and overruns
- Impact on PPP on project outcomes viz., access, cost, price, quality, and efficiency

Corporate Finance

- Real options
- Corporate social responsibility
- Sources of SME funding and impact of performance

Dr. Usha Mohan

PHD, Indian Statistical Institute, INDIA

Professor, Management Studies

044-2257-4576; ushamohan@iitm.ac.in

http://www.doms.iitm.ac.in/usha.html

- Quantitative Models in Supply Chain Management
- Socially Relevant Applications of Operations Research
- Combinatorial Optimization

Order Management in MTO environments and Design of Sales force Incentives

Design of Food Supply Chains to improve Food security and Scheduling patients in Health Care Delivery Systems

Pick up and Delivery Vehicle Routing Problems

Dr. Vaibhav Chawla

FPM (PhD), IIM Kozhikode,India

Associate Professor, Management Studies

044-2257-4585; vaibhavchawla@iitm.ac.in

- Role of positive psychology constructs (such as spirituality, mindfulness, delayed gratification etc.) and social media in salesperson performance
- Exploring mechanisms to address customer complaints over social media
- Understanding customer psychology during product return in e-commerce context

Sales force Performance

Positive Psychology & Sales Performance

Customer Complaint Handling

Complaint Recovery on Social Media

Customer Psychology

Customer Responses to Product Return Process of E-seller

BROAD DESCRIPTION OF THE AREAS OF RESEARCH

Dr. Varisha Rehman

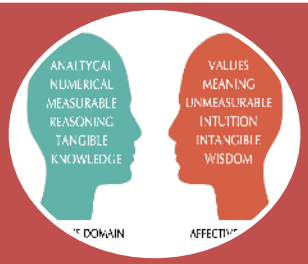
PhD, IIIT – Allahabad,India

Associate Professor, Management Studies

044-2257-4572; varisha@iitm.ac.in

http://www.doms.iitm.ac.in/domsnew/index.php/varisha-rehman

- Advertising (traditional and new media advertising)
- Consumer Behavior
- Entertainment Marketing



Cognitive , affective and evaluation aspects of advertising

Consumer Behavior

Entertainment Marketing

Research Spectrum

Dr. V Vijayalakshmi

PhD, Indian Institute of Technology Madras, India

Associate Professor, Management Studies

044-2257-4566; viji@iitm.ac.in

https://doms.iitm.ac.in/index.php/vijayalakshmi-v

- **Positive Organizational Behavior**: Generating Positivity in the Workplace, Happiness and Work, Workplace Emotions, Finding Meaning in Work, Strength-Based Approach to Work, Discovering Calling, Integral Leadership Development, Unlearning
- **Cross-Cultural Management:** Cultural Competence and Global Dexterity
- **Teaching, Learning and Education**: Holistic Education, Contemporary Teaching and Learning Beliefs and Practices, Creativity in Teaching-Learning

NURTURING THE INNER YOU: FOR INDIVIDUAL, GROUP, ORGANIZATIONAL TRANSFORMATION

INNOVATION IN TEACHING-LEARNING PRACTICES, INTEGRAL EDUCATION

CROSS-CULTURAL MANAGEMENT

ORGANIZATIONAL BEHAVIOR AND HUMAN RESOURCE DEVELOPMENT

Dr. Vipin B

PhD, IIT Madras, India

Assistant Professor, Management Studies

044-2257-4591; vipinb@iitm.ac.in

- Research Area/Focus 1 : Decision theory and behavioral operations
- Research Area/Focus 2 : Optimization in operations management
- Research Area/Focus 3: Modelling and analysis of complex systems

Sustainability in logistics and supply chains

Agricultural supply chain and international trade

Healthcare operations management

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

INDIVIDUAL FACULTY PROFILE

DEPARTMENT OF MATHEMATICS

LIST OF FACULTY

- Anoop T V
- Anuj Jakhar
- Anwoy Maitra
- Aprameyan P
- Arijit Dey
- Arindama Singh
- Arunkumar G
- Balaji R
- Barun Sarkar
- Bidhan Chandra Sardar
- Chand A K B
- Chidella Srinivasa Rao
- Dipramit Majumdar
- Jayanthan A V
- Kalpana Mahalingam
- Kunal Krishna Mukhopadhyay
- Narayanan N
- Neelesh S Upadhye
- Ponnusamy S
- Priyanka Shukla
- Radha R
- Rakhi Singh
- Rama R
- Ramesh Kasilingam
- Santanu Sarkar
- Sanyasiraju Y V S S
- Sarang S Sane
- Sathish Kumar A
- Satyajit Roy
- Shaiju A J
- Shruti Dubey
- Sivakumar K C
- Soumen Sarkar
- Sounaka Mishra
- Srinivasa Rao Manam
- Sriram B
- Subhajit Ghosh
- Suhas Jaykumar Pandit
- Sumesh K
- Sundar S
- Surjit Kumar
- Uma V
- Venkata Balaji T E
- Vetrivel V

Dr. Anoop T V

PhD, The Institute of Mathematical Sciences, India

Associate Professor, Mathematics

044-2257 4634; anoop@iitm.ac.in

https://home.iitm.ac.in/anoop/

Major Areas of Research

- **Analysis and Linear Algebra**
- **Differential Equations and Applied Mathematics**

Source: Faculty website

Dr. Anuj Jakhar

PhD, IISER Mohali, India

Associate Professor, Mathematics

044-2257-4649; anujjakhar@iitm.ac.in

A study of valued fields and irreducible polynomials

The question of irreducibility of polynomials over the field Q of rational numbers has been of interest to many mathematicians. Further, if a polynomial is reducible, then what can we say about its irreducible factors over Q? Polynomial factorization is very useful in Algebraic Number Theory, Coding Theory and Cryptography, Galois Theory etc. Irreducible polynomials appear naturally in the study of polynomial factorization and algebraic field extensions.

Objectives:

1. We would like to find out the accurate information regarding the degrees and coefficients of the irreducible factors of any given polynomial having coefficient from a valued field of arbitrary rank.
2. Additionally, we would like to prove/disprove the statement that f(n) takes a finite number of square-free values for an integer n (bigger than one) if f(x) is an irreducible polynomial with degree larger than or equal to 3.
3. There are some indications that we can find the necessary and sufficient condition in terms of coefficients and degree of a polynomial so that its translation becomes Eisenstein-Dumas polynomial. So we would like to attempt this problem.
4. We have proved the irreducibility of a class of truncated binomial expansions. We would like to generalize this result.

Dr. Anwoy Maitra

PhD, IISc, Bangalore, India

Assistant Professor, Mathematics

044-2257-4600; anwoy@iitm.ac.in

https://math.iitm.ac.in/anwoy

- I work in the broad area of Several Complex Variables, with specific focus on
  - Invariant distances and metrics in complex analysis
  - Negative-curvature-type properties of invariant distances, especially a particular property of this type, namely *visibility relative to the Kobayashi distance*, which has been recently introduced
  - Iteration of holomorphic maps and the continuous extension of holomorphic maps

I am interested in proving results about:

- What happens when a holomorphic self-map of a domain is iterated (e.g. results of Wolff–Denjoy type);
- The localisation of various invariant distances and metrics, such as the Kobayashi distance and metric;
- The continuous—or better—extension of biholomorphic maps and, more generally, maps that preserve or respect the Kobayashi distance;
- Visibility relative to the Kobayashi distance (mentioned above) and more recently introduced *quantitative* forms of visibility.

Dr. P Aprameyan

Ph.D., Philipps Universität Marburg, Germany

Assistant Professor, Mathematics

044-2257-4645; aprameyan@iitm.ac.in

https://math.iitm.ac.in/aprameyan

My interests lie, broadly, in analysis on spaces admitting large groups of symmetries (Lie group actions). Currently, this includes

- Analysis (harmonic analysis, microlocal analysis, spectral analysis) on Riemannian symmetric spaces and their compactifications
- Representations of real Lie groups, including a study of its relation to complex geometry
- Geometric quantization in relation to representations of Lie groups, especially real degenerations of Kähler polarizations

The unifying feature, both thematically and in the methods which are used, is the presence of, typically, a non-compact Lie group acting as symmetries. The interaction between the algebraic, analytic and geometric aspects of such groups is what enables us to obtain refined results, often with explicit formulae

Dr. Arijit Dey

Professor, Mathematics

044-2257-4635; arijit@iitm.ac.in

My broad subject of research is algebraic geometry in particular I am interested in following topics:

- Vector Bundles and Decorated sheaves over algebraic varieties, Principal Bundles over algebraic varieties.
- Toric Geometry (Bundle theoretic questions)

Dr. Arindama Singh

PhD, IIT Kanpur, India

Professor, Mathematics

044-2257-4613; asingh@iitm.ac.in

http://mat.iitm.ac.in/home/asingh/public_html/index.html

- Numerical Analysis
- Knowledge Compilation
- Image Processing

APPLICATION 1

Numerical solution of singularly perturbed two-point boundary-value problems and of elliptic PDEs, use of regularization methods

APPLICATION 2

A propositional knowledge base is converted to a set of its prime implicants or prime implicates so that conclusions can be drawn from the knowledge base comparatively easily

APPLICATION 3

PDEs are used to deblur and denoise images using regularization methods. Improvisation on the Perrona-Mallick type of PDE-based image processing is the main trick used here

Dr. G. Arunkumar

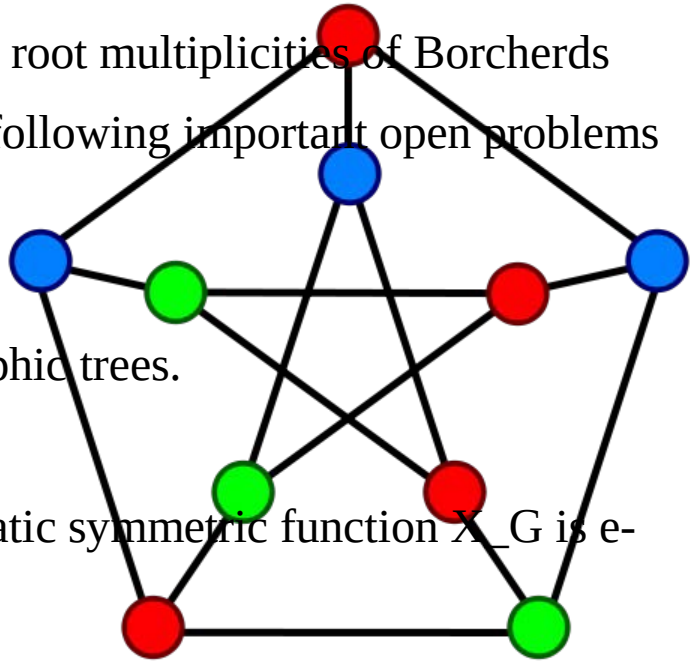
PhD, The Institute of Mathematical Sciences, Chennai

Assistant Professor ; Mathematics

044-2257-4648; garunkumar@iitm.ac.in

Chromatic symmetric function of graphs and Stanley's tree isomorphism conjecture

The chromatic polynomial of a graph G is an important graph polynomial which counts the number of proper coloring of the graph using q colors. These polynomials have many real-life applications as well. The chromatic polynomials has a natural generalization to symmetric functions called chromatic symmetric functions which are introduced by R. Stanley. In this research proposal, we want to explore the connection between root multiplicities of Borcherds algebras and the chromatic symmetric functions to attack the following important open problems suggested by Stanley.



Stanley's Tree Conjecture:

Chromatic symmetric function distinguishes non-isomorphic trees.

Poset chain conjecture or (3+1)-free conjecture:

If G is a claw-free incomparability graph then its chromatic symmetric function X_G is e-positive. (s-positive is known!)

Dr. Balaji R

Professor, Mathematics

044-2257 4631; balaji5@iitm.ac.in

Major Areas of Research

- **Analysis and Linear Algebra**

Source: Faculty website

Dr. Barun Sarkar

PhD, University of Wuppertal, Germany

Assistant Professor, Mathematics

044-2257-4614; barun@iitm.ac.iin

Major Areas of Research

- Probability Theory and it's applications,
- Stochastic Partial Differential Equations (SPDEs),
- Stochastic Differential Equations (SDEs),
- Quantitative Finance

Dr. Bidhan Chandra Sardar

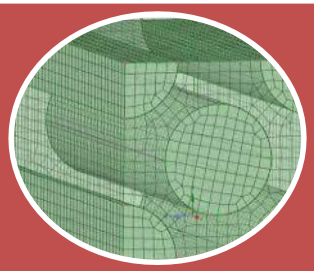
PhD, IISc Bangalore, India

Assistant Professor, Mathematics

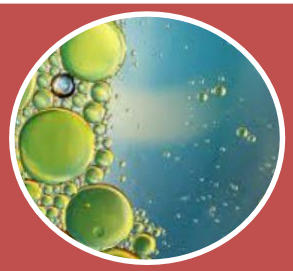
044-2257-4606; bidhan.math@iitm.ac.in

https://math.iitm.ac.in/outerfaculty.php

- Research Area/Focus 1: Partial Differential Equations (PDEs)
- Research Area/Focus 2: Multi-scale Analysis of PDEs
- Research Area/Focus 3: Optimal Control and Control Theory of PDEs



Composite Material



Flow in Porous Media

Control Dynamics in Aerospace

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

Dr. Chand A K B

PhD, Indian Institute of Technology, Kanpur

Professor, Mathematics

044-2257 4629; chand@iitm.ac.in

Major Areas of Research

- **Analysis and Linear Algebra**
- **Differential Equations and Applied Mathematics**

Source: Faculty website

Dr. Chidella Srinivasa Rao

PhD, IISc Bangalore, India

Professor, Mathematics

044-2257-4623; chsrao@iitm.ac.in

http://mat.iitm.ac.in/home/chsrao/public_html

- Nonlinear Ordinary Differential Equations
- Nonlinear Partial Differential Equations
- Generalized Burgers Equations

Existence and Uniqueness of solutions of nonlinear Ordinary differential equations

Approximate /large time asymptotic solutions to generalized Burgers equations

These partial differential equations appear in nonlinear acoustics

Dr. Dipramit Manjumdar

Assistant Professor, Mathematics

044-2257 4644; dipramit@iitm.ac.in

Major Areas of Research

- p-adic families of modular forms and automorphic forms
- Selmer group and Iwasawa theory for modular forms

Other Areas of Interest

- Application of elliptic curves in cryptology
- Analytic number theory, specifically application of Galois representation in analytic number theory

Dr. A V Jayanthan

PhD, IIT Bombay, India

Professor, Mathematics

044-2257-4625; jayanav@iitm.ac.in

http://mat.iitm.ac.in/home/jayan/public_html/index.html

- Hilbert coefficients and homological properties of Blowup algebras
- Betti numbers of affine and projective monomial curves
- Buchsbaum-Rim function, polynomial and their coefficients

Blow-up algebras arise from the process of blowing up of an algebraic variety. This is an important process in the resolution of sigularities. I study homological properties, such as Cohen-Macaulayness, Gorensteinness using a certain numerical function known as Hilbert function and its coefficients.

Buchsbaum-Rim function is a generalization of Hilbert function. Though the Hilbert function and its coefficients are very well studied, the Buchsbaum-Rim function and its coefficients are not very well studied. I study these coefficients and its relation with homological properties of a given module.

Betti number of a module indicates its computational complexity. It is an important invariant in many applied areas. I study certain classes of affine and projective curves and their Betti numbers.

Dr. Kalpana Mahalingam

Professor, Mathematics

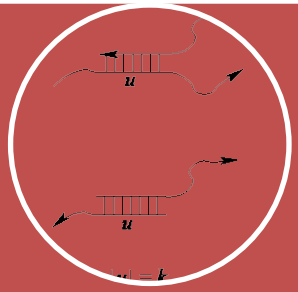
044-2257-4630; kmahalingam@iitm.ac.in

http://mat.iitm.ac.in/home/kalpana/public_html/

Major Areas of Research

- Theory of Codes
- Theory of Biomolecular Computing
- Combinatorics of words

Study of codes relative to a set of meaningful messages



Study of structures and operations on biomolecules using formal language theory

Study of words using matrices

Dr. Kunal Krishna Mukhopadhyay

Professor, Mathematics

044-2257-4640; kunal@iitm.ac.in

Major Areas of Research

- C* and von Neumann Algebras
- Ergodic Theory, Free Probability
- Quantum Groups, Quantum Information
- Recently interested in Radom Matrices

Source: Faculty website

Dr. Narayanan N

PhD, The Institute of Mathematical Sciences

Associate Professor, Mathematics

044-2257-4605; naru@iitm.ac.in

https://math.iitm.ac.in/naru

Major Areas of Research

- **Structural Graph Theory**
- **Combinatorial Algebra**
- **Combinatorics**

Source: Faculty website

Dr. Neelesh S Upadhye

PhD, IIT Bombay

Professor, Mathematics

044-2257-4625; neelesh@iitm.ac.in

http://mat.iitm.ac.in/neelesh

Major Areas of Research

- **Probabilistic Approximations, Estimation Methods**
- **Financial Time Series Modelling**
- **Data Science: R programming, Statistical Learning**
- **Subordinated Stochastic Processes, Modelling and Simulation**

Source: Faculty website

Dr. S Ponnusamy

PhD, IIT Kanpur, India

Professor, Mathematics

044-2257 4615; samy@iitm.ac.in

https://sites.google.com/site/samy8560/

- Complex Analysis
- Quasiconformal and Harmonic Mappings
- Special Functions and Function Spaces

Main themes which I deal with include:

Bohr Phenomenon on various function spaces, Integral transforms acting on function spaces, Quasiconformal and elliptic mappings, Univalent harmonic mappings in plane and in higher dimensions, Landau and Bloch type Theorems for p-harmonic mappings in several complex variables, Inequalities concerning special functions and John disks, Characterization of domains in terms of metric inequalities.

Dr. Priyanka Shukla

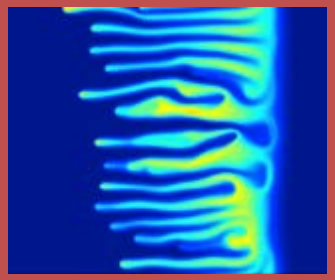
PhD, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore

Associate Professor, Mathematics

044 2257 4609; priyanka@iitm.ac.in

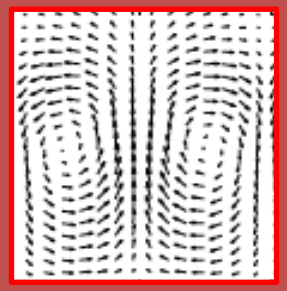
https://home.iitm.ac.in/priyanka/

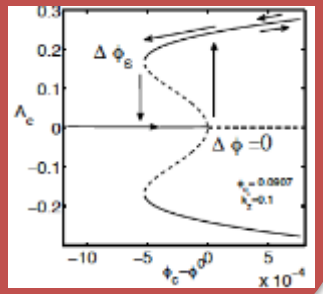
- Granular flows
- Hydrodynamic stability
- Mode interactions in fluid flows
- Kinetic theory

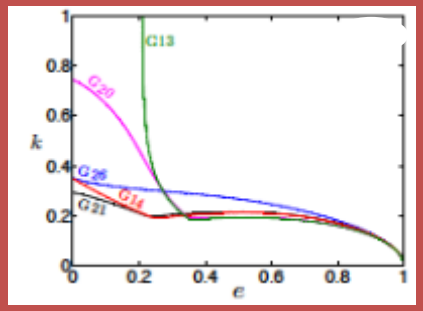


Chemically driven fingering instability: theory and simulations

Granular convection, shearbanding, etc. Landau equation, mode interactions and resonance







Higher order moment theories for rarified and granular gases

Dr. R Radha

PhD, Institute of Mathematical Sciences, Chennai

Professor, Mathematics

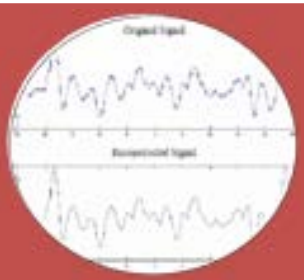
044-2257-4620; radharam@iitm.ac.in

https://math.iitm.ac.in/naru

Major Areas of Research

- Harmonic Analysis on Euclidean spaces, LCA groups, Compact groups and Heisenberg group
- Frame theory, Wavelet Analysis and Invertibility of Operations
- Theory of Multipliers, Segal algebras and Bergman-Fock spaces

Hardy's inequalities for Hermite, special Hermite and Laguerre expansions



Sampling and reconstruction in shift invariant spaces

Wavelet applications to signal and image processing

Applying wavelets to Voice system and Identication of Micro calcification clusters

Dr. Rakhi Singh

PhD, IITB-Monash Research Academy, India

Assistant Professor, Dept. of Mathematics, IIT Madras

044-2257-4610; rakhi@smail.iitm.ac.in

Screening experiments:

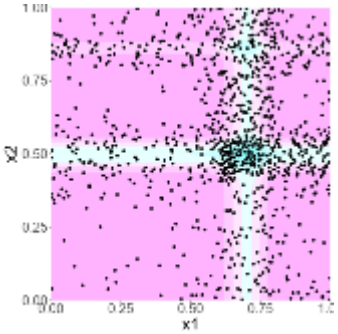
- ✓ Construction of two-level designs capable of estimating variance.
- ✓ Design of two-, multi- and mixed-level Pareto-efficient supersaturated designs.
- ✓ Development of analysis methods that can incorporate interactions.
- ✓ Applications in materials science, mechanical, chemical and biomedical experiments.

Discrete choice experiments:

- ✓ Construction of optimal designs addressing respondent fatigue and cognitive burden.
- ✓ Solutions for design balance, level overlap, and parameter identifiability.
- ✓ Development of a comprehensive framework for analysis, including heterogeneity.
- ✓ Applications in business and marketing for assessing consumer preferences, transportation, and healthcare policies.

Subdata selection methods:

- ✓ Enabling analysis with small, information-rich datasets using techniques like random forests and neural networks for high-dimensional datasets.
- ✓ Proposing model-free sampling strategies for efficient learning.
- ✓ Applications in fields using statistical modeling and predictive analytics.



Dr. Rama R

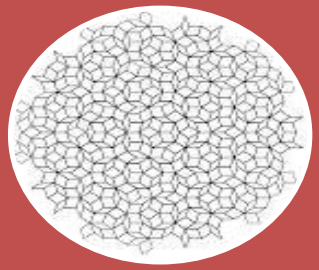
Professor, Mathematics

044-2257-4616; ramar@iitm.ac.in

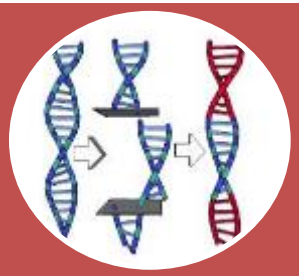
http://mat.iitm.ac.in/home/ramar/public_html/index.html

Major Areas of Research

- Formal Languages and Automata Theory
- Molecular Computing
- Image Cryptography



Using abstract computing models for digital picture generation



Abstracting splicing operation for the generation structured strings

Image Cryptosystem using Cellular automata.(For pixel randomness)

Image Cryptosystem using Wavelet transformations and CRT.(For image compression)

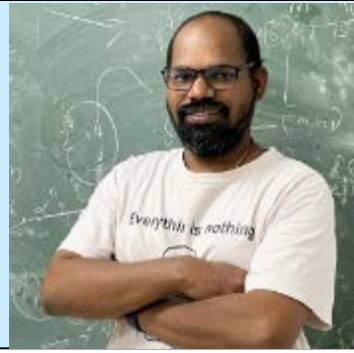
Dr. Ramesh Kasilingam

PhD, IIT Madras, India

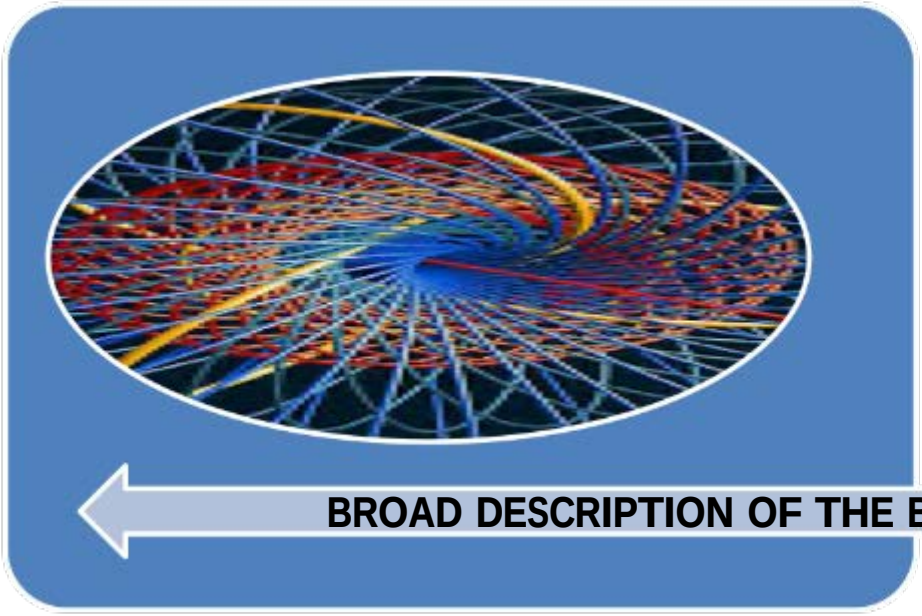
Assistant Professor, Mathematics

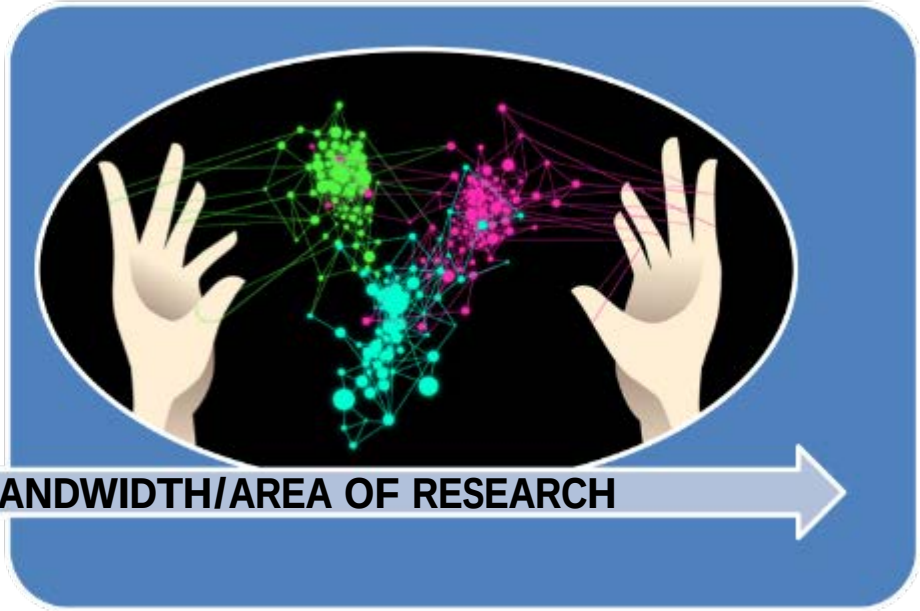
044-2257-4647; rameshk@iitm.ac.in

https://math.iitm.ac.in/rameshk



- Differential topology and Algebraic topology
- Surgery classification of manifolds
- Topological Data Analysis





BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

Dr. Santanu Sarkar

PhD, Indian Statistical Institute

Professor, Mathematics

santanu@iitm.ac.in

https://sites.google.com/site/santanusarkarwb/

- Cryptology
- Computational Number Theory
- Coding Theory

Dr. A. J. Shaiju

PhD, Indian Institute of Science India

Professor; Mathematics

044-2257-4638; ajshaiju@iitm.ac.in

- Game Theory
- Control Theory
- Optimization

My research

Currently I focus on evolutionary game theory, which provides explanation of many social and population behaviour as a result of different adaptive and learning mechanisms. This has a lot of applications in evolutionary biology, economics, computer science, and international relations.

Back to Faculty list

Dr. Y V S S Sanyasiraju

PHD, IIT Madras, India

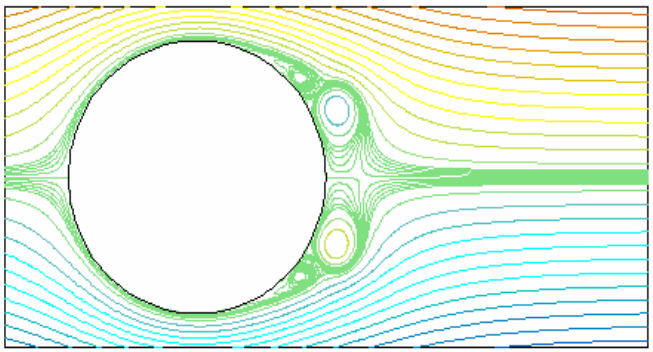
Professor, Mathematics

044-2257-4621; sryedida@iitm.ac.in

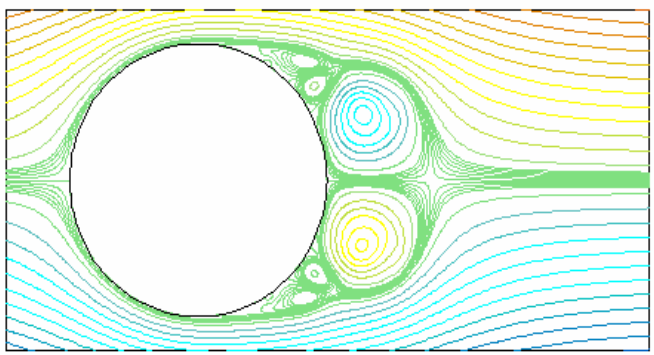
http://www.iitm.ac.in/home/sryedida/public_html/index.html

- Development of RBF based grid free schemes
- Higher order compact schemes
- Finite difference and finite volume schemes for incompressible flows

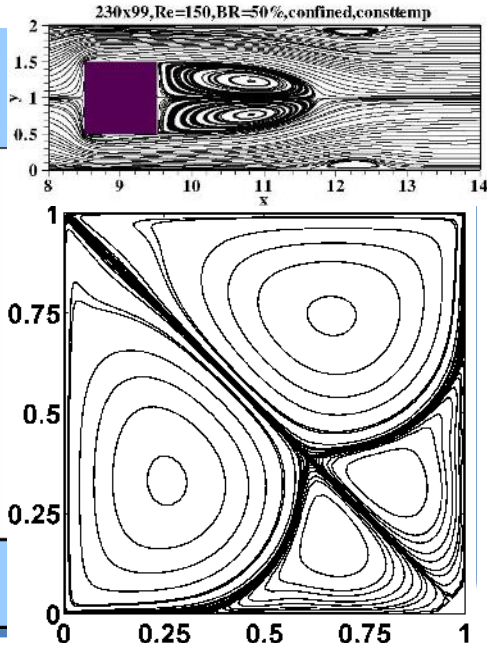
Capturing β and α phenomena for unsteady, viscous, incompressible flow past a circular cylinder using Higher Order Semi Compact scheme at Reynolds number Re = 5000



β phenomenon at t = 1.5



α phenomenon at t = 2.5



Dr. Sarang S Sane

Assistant Professor, Mathematics

044-2257-4604; sarang@iitm.ac.in

https://home.iitm.ac.in/sarang/

Broad Research Interests

- My current research interests are broadly centred around commutative algebra, K-theory, geometry and topology. But I like to study anything that I find beautiful.

Some more details

One of the themes I work on is doing obstruction theory in algebra with intuition from topology.

The main question I study in this regard is to analyze the structure of various obstruction theories (e.g. Euler class groups, Chow groups, Chow-Witt groups, etc.) with the aim of studying the splitting properties of projective modules/vector bundles.

Another theme which I am currently pursuing is the study of triangulated categories. More specifically, studying special derived subcategories of the derived category of modules/sheaves for a ring/scheme.

Invariants associated to these, such as K-theory or Witt theory are also of considerable interest to me and are part of both mentioned themes.

Dr. Sathish Kumar A

PhD, IIT Roorkee, India

Assistant Professor; Mathematics

044-2257-4636; sathishkumar@iitm.ac.in

- Approximation Theory
- Approximation of Real and Complex Functions
- Sampling Operators

The theory of approximation of functions is an integral part of mathematical analysis which provides a constructive approach to approximate complicated functions with the help of simpler functions such as polynomials, linear and nonlinear operators. In recent years, we try to approximate functions belonging to certain function spaces by linear and nonlinear sampling operators. Since the sampling operators have a lot of applications in signal and image processing, so it is very important to analyse these operators in various settings.

Dr. Satyajit Roy

PhD, IISc. Bangalore, India

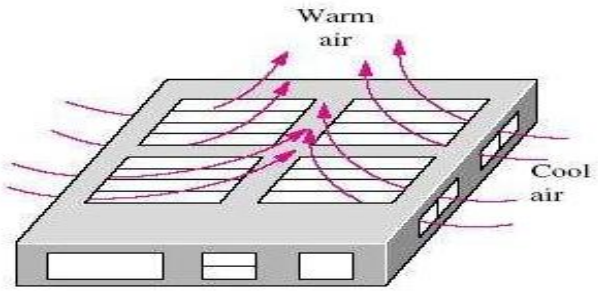
Professor, Mathematics

044-2257-4617; sjroy@iitm.ac.in

http://www.iitm.ac.in/sjroy.html

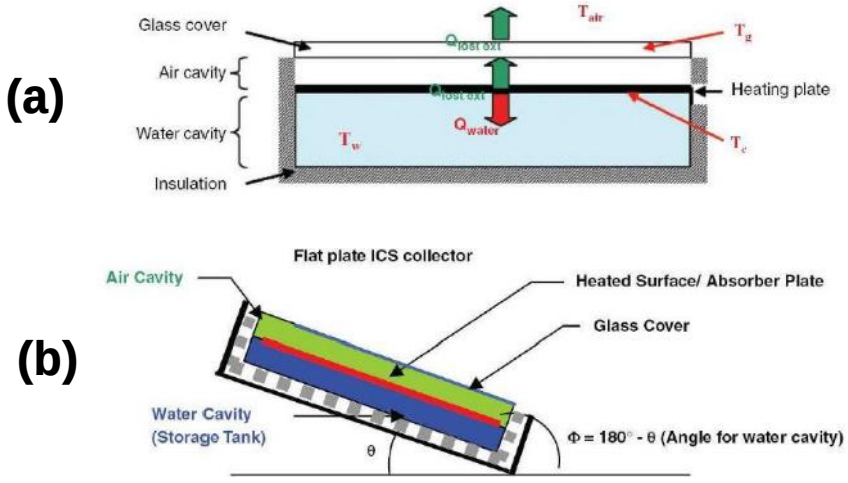
- Boundary Layer Theory
- Convective Heat and Mass Transfer
- Computational Fluid Dynamics

Cooling of Electronic Devices



Natural convection phenomena within enclosures for cooling of electronic components

Integrated Collector Storage Solar Water Heater



Natural convection phenomena within solar water heater

Dr. Shruti Dubey

PhD, Indian Institute of Technology Kanpur

Associate Professor, Mathematics

044-2257-4639; sdubey@iitm.ac.in

http://www.mat.iitm.ac.in/home/sdubey/public.html/index.html

Major Areas of Research

- **Nonlinear Analysis of Fractional Functional Differential Equations**
- **Mathematical Study of Ferromagnetic Systems**

Source: Faculty website

Dr. Sivakumar K C

Professor, Mathematics

044-2257-4622; kcskumar@iitm.ac.in

Major Areas of Research

Functional Analysis and Mathematical Programming

Source: Faculty website

Dr. Soumen Sarkar

PhD, Indian Statistical Institute Kolkata

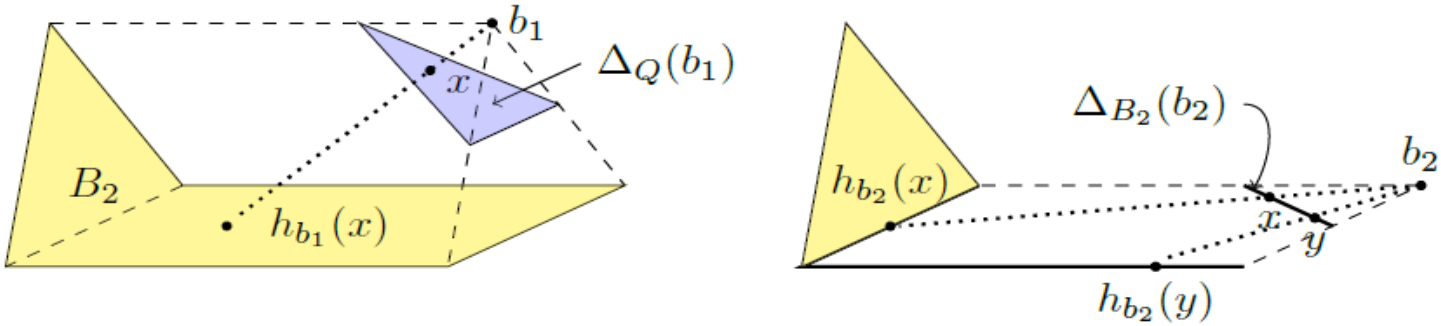
Associate Professor, Mathematics

044-2257-4643; soumen@iitm.ac.in

https://home.iitm.ac.in/soumen/

RESEARCH INTERESTS

1. **Topology:** Algebraic Topology, Differential Topology, Toric Topology
2. **Geometry:** Toric Geometry, Convex Geometry, Differential Geometry
3. **Analysis:** Analysis on Manifolds, Functional Analysis
4. **Computing Research:** Topological Complexity of Motion Planning Algorithms, Topological Data Analysis, Persistent Homology
5. **Algebra:** Homological Algebra, Equivariant Cobordism and K-theory



The geometric interpretation of a retraction sequence

Dr. Sounaka Mishra

PhD, Indian Statistical Institute Kolkata

Associate Professor, Mathematics

044-2257-4627; sounak@iitm.ac.in

- Combinatorial Optimization
- Design of Approximation Algorithms for Hard Optimization Problems
- Graph Theory

Complexity of Minimum Dominating Set and its variations

Approximation algorithms for node/edge deletion problems

Dr. Srinivasa Rao Manam

Professor, Mathematics

044-2257-4637; manam@iitm.ac.in

http://www.iitm.ac.in/info/fac/manam

Major Areas of Research

- **Integral Equation Methods in water wave Scattering**
- **Wave-Bottom and Wave-Structure Interactions**

Source: Faculty website

Dr. B Sriram

PhD, University of Florida, USA

Assistant Professor, Mathematics

044-2257-4641; bsriram@iitm.ac.in

https://math.iitm.ac.in/bsriram

- Functional Analysis
- Operator Theory

Positive maps

Non-Commutative Sets / Functions

Interpolation

Dr. Subhajit Ghosh

PhD, Indian Institute of Science Bangalore, India

Assistant Professor, Mathematics

044-2257-4600; subhajit@iitm.ac.in

- Research interest: Probability Theory, Representation theory of finite groups, and Algebraic combinatorics.

Mixing time for finite Markov chains: **F**inite **M**arkov **C**hain (FMC) models are one of the central objects in many scientific disciplines. Given a FMC (satisfying a few simple ergodicity conditions), there is significant interest in determining, or at least bounding, the associated mixing time, which is a measure of the number of transitions required for the FMC to approach statistical equilibrium or stationarity. My research focuses on models that are primarily theoretical, prototypes of more complicated models arising in theoretical computer science, statistical physics, and biology, where they are used to address many important real-life problems.

Noise sensitivity of Boolean functions: 'A small change in the input how much affects the output' is one of the prime interests of modern-day scientists. This phenomenon is mathematically modelled and studied in the **N**oise **S**ensitivity (NS) literature. The NS has been extensively studied in probability, combinatorics, mathematical physics, theoretical computer science, and social choice theory. Formally, the NS of a function defined on the state space of a Markov chain means that the function de-correlates faster than the relaxation time of the entire system. I am interested in Boolean functions where the noise source is a continuous-time Markov Chain.

Dr. Suhas Jaykumar Pandit

Assistant Professor, Mathematics

044-2257-4608; suhas@iitm.ac.in

Major Areas of Research

- **Geometry and Topology**

Source: Faculty website

Dr. Sumesh K

PhD, Indian Statistical Institute, India

Assistant Professor, Dept. of Mathematics

044-2257-4642; sumeshkpl@iitm.ac.in

https://math.iitm.ac.in/innerfaculty.php?fname=Sumesh%20K

- **Operator Algebra/Theory**
- **Quantum Information Theory**
- **Quantum Probability**

My research lies broadly in Functional Analysis, with particular emphasis on Operator Algebras, Quantum Probability, and Quantum Information Theory. I focus on the theory of completely positive maps and their wide-ranging applications in both operator algebras and quantum information theory.

Currently, I am particularly interested in Gaussian quantum channels and entanglement-breaking channels, which play a central role in understanding quantum communication and the impact of noise on quantum systems. Previously, my work has explored the theory and structure of completely positive and completely bounded maps, their semigroups and dilations, as well as the representations of C*-algebras and Hilbert C*-modules.

Dr. Sundar S

PhD., IIT Madras, India

Professor, Mathematics

044-2257-4618; slnt@iitm.ac.in

https://math.iitm.ac.in/public_html/slnt/index.htm

Major Areas of Research

- **Numerics for PDEs**
- **Mathematical Modeling and Numerical Simulation**

Source: Faculty website

Dr. Surjit Kumar

PhD, IIT Kanpur, India

Assistant Professor, Mathematics

044 - 2257 - 4612; surjit@iitm.ac.in

- Operator theory on the reproducing kernel Hilbert space of holomorphic functions defined on irreducible bounded symmetric domains
- Commuting tuple of operators homogeneous under compact group

Ω : Irreducible bounded symmetric domain

K : Maximal compact subgroup of bi-holomorphic automorphism group $\mathrm{Aut}(\Omega)$

The group K acts naturally on a commuting d-tuple $\mathbf{T} = (T_1, \ldots, T_d)$ of bounded linear operators defined on a complex separable Hilbert space. If the orbit of this action modulo unitary equivalence is a singleton, then we say that **T** is K-homogeneous.

$\forall\, k \in K$, $\exists$ unitary $\Gamma(k)$ such that

$T_j \Gamma(k) = \Gamma(k)\, k_j\, (T_1, \ldots, T_d)$, $j = 1, 2, \ldots, d$.

- $F: \Omega \times \Omega \to M_n(\mathbb{C})$ sesqui-analytic Hermitian function
- $c : K \times \Omega \to GL_n(\mathbb{C})$ holomorphic in second variable
- F is said to be quasi-invariant under K if

$$F(z,w) = c(k,z)F(k\cdot z, k\cdot w)c(k,w)^*, \quad k \in K \ \&\ z,w \in \Omega .$$

Dr. Uma V

Professor, Mathematics

044-2257-4626; vuma@iitm.ac.in

https://math.iitm.ac.in/public_html/uma/index.html

Major Areas of Research

- **Geometry and Topology**

Source: Faculty website

Dr. Venkata Balaji T E

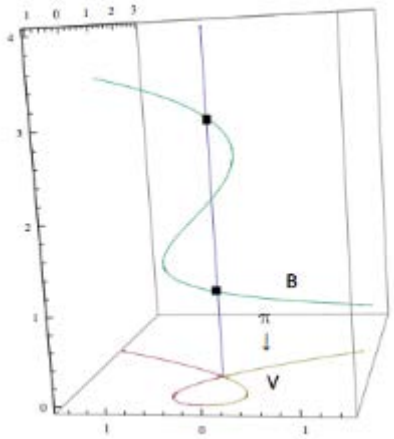
PhD, CMI, Siruseri, Chennai, India

Assistant Professor, Mathematics

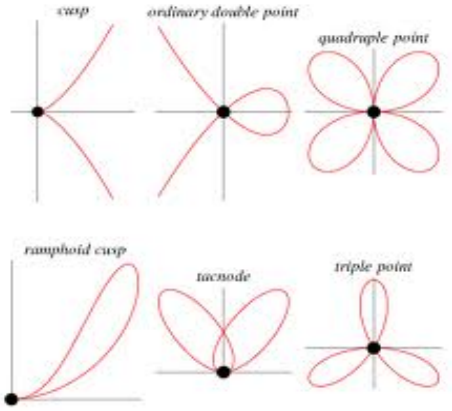
044-2257-4628; tevbal@iitm.ac.in

http://www.iitm.ac.in/component/faculty/77/tevbal/

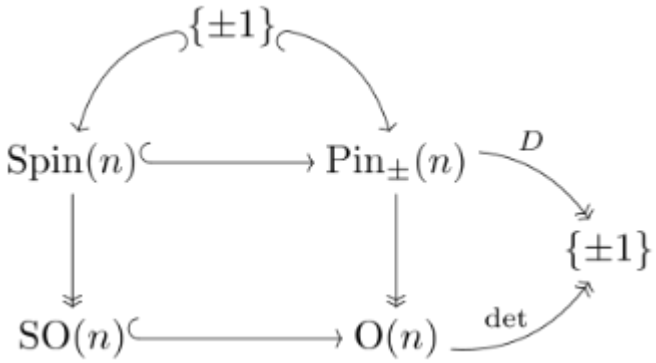
- Algebraic Geometry and Commutative Algebra
- Moduli and Classification of Vector Bundles, Quadratic Modules, Clifford Algebras
- Arbitrary Base Scheme Constructions and Specialisation Problems
- Orthogonal and Spin Groups



Desingularisations



Singularities



Clifford Algebras

For Moduli / Parameter Spaces of Degenerate Forms and Algebras

Dr. V Vetrivel

PHD, IIT Madras

Professor, Mathematics

044-2257-4619; vetri@iitm.ac.in

- Non-linear Analysis – Solving inclusions involving set valued functions without convexity
- Non-smooth Analysis – Specifically, the sufficiency of optimality criteria for non-smooth optimization problems is focused to study how far the convexity can be relaxed. This helps extend the existing algorithms to solve non-smooth optimization problems.
- Variational Inequalities - Algorithmic approach to solve variatinal inequality problems and their variants has been developed which paves the way for looking at interesting applications.
- We study robustness concepts for set-valued optimization problems using set approach. This helps deal with uncertainty in data.

INDIVIDUAL FACULTY PROFILE

DEPARTMENT OF MECHANICAL ENGINEERING

Abhijit Sarkar
Advaith S
Amitava Ghosh
Anand K
Anil Kumar Meena
Anirudh Udupa
Anuj Kumar Tiwari
Arunachalam N
Arunn Narasimhan
Arvind Pattamatta
Ashis Kumar Sen
Babu V
Balaji C
Balaji Srinivasan
Chandramouli P
Charchit Kumar
Dhiman Chatterjee
Gnanamoorthy R
Hariharan K
Kameswararao Anupindi
Krishna Kannan
Krishnan Balasubramaniam
Krithika Narayanaswamy
Kumar Annabattula V V S D R
Mallikarjuna J M
Manish Anand
Manivannan P V
Manoj Pandey
Manoj Myneni
Mayank Mittal
Narsimhan Swaminathan
Pallab Sinha Mahapatra
Parag Ravindran
Piyush Shakya
Prabhu Rajagopal
Raghavan V
Raghu Prakash
Raju Sethuraman
Ramkumar P
Raushan Singh
Regulagadda Karthik
Samuel G L
Samya Sen
Sarit Kumar Das
Sateesh Gedupudi
Sathyan Subbiah
Seshadri Sekhar
Shaligram Tiwari
Shamit Bakshi
Shankar Krishnapillai
Shyama Prasad Das
Sivasrinivasu Devadula
Somashekhar S. Hiremath
Sourav Rakshit
Sree Hari Perumanath Dharmapalan
Srinivas Reddy K
Srinivasan K
Srikrishna Sahu
Sujatha Srinivasan
Sundararajan Natarajan
Sushanta Kumar Panigrahi
Varunkumar S
Venkataratnam G
Vimal Edachery
Vishal V R Nandigana
Viswanath K

Dr. Abhijit Sarkar

PhD, IISc Bangalore, India

Professor, Mechanical Engineering

044-2257-4723; asarkar@iitm.ac.in

http://www.iitm.ac.in/component/faculty/78/asarkar/

- Acoustics
- Vibration
- Wave Propagation

Dispersion characteristics of structural acoustic waveguides

Application areas: Noise Control in Ducts and Mufflers

Vibration of Shells

Application areas: Dynamics of sheet metal components

Applications of Mathematics to Problems in Mechanics

- Asymptotic Methods
- Computational methods
- Continuum Mechanics
- Fluid-Structure Interaction
- Signal Processing algorithims for condition monitoring, music, etc.

Dr. Advaith Sankar

PhD, IISc Bangalore, India

Assistant Professor, Mechanical Engineering

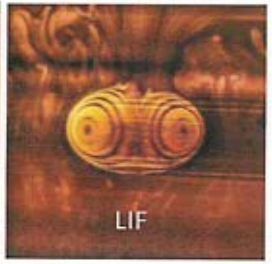
044-2257-4670; advaith@iitm.ac.in

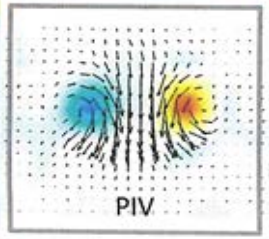
https://mech.iitm.ac.in/profile.php?fname=advaith

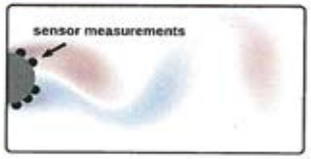
- Thermal management of Lithium ion batteries, EV charging stations, Fuel cells
- Design and development of renewable energy storage systems & their applications
- Advanced fluid – thermal flow diagnostics
- R and AC : Cold storage systems and solar desalination
- Machine learning approach towards and energy engineering and fluid flow

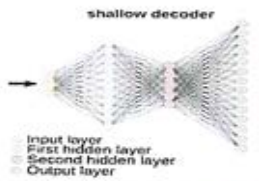
For more info.

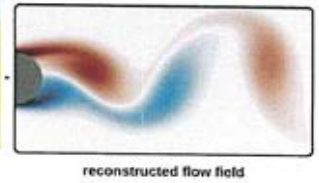
Development of renewable energy storage systems → CFD/ Numerical simulations → Fluid – thermal flow diagnostics → EV Thermal management → R & Ac : Cold storage system and solar desalination → Data driven (ML/DL) approach towards Energy & fluid flow











Dr. Amitava Ghosh

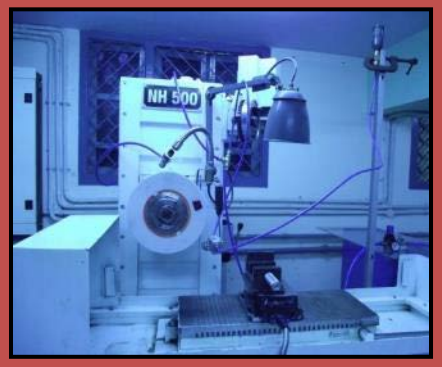
PhD, IIT Kharagpur, India

Professor, Mechanical Engineering

044-2257-4724; amitava_g@iitm.ac.in

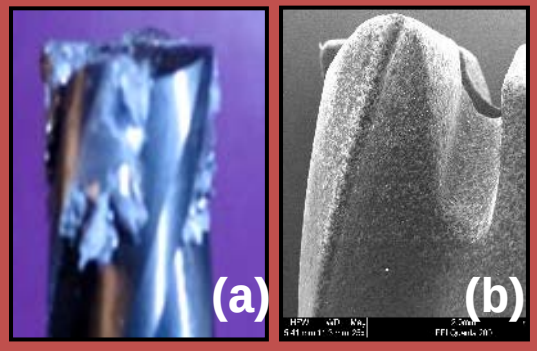
Current research activities:

- High speed machining / ***Focus: nano-MQL and Cryogenic application***
- Cutting tools with soft and hard tribo-coating / ***Focus: machining of Al-alloys***
- Development of single layer (SL) abrasive tool / ***Focus: SL diamond dressing tool***



MQL

(minimum quantity lubrication)



End mill (after Al-machining)

(a) uncoated (b) graphite-x coated

Brazed cBN

(from a single layer abrasive tool)

High speed machining, grinding-Development of cutting tools-Sustainable solutions

Dr. K Anand

PhD, IIT Madras, India

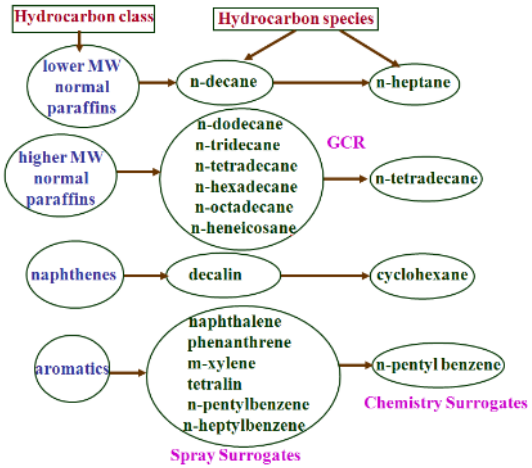
Professor, Mechanical Engineering

044-2257-4720; anand_k@iitm.ac.in

Major Areas of Research

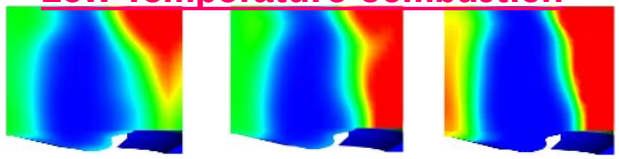
- Experimental and Numerical Investigations on Low Temperature Combustion
- Automotive Fuel Surrogate Modelling
- Developing High Efficiency, Clean Combustion Engines through Fuel Modifications

Diesel Fuel Surrogate Model Representation

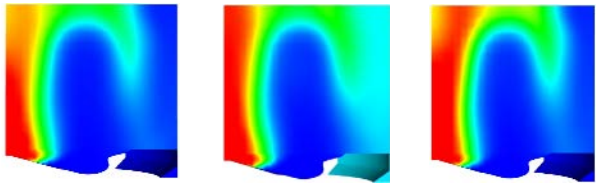


Fuel and Combustion Mode Effects

Low Temperature Combustion



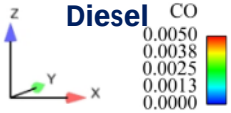
Conventional Combustion



High-CN Diesel

Mid-CN Diesel

Low-CN Diesel



In-cylinder CO at EVO Period

Dr. Anil Kumar Meena

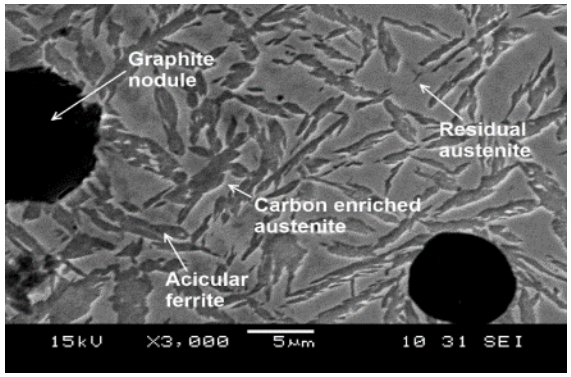
PhD, Arts et Métiers ParisTech, Paris, France

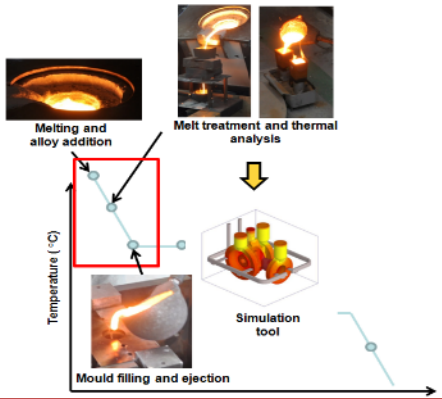
Associate Professor, Mechanical Engineering

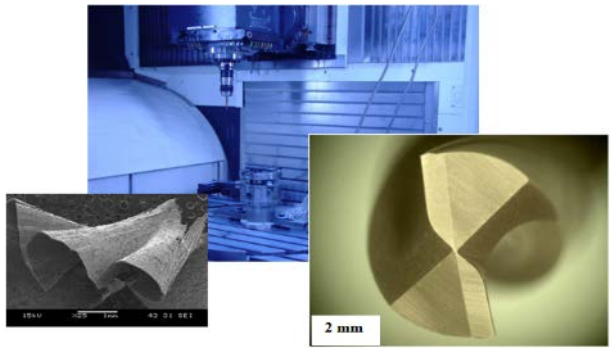
044-2257-4726; anilm@iitm.ac.in

Research interests:

- Casting, Heat Treatment, Microstructure and properties of ADI
- Dry and near dry machining
- High speed machining
- Sustainable manufacturing
- Light-weight alloys for automotive applications







Microstructure & Material properties **Process route optimization** **Dry and MQL machining**

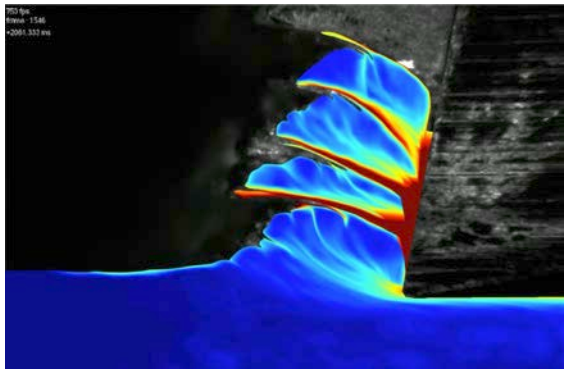
Dr. Anirudh Udupa

PhD, Purdue University, USA

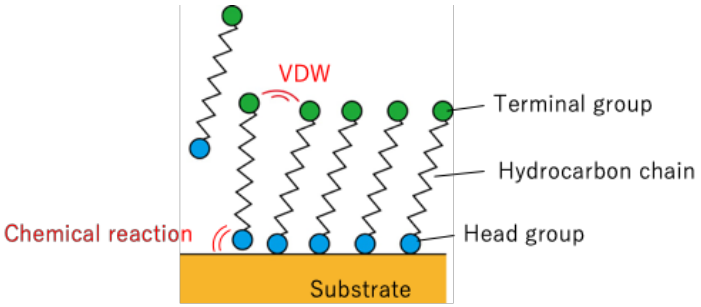
Assistant Professor, Mechanical Engineering

044-2257-4653; audupa@iitm.ac.in

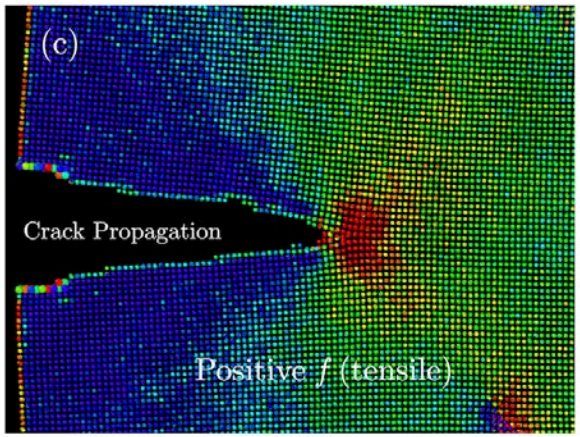
- Experimental and theoretical mechanics
- Semiconductor reliability (mechanical)
- Mechanics of manufacturing processes



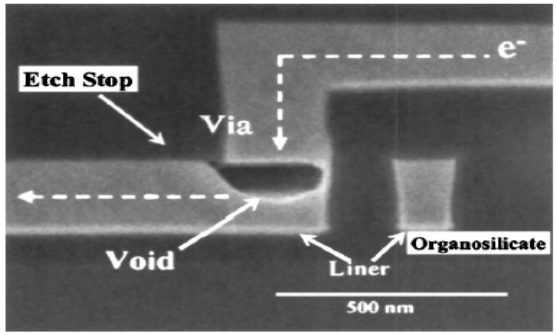
High-speed imaging of metal cutting



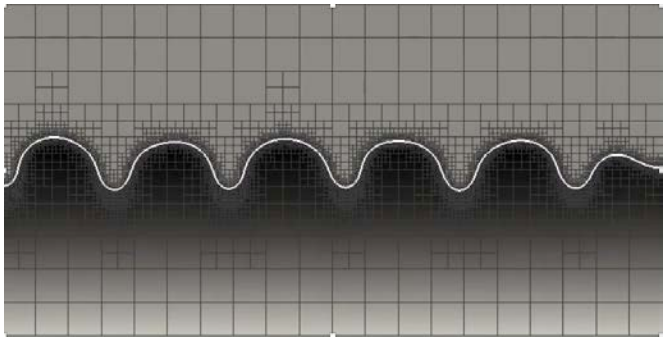
Self-assembled monolayers for surface engineering



Atomistic simulations of fracture



Experimental study of semiconductor reliability - Electromigration



Phase-field modeling of semiconductor reliability – intermetallic growth in solder joints

Dr. Anuj K. Tiwari

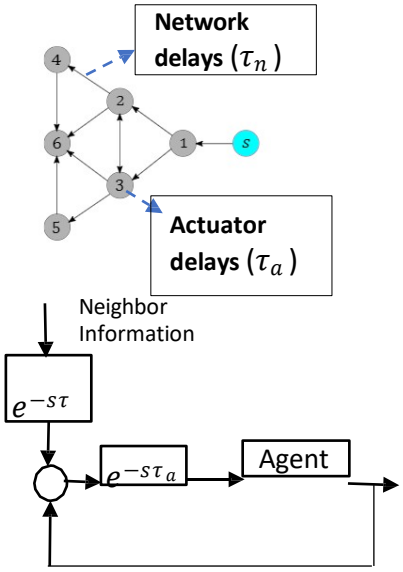
PhD, Univ. of Washington Seattle, USA

Asst. Professor, Mechanical Engineering

044-2257-4659; anujt@iitm.ac.in

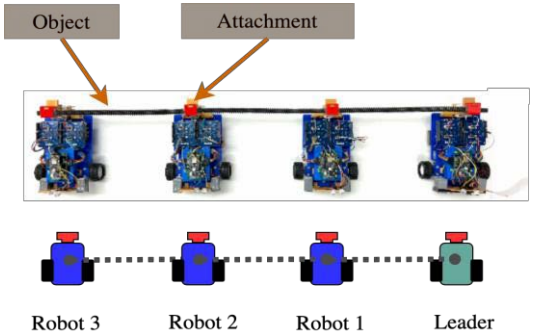
- Automation and controls in advanced manufacturing systems
- Multi-agent and swarm robotics
- Time delays in networked systems

Develop network control algorithms



+

Implementation and testing on ground and aerial robotic testbeds

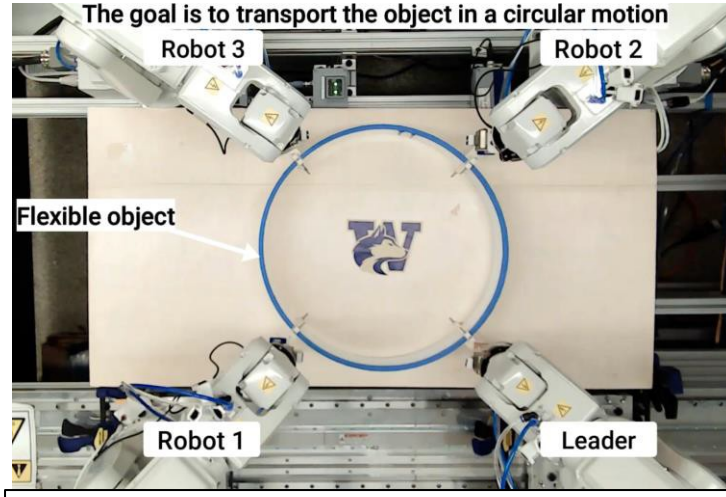


Object transport with mobile robots

Fly in a formation

=

Using the developed and tested algorithms for automation of manufacturing tasks



Experimental setup of one leader robot and three follower robots cooperatively transporting a flexible object using only local force sensing (work done at Boeing Advanced Research Center at UW).

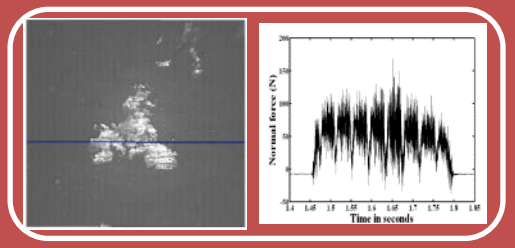
Dr. N Arunachalam

Professor, Mechanical Engineering

044-2257-4722; chalam@iitm.ac.in

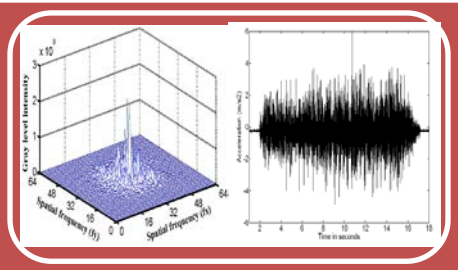
Major Areas of Research:

- Prognostics and health management of industrial systems
- Grinding Process modeling and control for advanced materials
- Machine vision and its applications



Multi sensor fusion for data and model based diagnosis and prognostics

Machine vision for process monitoring and control



Grinding Process modeling for MMC and CMC'S

Applying advanced sensors and models for condition based maintenance of mechanical systems

Dr. Arunn Narasimhan

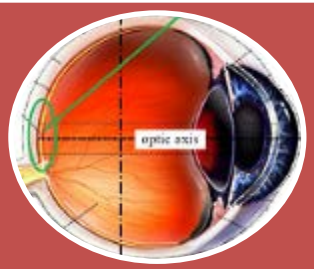
PhD, Southern Methodist University, USA

Professor, Mechanical Engineering

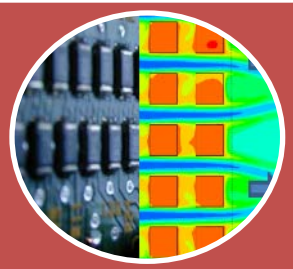
044-2257-4696; arunn@iitm.ac.in

http://www.iitm.ac.in/component/faculty/78/arunn/

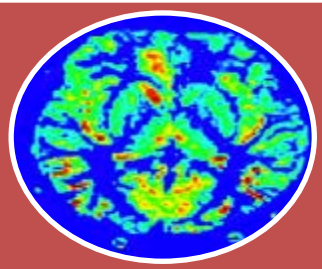
- Heat and Fluid Flow in Porous Media (sand, metal foam, electronics, bio-tissue)
- Heat and Fluid Flow in Biological Systems (Bio-heat and Bio-fluids)
- Phase Change and Convection Heat Transfer (passive cooling / thermal storage)



Retinal Laser Surgery / Retinal Drug Delivery (Bio-heat-flow Models)



Electronics Cooling as Bi-disperse Porous Media / Porous Medium Combustion / Heat Transfer Enhancement



Brain Stroke Cooling / Cryosurgery (Bio-heat-porous – medium Models)

Dr. Arvind Pattamatta

Professor, Mechanical Engineering

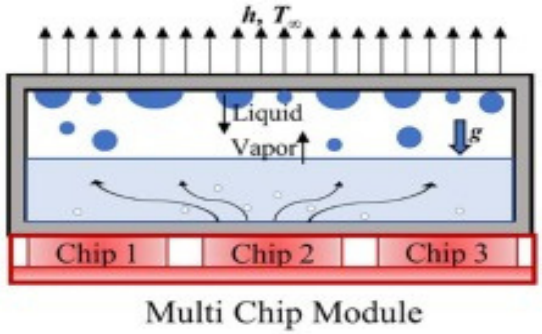
044-2257-4654; arvindp@iitm.ac.in

Research Website: https://www.mt2rl.in/

Research Activities at the Multiscale Thermal Transport Research Laboratory (MT2RL)

Two-Phase Electronic Cooling

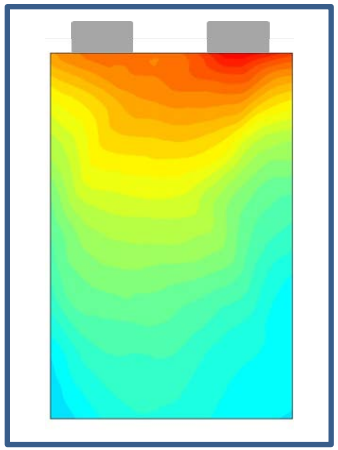
- Flat thermosyphon & Vapor chamber-based heat sink
- Flow Boiling in microchannels
- Spray Cooing
- Flat Plate Pulsating Heat Pipe



Multi Chip Module

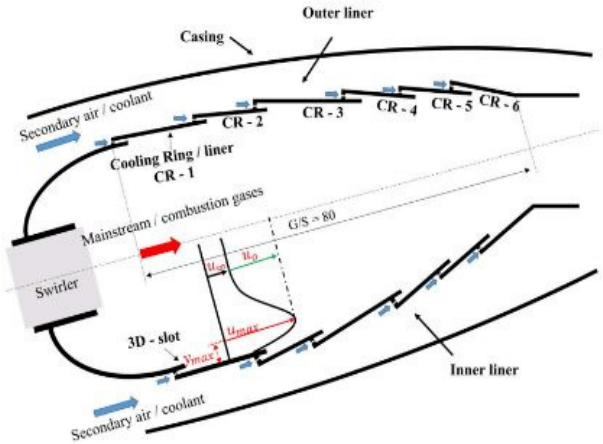
Battery Thermal Management

- Phase Change Material heat sink
- Pulsating Heat Pipe
- Liquid Cooling



Gas Turbine Cooling

- Film cooling of Combustor
- Turbine blade cooling



Numerical Modelling of Single phase and Phase change heat transport using advanced simulation techniques developed in OpenFOAM, ANSYS Fluent and COMSOL.

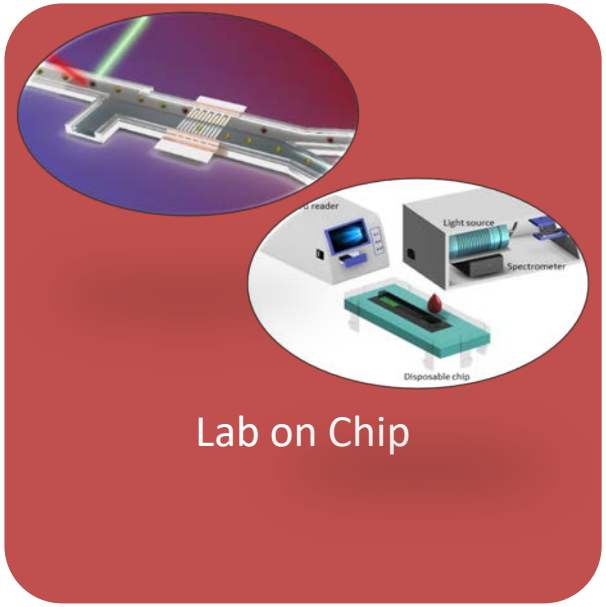
Dr. Ashis Kumar Sen

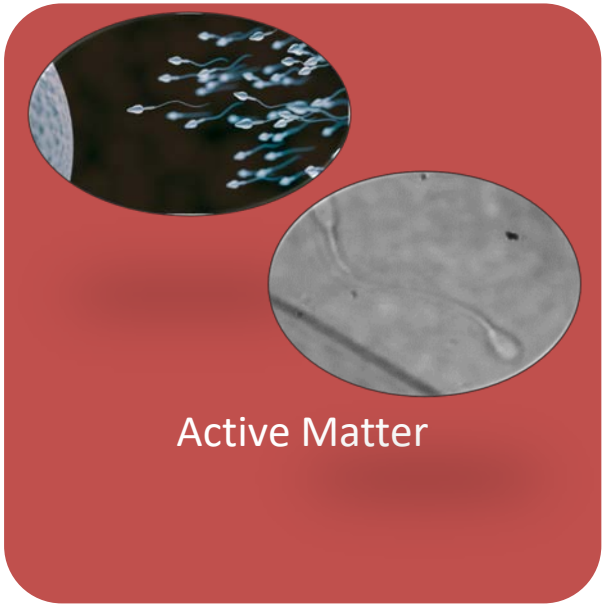
Professor, Dept. of Mechanical Engineering

044-2257-4716; ashis@iitm.ac.in

http://ashislab.in

- Soft Matter (Drops, Bubbles and Fluid interfaces)
- Lab on Chip (Biomedical diagnostics, Healthcare technology)
- Active Matter (Sperm cells and biological cells)





Micro Nano Bio Fluidics - Soft Matter to Bioengineering

Dr. V. Babu

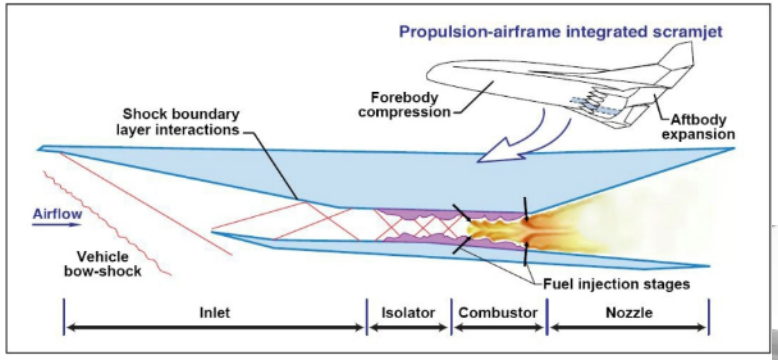
PhD, The Ohio State University, USA

Professor, Mechanical Engineering

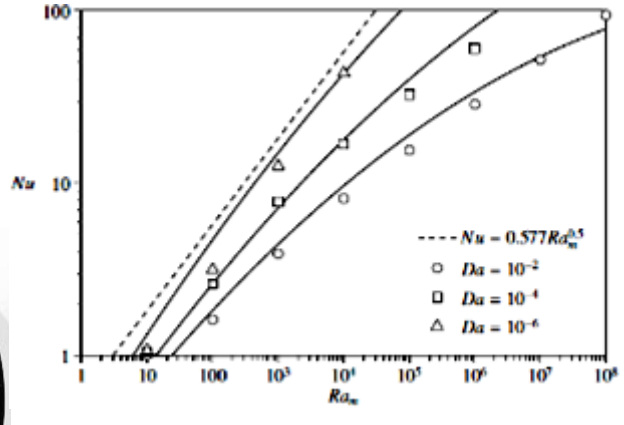
044-2257-4688; vbabu@iitm.ac.in

http://www.iitm.ac.in/

- High Speed Propulsion/Supersonic intakes; Supersonic combustion
- Computational Aero-acoustics/Prediction and mitigation
- Lattice Boltzmann method/Simulations of flow and heat transfer; HPC



Source: http://www.nasa.gov/



Dr. C Balaji

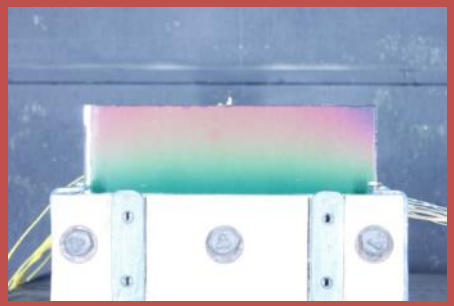
PhD, IIT Madras

Professor, Mechanical Engineering

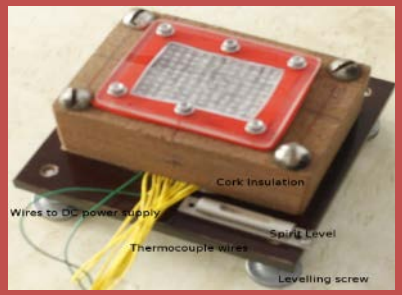
044-2257-4689; balaji@iitm.ac.in

http://mech.iitm.ac.in/Faculty/CB/home.php

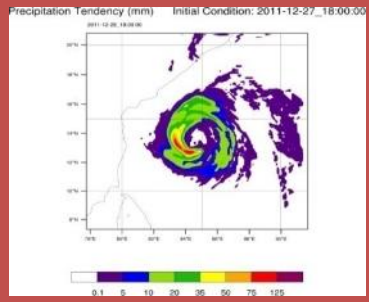
- Optimization in heat transfer
- Inverse heat transfer
- Satellite meteorology, numerical weather prediction and data assimilation



Temperature field with thermo chromic liquid crystals



Thermal optimization of phase change material based heat sinks



Prediction of 24hr accumulated rainfall for cyclone Thane

Heat transfer, optimization and atmospheric sciences

Dr. Chandramouli P

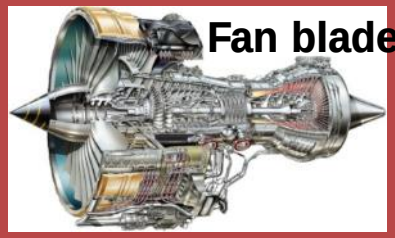
PhD, The Ohio State University, USA

Professor, Mechanical Engineering

+91 44 22574690; mouli@iitm.ac.in

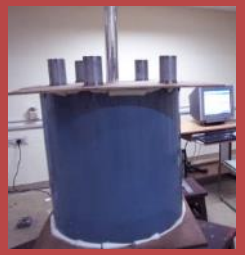
https://sites.google.com/site/iitmmouli/

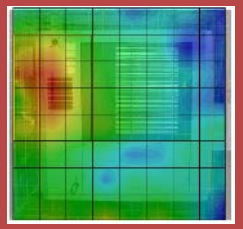
- Nonlinear Dynamics
- Noise and Vibration Control
- Fluid-Structure-Acoustic Interactions



Efficient computation of large order nonlinear dynamical systems

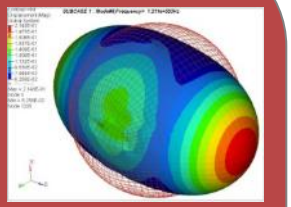
Windmilling in aero-engines





Hybrid techniques for noise control

Double porous linings & embedded resonators



Breathing waves in submerged fluid filled tubes

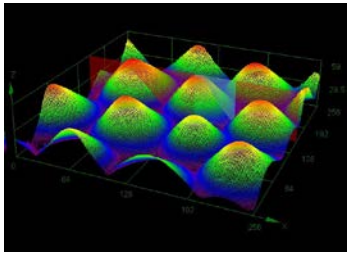
Flow acoustics of fluid filled shells

COMPUTATIONAL AND EXPERIMENTAL METHODS FOR NVH

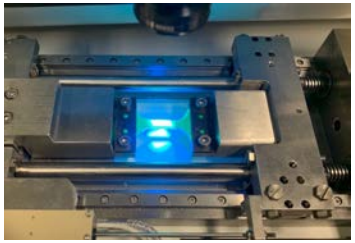
Dr. Charchit Kumar

Joint-PhD, University of Strasbourg France
& University of Freiburg Germany
Assistant Professor, Mechanical Engineering
044-2257-4686; charchit@iitm.ac.in

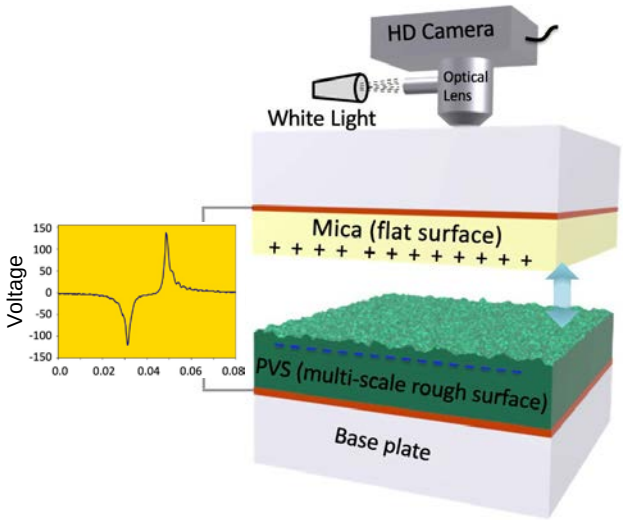
- Contact mechanics and tribology
- Micro-/nano-textured functional surfaces
- Sustainable energy harvesters and triboelectrification
- Novel in-situ experimental techniques in mechanics
- Additive manufacturing



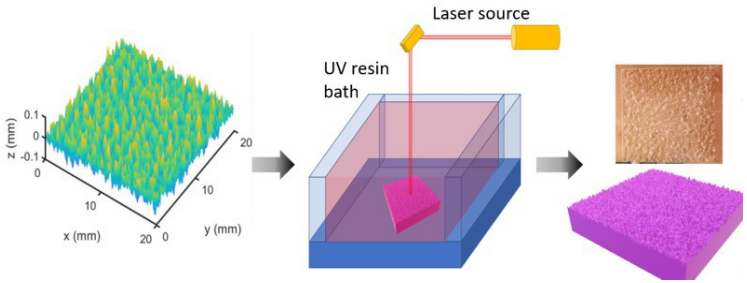
Bio-inspired micro-textured surface



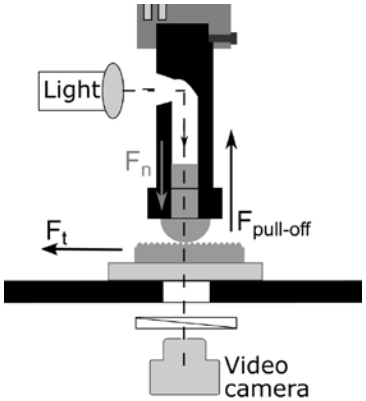
Micro-mechanical tester with DIC

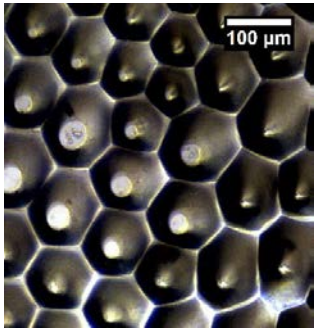


Tribo-electrification and sustainable energy harvesting



Multi-scale rough surface manufacturing via additive manufacturing





Adhesion and friction mechanics with in-situ real contact visualization

Dr. Dhiman Chatterjee

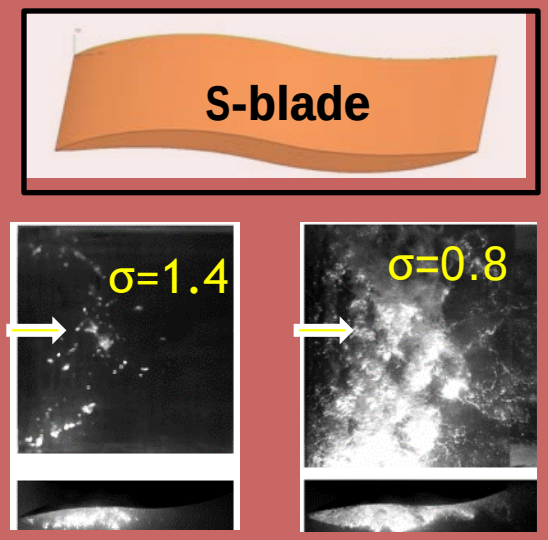
PhD., Indian Institute of Science, India

Professor, Mechanical Engineering

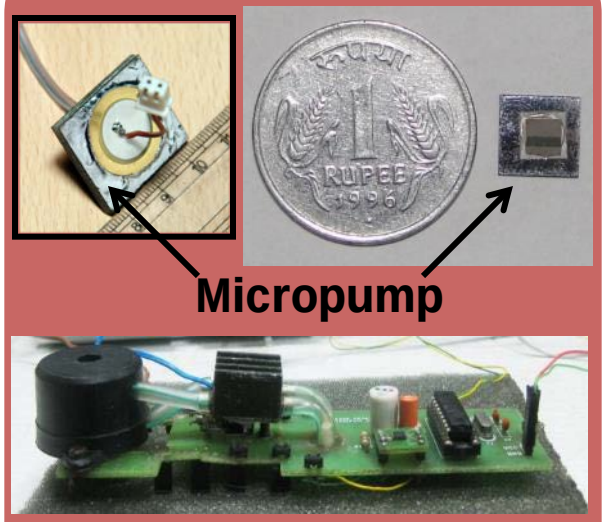
Ph: +91 44-2257 4697; Email: dhiman@iitm.ac.in

http://mech.iitm.ac.in/Faculty/dc/home.php

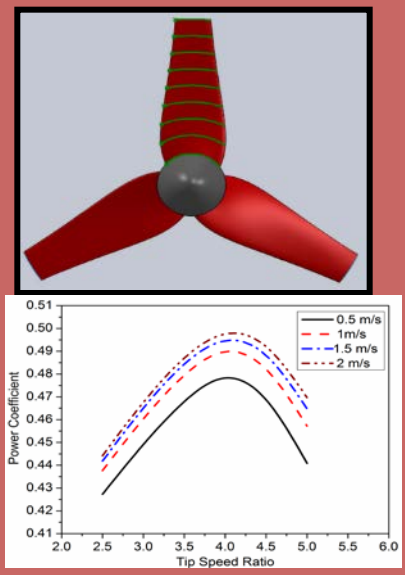
- Cavitation and two-phase flow
- Microscale flow and flow devices
- Turbomachinery



Development of cavitation over S-blade



Micro pumping system for electronic cooling



Hydrokinetic turbine

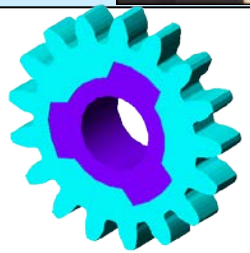
Dr. R Gnanamoorthy, Dr Eng (Japan)

Professor, Mechanical Engineering

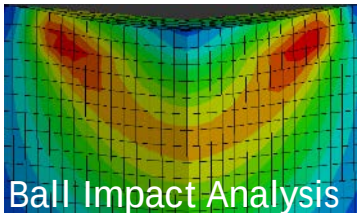
Ph: +91 44-27476302; gmoorthy@iitm.ac.in

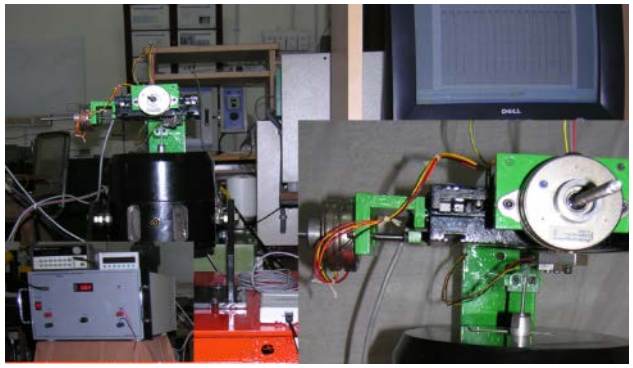
http://www.iiitdm.ac.in/faculty.php?pid=RGM

- **Focus**
- 'Engineering' Surfaces for Improved Performance
- Damage Tolerant Design and Tribo Design
- Advanced Materials & Product Design
- High Performance Test Machines and Product Development

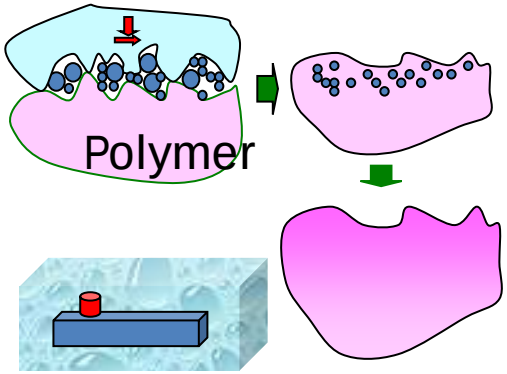


Duplex Gear





'Engineering' Surfaces for Nanostructure



Damage Mechanisms

Dr. K.Hariharan

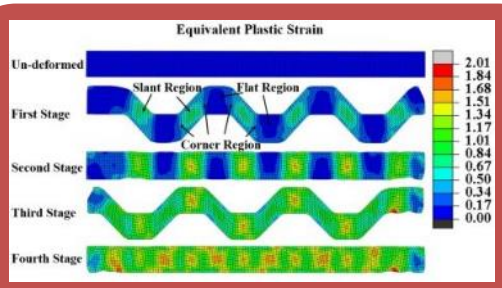
PhD, IIT Madras , India

Associate Professor, Mechanical Engineering

044-2257-4679; hariharan@iitm.ac.in

http://www.iitm.ac.in/hariharan

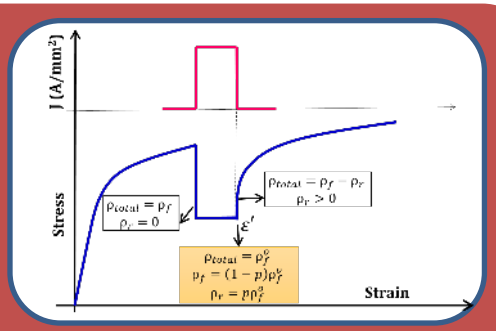
- Stress relaxation/ Servo press formability
- Electro plasticity
- Robo forming
- Severe plastic deformation



Simulation of Manufacturing Process

Formability improvement

Image © Ionut (2013) Applied Mechanics and Materials 271:416-421



Constitutive modelling of mechanical behaviour

Mechanics based manufacturing modelling

Dr. Kameswararao Anupindi

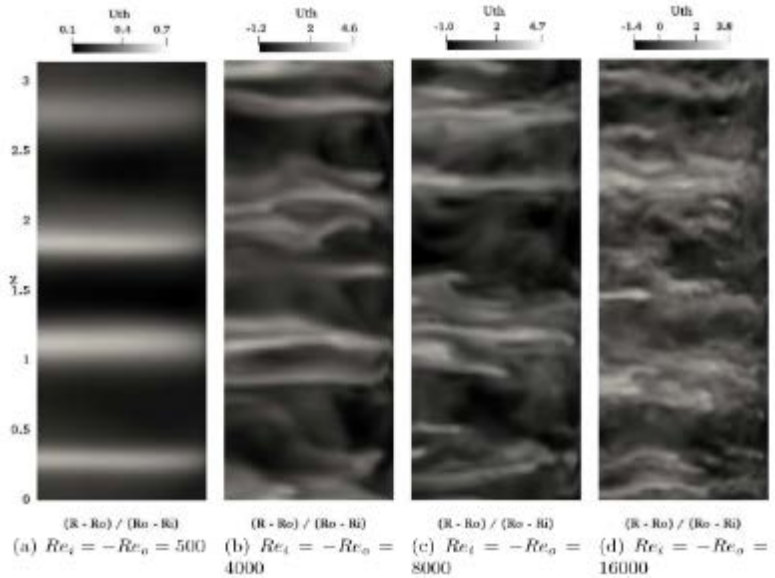
PhD, Purdue University, USA

Associate Professor, Mechanical Engineering

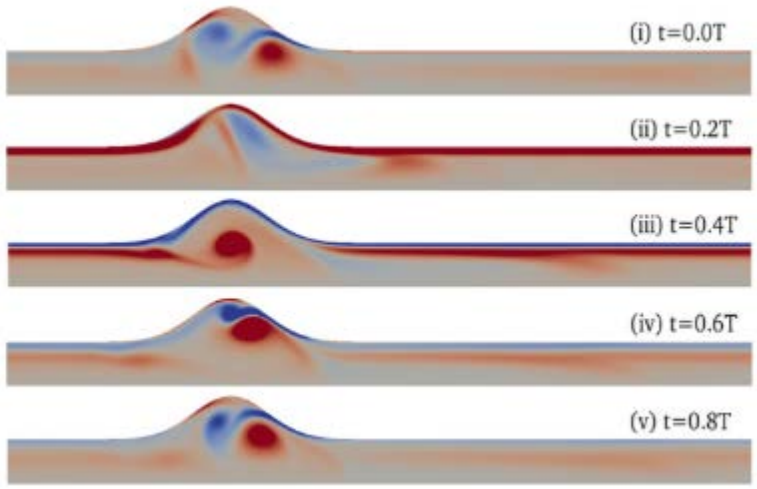
044-2257-4695; kanupindi@iitm.ac.in

https://home.iitm.ac.in/kanupindi/

- Eddy-resolving simulations of turbulent flow and heat transfer
- Lattice Boltzmann methods
- Bio-fluid dynamics



Turbulent flow in a counter-rotating Taylor-Couette flow



Evolution of vorticity in abdominal aortic aneurysm

Dr. Krishna Kannan

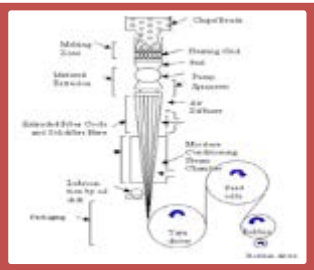
PhD, Texas A&M University, USA

Professor, Mechanical Engineering

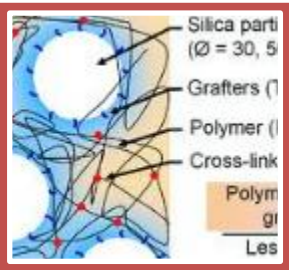
044-2257-4708; krishnakannan@iitm.ac.in

http://www.iitm.ac.in/component/faculty/78/kkrishna

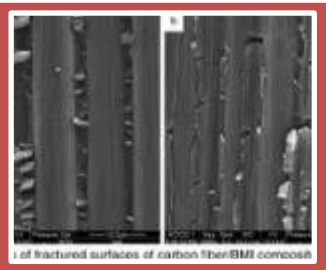
- **Broad area of research**: Continuum mechanics
- **Research focus**: Development of constitutive equations using rigorous and systematic thermodynamically frameworks describing many phenomena such as crystallization of polymeric melts, and viscoelasticity and chemical aging of polymeric materials
- **Some applications:**



Constitutive equations for fiber spinning of crystallizing polymeric melts



Constitutive equations for vulcanization of rubber and thermo-mechanical behavior of (viscoelastic) filled networked rubbers



Constitutive equations for chemical aging of composites

Dr. Krishnan Balasubramaniam

Professor, Mechanical Engineering

044-2257-4662; balas@iitm.ac.in

http://www.cnde-iitm.net/balas/index.html

Major Areas of Research

- Non-destructive Imaging & Evaluation of Materials, Structures, Products
- Structural Health Monitoring using in-situ Sensor Systems
- Measurements of Material Properties and In-Process Parameters

GPR Testing Techniques and Models for Structures

IN-PROCESS monitoring of Cure Properties of Concrete, Polymers, and Joints

Material Property Measurements at Ambient Temperatures and Elevated temperatures up to 1500 C

Applying Acoustic and Electromagnetic Spectrum for Industrial Measurements

Dr. Krithika Narayanaswamy

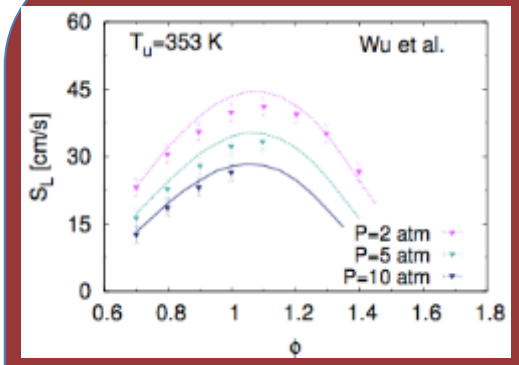
Associate Professor, Mechanical Engineering

044-2257-4650; krithika@iitm.ac.in

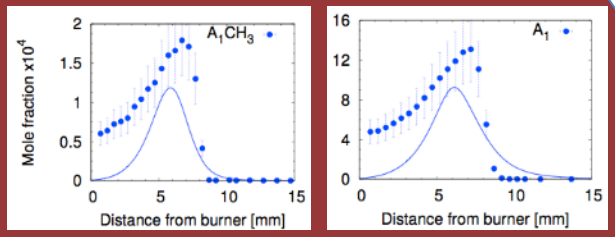
https://mech.iitm.ac.in/meiitm/personnal/dr-krithika-narayanaswamy/

Major Areas of Research

- Chemical kinetic modeling of transportation fuel surrogates
- Development of compact kinetic schemes and reduction methods
- Reactive flow simulations with accurate finite rate chemistry



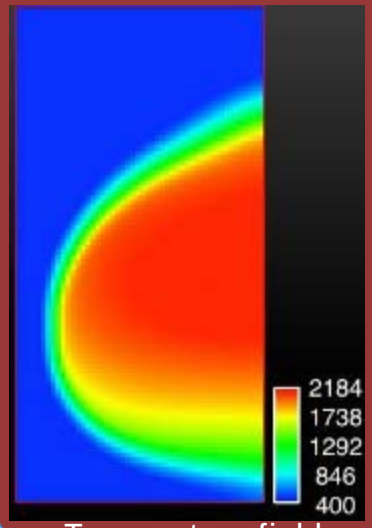
Laminar flame speeds



Amounts of aromatics in a rich methylcyclohexane flame

Symbols – experiments (literature)
Lines – simulations (using proposed kinetic scheme)

Chemical kinetic modeling of methylcyclohexane, which is a potential candidate to represent the cycloalkane class in transportation fuels



Temperature field

Simulation of a 2D laminar triple flame burning a jet fuel surrogate with n-dodecane, methylcyclohexane, and m-xylene as components

Dr. Ratna Kumar Annabattula

PhD, University of Groningen, The Netherlands

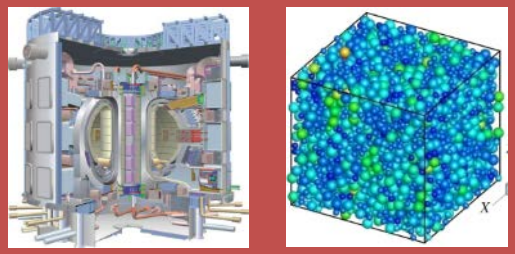
Professor, Mechanical Engineering

044-2257-4719; ratna@iitm.ac.in

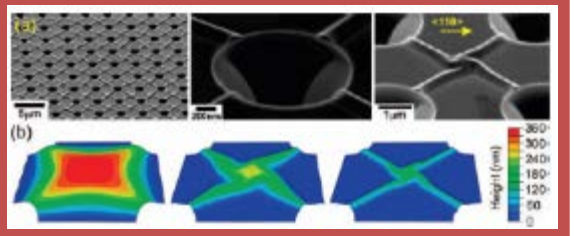
http://home.iitm.ac.in/ratna

Major Areas of Research

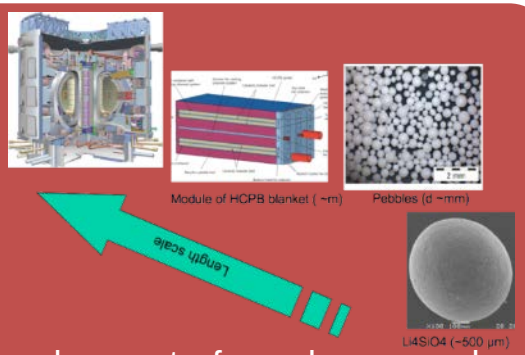
- Thermo-mechanics of Granular Materials
- Nuclear fusion, Li-Ion batteries, Thermal energy storage
- Nature Inspired Microsystem Design
- Multi-Scale Modeling of Materials



Micromechanics of granular materials for nuclear fusion



Spontaneous formation of three dimensional micro structures from pre-stressed thin films



Development of novel meso-scale computational techniques to bridge the micro and continuum length scales

Computational Solid Mechanics for Sustainable Energy and Microsystem Design

Dr. J M Mallikarjuna

PhD, IIT Madras, India

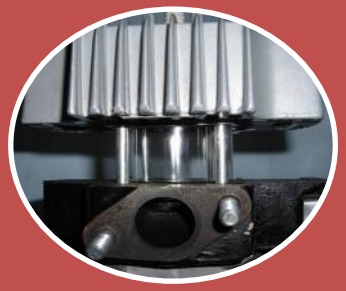
Professor, Mechanical Engineering

044-2257-4698; jmmallik@iitm.ac.in

http://www.iitm.ac.in/component/faculty/78/jmmallik/

- Alternate fuels – Vegetable oils, Biodiesel, Hydrogen, Ethanol, Methanol, LPG, Biogas, CNG
- In-cylinder flows, liquid and air interaction analysis using PIV and CFD in 4 and 2 Stroke engines
- HCCI Engines – Liquid and gaseous fuels, GDI engines

Performance and Emission characteristics of alternate fuels. Engine modifications for liquid and gaseous fuels. Combustion characteristics.



In-cylinder flows and air-fuel interaction in 4S and 2 stroke engines is done through PIV and CFD analysis

HCCI – usage of liquid and gaseous fuels for HCCI operation, engine modifications, performance, emission and combustion characteristics is done. Diesel, LPG, biogas have been tried

Dr.Manish Anand

PhD, Purdue University, USA

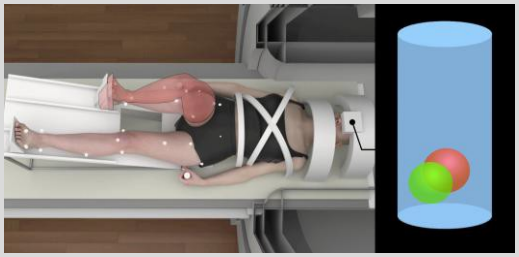
Assistant Professor, Mechanical Engineering

044-2257-4671; manand@iitm.ac.in

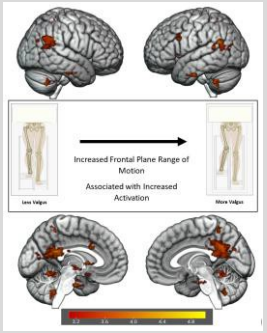
Area of work : Biomechatronics with focus on assistive tech and rehab

- Markerless 3D Pose estimation for clinical applications
- Biofeedback driven objective gait rehab
- Automotive assistive technology systems for wheelchair users
- Robotic rehab systems driven by biofeedback
- Neurological mapping of functional brain activity to test efficacy of different gait rehabilitation methods

Markered to Markerless



Biofeedback driven rehab



fMRI to evaluate efficacy of rehab

Dr. P V Manivannan

PhD, IIT Madras, India

Professor, Mechanical Engineering

Ph:044-22574710; Cell: 9444952257 Email: pvm@iitm.ac.in

http://www.iitm.ac.in/component/faculty/78/pvm/

Major Areas of Research

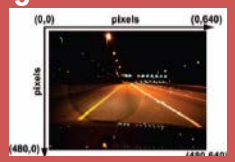
- **Automotive Control systems**: Engine Management Systems (SI, CI, Hydrogen Fueled Engines), Electric Power Steering, Active Suspension system (MR damper), etc.

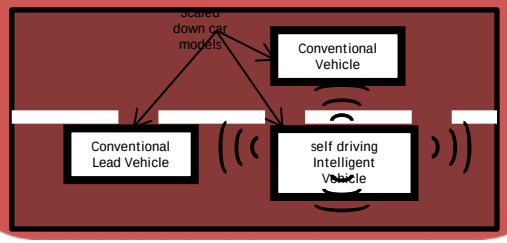
- **Robotics and Sensor Network**: Robotics / Unmanned Vehicle Guidance and Control, Sensors and Sensor Network (wired / wireless), Automated Highway System (AHS) & Intelligent Vehicles

- **Industrial automation:** Embedded Controller and Real Time Operating System (RTOS) for Mechatronic System

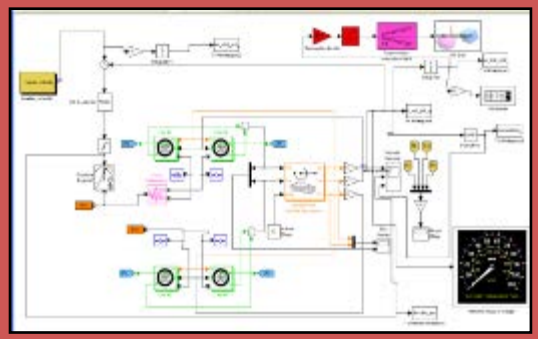
Automotive Control Systems

Automated Highway System (AHS) and Intelligent Vehicles





Real Time Embedded Controller Design (Modeling, Simulation, Optimization)



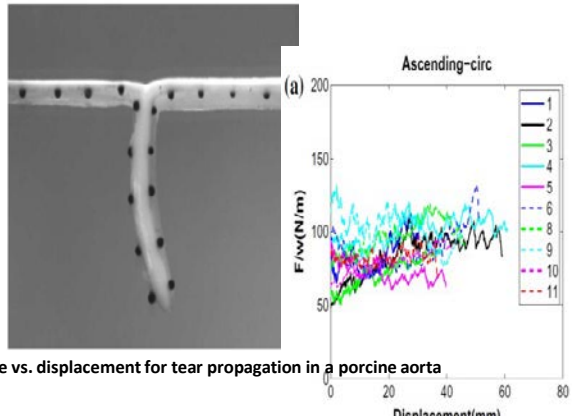
Dr. Manoj Myneni

PhD, Texas A&M University, USA

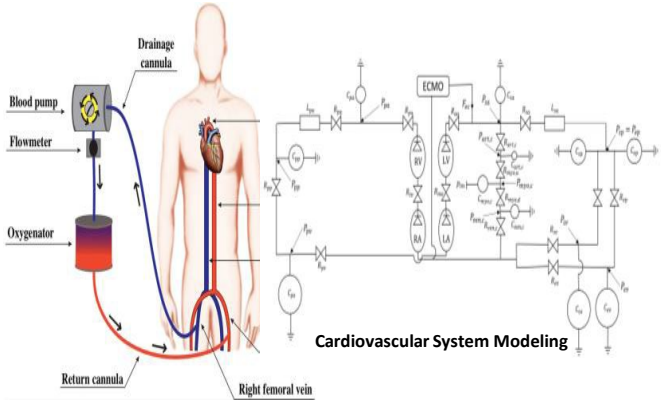
Assistant Professor, Mechanical Engineering

044 2257-4678; mmyneni@iitm.ac.in

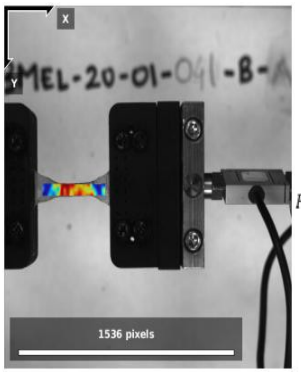
- Cardiovascular System Modeling, Circulatory Assist Devices, Biomechanics
- Soft Tissue Mechanics, Viscoelastic Behavior of Soft Materials and Polymers
- Experimental Characterization of Tissues and Biomaterials



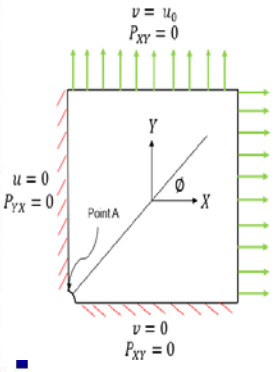
Force vs. displacement for tear propagation in a porcine aorta

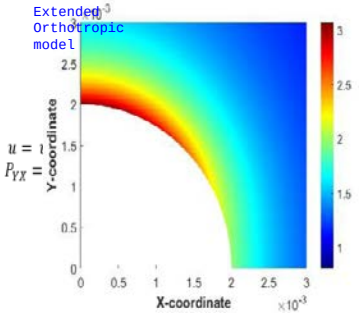


Cardiovascular System Modeling



Tensile testing of the aorta and strain measurement using digital image correlation





Constitutive Modeling and Finite Element Analysis

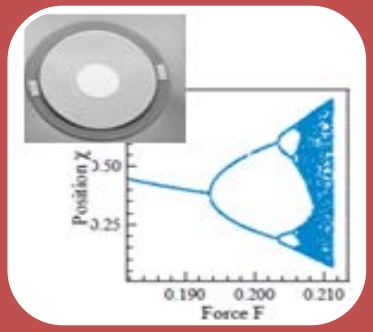
Dr. Manoj Pandey

PhD, Cornell University, USA

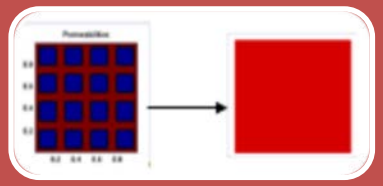
Associate Professor, Mechanical Engineering

044-2257-4658; mpandey@iitm.ac.in

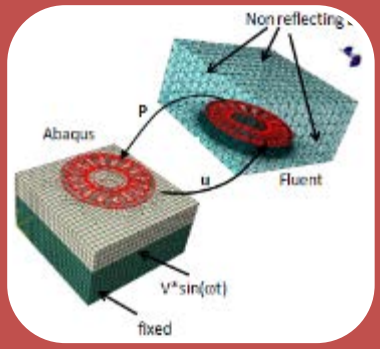
- Reduced Order Modeling and Nonlinear Dynamics of Resonant MEMS
- Finite Element based Multi scale Modelling of Elastic Plastic Applications
- Multi Physics analysis of MEMS



Nonlinear Modeling and Analysis of MEMS



Multiscale Modeling/Homogenization for composites



Multi-Physics Analysis

Dr. Mayank Mittal

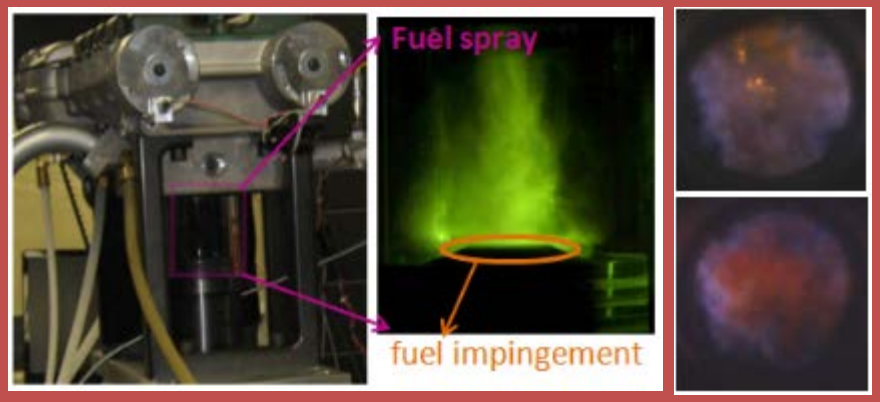
Professor, Mechanical Engineering

+91-44-2257-4680; mmittal@iitm.ac.in

https://www.iitm.ac.in/info/fac/mmittal

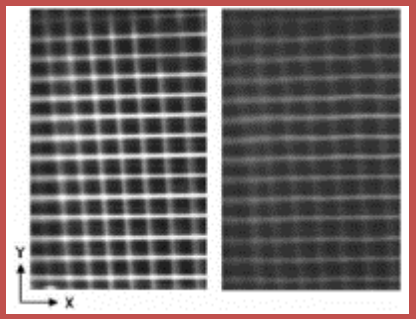
Major Areas of Research

- Experimental diagnostics and modeling of advanced internal combustion engine; alternate fuels; aftertreatment system
- Laser-based diagnostics for flow and combustion
- Signal and image processing; computer vision



In-cylinder fuel spray and combustion visualization

Laser grid inside the engine cylinder



Undelayed and delayed images of molecular tagging velocimetry

Dr. Narasimhan Swaminathan

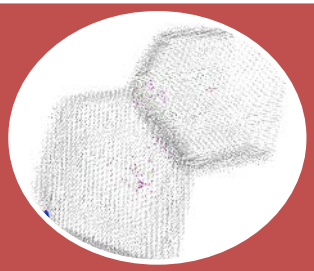
PhD, Georgia Institute of Technology, USA

Professor, Mechanical Engineering

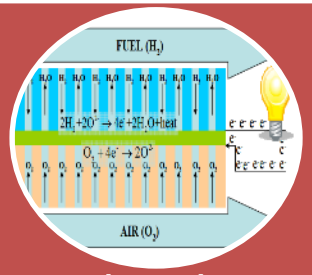
044-2257-4743; n.swaminathan@iitm.ac.in

http://www.iitm.ac.in/component/faculty/78/n.swaminathan/

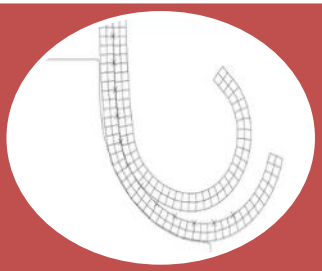
- Grain size and defect kinetics interactions in ceramics
- Material property determination using atomistic methods
- Finite element modeling of multiphysics phenomena



Radiation damage in nuclear materials with nanosized grains



Interactions between electrochemistry and mechanics in fuel cell electrolytes



Crashworthiness of composite materials

Computational materials science and mechanics

Dr. Pallab Sinha Mahapatra

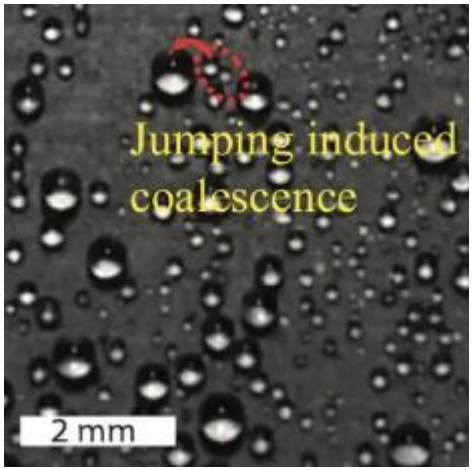
PhD, Jadavpur University, India

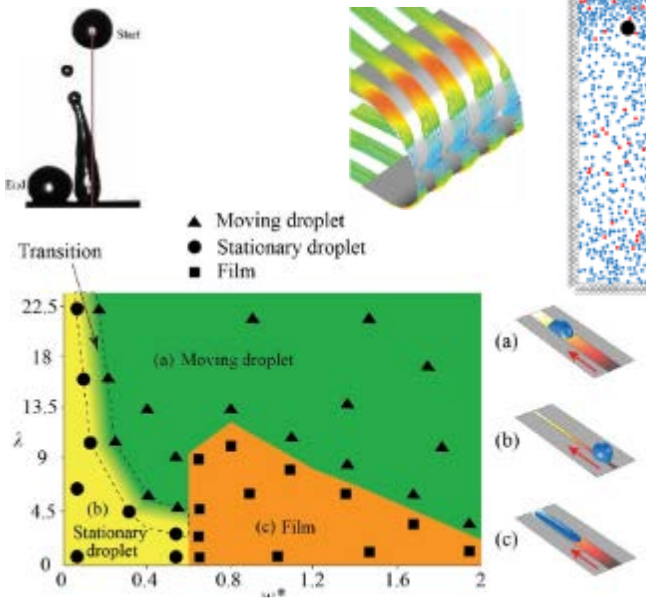
Assistant Professor, Mechanical Engineering

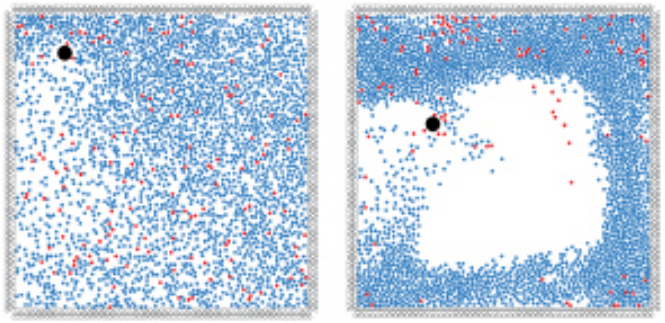
044-2257-4692; pallab@iitm.ac.in

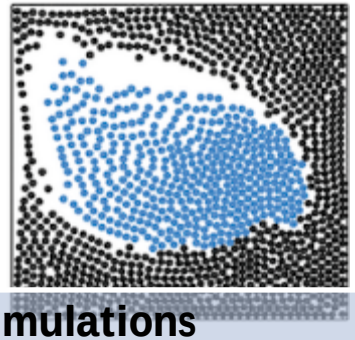
http://www.iitm.ac.in/pallab

- Surface engineering: open surface microfluidics, micro texturing, wettability engineering, interfacial flows
- Multiphase heat transfer: condensation and boiling, multiphase modelling
- Self-propelled systems: collective dynamics, crowd modelling









Multiscale multiphase flows: experiments and simulations

Dr. Parag Ravindran

PhD, Texas A&M University, USA

Professor, Mechanical Engineering

044-2257-4714; paragr@iitm.ac.in

http://www.iitm.ac.in/component/faculty/78/paragr/

- Constitutive modeling of viscoelastic materials
- Modeling of creep response in metals
- Modeling of fatigue loading in fibre reinforced composites

- Linear and non-linear constitutive models for viscoelastic materials within a thermodynamic framework.
- Development of continuum models for creep in copper.
- Thermo-mechanical response of glass-epoxy composites: coupling between the thermal and mechanical response in composites.
- Development of continuum models for composites and polymers and comparison to experiments involving cyclic loading.

Dr. Piyush Shakya

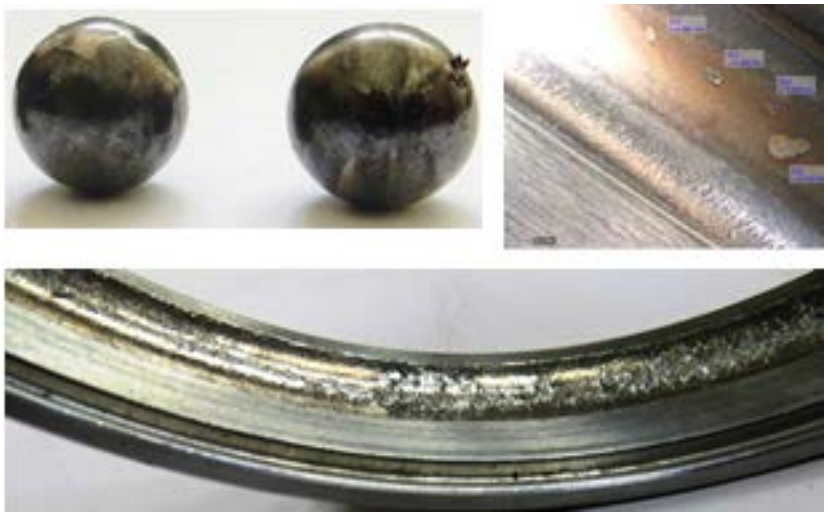
PhD, Texas A&M University, USA

Associate Professor, Mechanical Engineering

044 2257 4663; pshakya@iitm.ac.in

Major Areas of Research

- Condition monitoring
- Fault Diagnosis and Prognosis
- Innovative signal processing
- Bearings, Gears



Failed bearings samples after dismantling

Dr. Prabhu Rajagopal

PhD, Imperial College London, UK

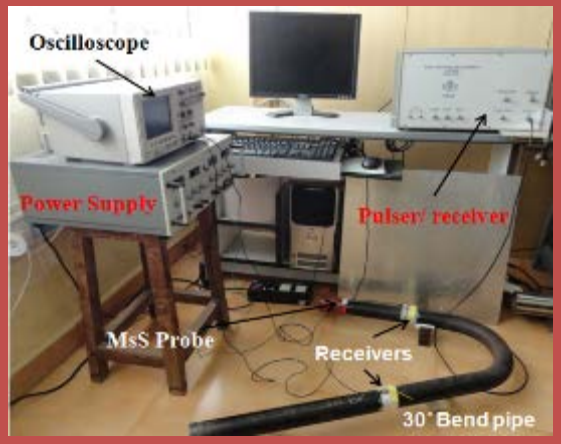
Professor, Mechanical Engineering

044-2257-4741; prajagopal@iitm.ac.in

https://sites.google.com/site/iitmprabhu

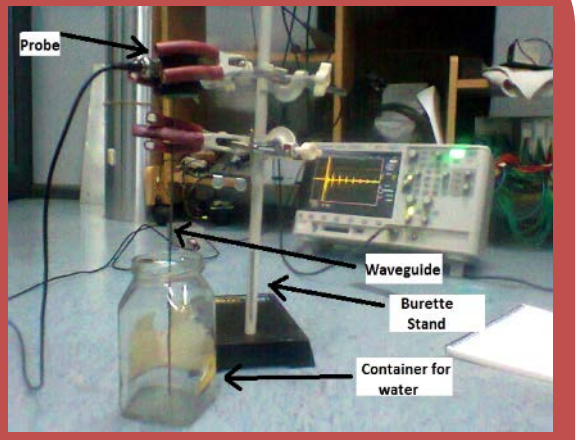
Ultrasonic techniques for inspection, monitoring and control

- Nondestructive Evaluation & Structural Health Monitoring
- Manufacturing Process Control



Inspection of pipe networks (*e.g.*, Oil and Gas Industry , Heat Exchanger Tubes)

Monitor structural health (*e.g.*, aircraft wings, ship hull, wind turbines)



Measurement of liquid level (*e.g.*, Underground/ pressurized fluid reservoir)

Dr. V Raghavan

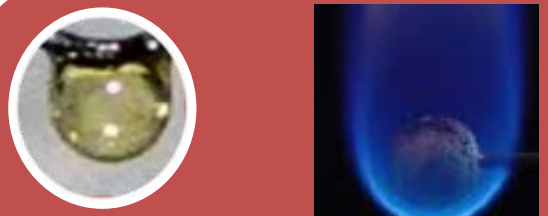
PhD, IIT Madras, India

Professor, Mechanical Engineering

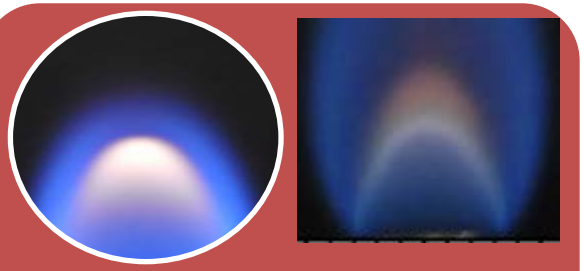
044-2257-4712; raghavan@iitm.ac.in

http://www.iitm.ac.in/component/faculty/78/raghavan/

- Liquid Fuel Droplet Evaporation and Combustion – alcohols and biofuels
- Laminar Flames – Hydrogen and oxygen enhanced flames, flame stability studies
- Heterogeneous Combustion – pool flames, coal and biomass gasification



Liquid Fuel droplet Evaporation and Combustion

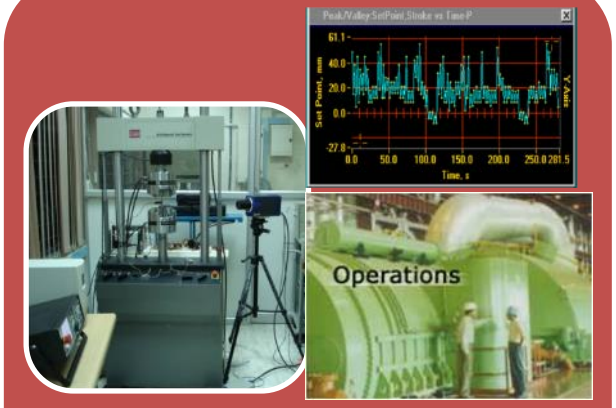


Laminar Flame studies

Heterogeneous combustion

Dr. V Raghu Prakash
PhD. (IISc)
Professor, Mechanical Engineering
044-2257-4694; raghuprakash@iitm.ac.in
http://www.mech.iitm.ac.in/Faculty/vrp/home.php

- Fatigue, Fracture and Failure Analysis
- Materials Characterization
- Crash Performance
- Product Design



Life Prediction and Residual Life Extension

Development of crash compliant structures

New Product Development

Dr. Raju Sethuraman

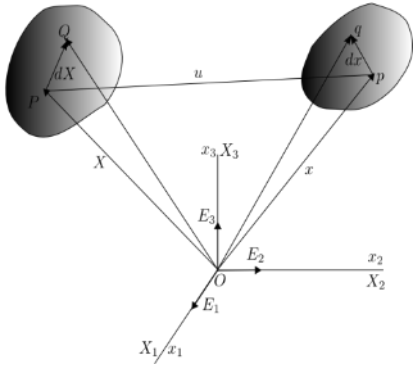
PhD, IIT Bombay

Professor, Mechanical Engineering

044-2257-4673; sethu@iitm.ac.in

Research Area/Focus : Computational Solid Mechanics

- Modeling and simulation of structural materials undergoing inelastic finite deformation

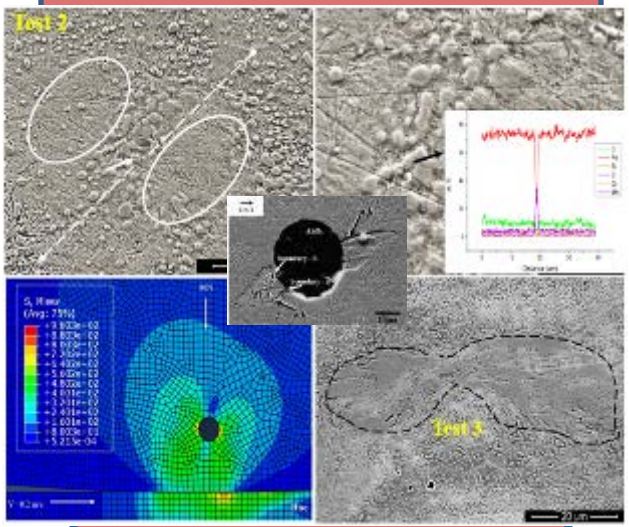


Dr. Ramkumar Penchaliah
Ph.D., University of Southampton, UK
Professor, Dept. of Mechanical Engineering
044-22574816; ramkumar@iitm.ac.in
http://home.iitm.ac.in/ramkumar

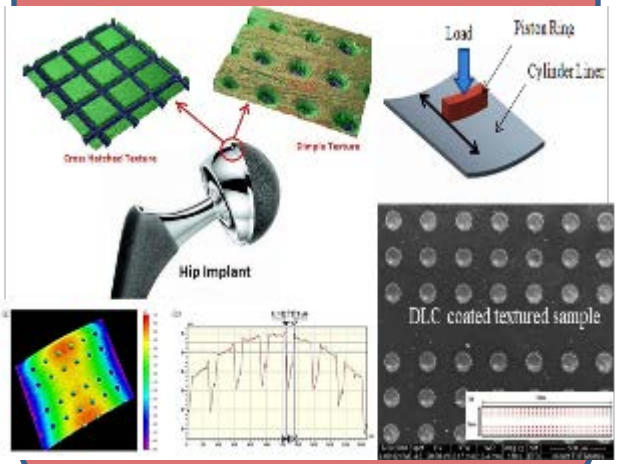
Major Areas of Research

- Automotive Tribology, Tribo design of Machine Components and Gearbox
- Mitigation of White Etching Areas & H_2 Embrittlement in EV and Wind Turbine Bearings
- Surface Engineering: Surface Texture and Coatings
- Contact Mechanics Wear Models & Structural Design Validation
- Bio-tribology and Bio-TriboCorrosion of Biomaterials/Implants

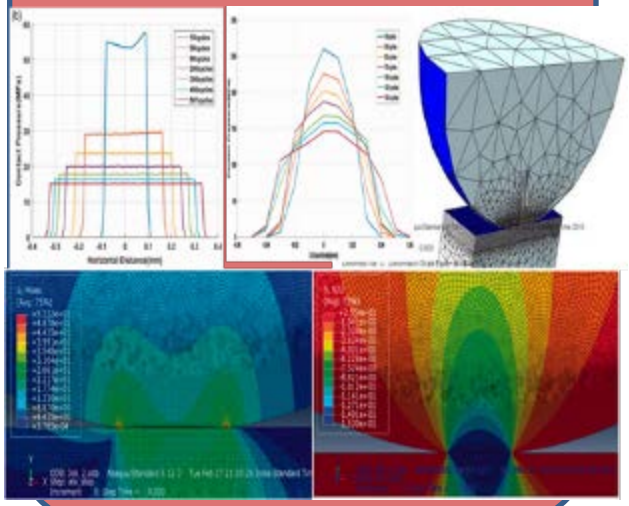
WEAs Formation



Laser surface texturing



FEM Wear Prediction



Dr. Raushan Singh

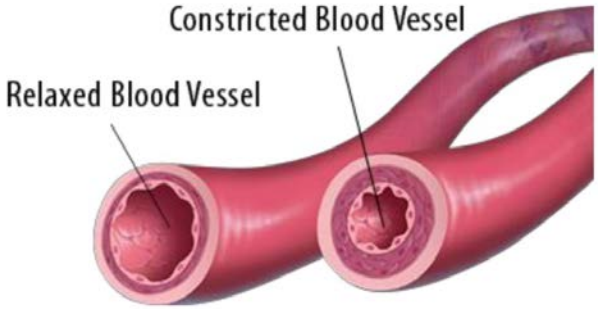
PhD, IIT Delhi, India

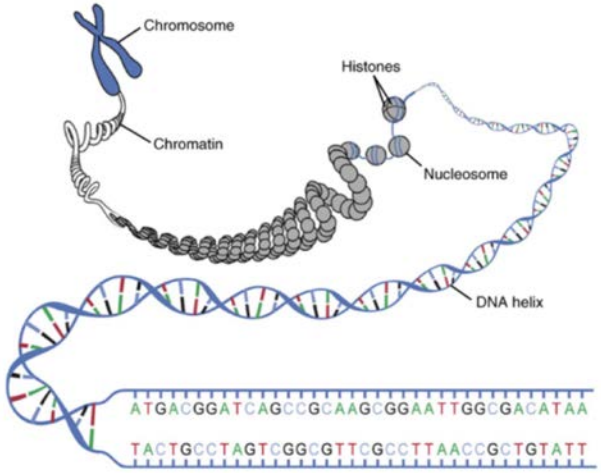
Assistant Professor, Mechanical Engineering

044 2257-4677; raushan@iitm.ac.in

https://mech.iitm.ac.in/meiitm/personnal/dr-raushan-singh/

- Solid Mechanics/Unusual deformation in tubes/rods
- Nano Mechanics/Deriving constitutive relations for nanorods/nanotubes
- DNA Mechanics & Polymer Physics/Modelling of sequence-dependent DNA and Nucleosome





Modelling Rod-like Structures at Multiscale

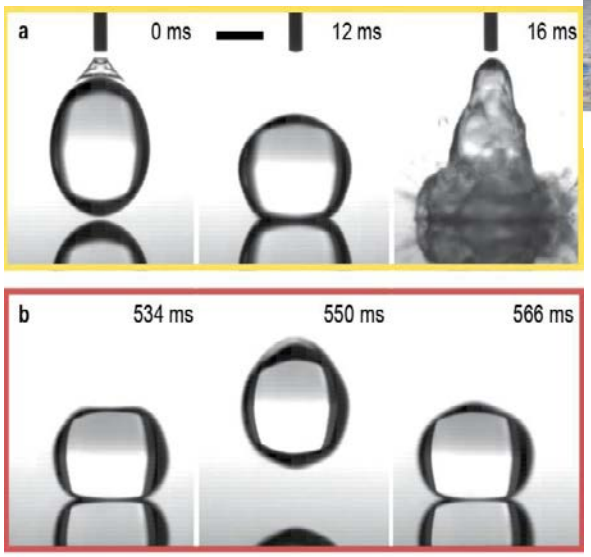
Dr.Regulagadda Kartik

PhD, IIT Madras, India

Assistant Professor, Mechanical Engineering

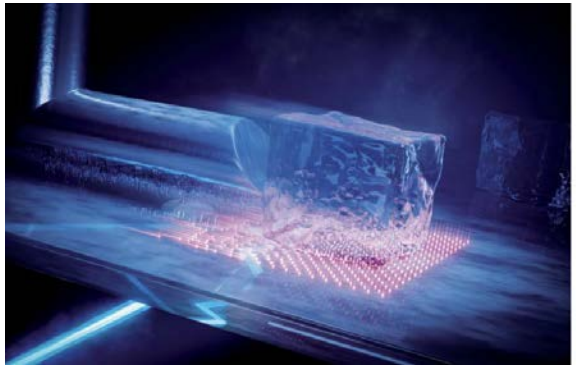
044 2257-4666; kartik@iitm.ac.in

- Droplets
- Ice adhesion on soft surfaces
- Condensation
- Nanoscale 3D printing

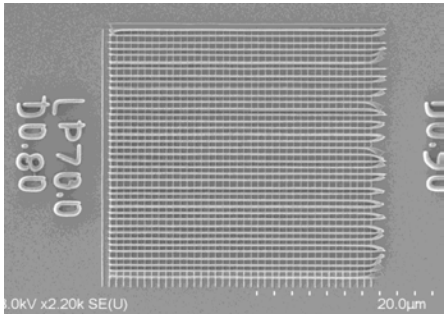


Leidenfrost droplet trampolining

Durable hydrophobic coatings for dropwise condensation



Investigating *in situ* ice adhesion on soft surfaces



3D printing nanoscale metamaterials for structural coloring

Dr. GL Samuel

PhD, IIT Madras, India

Professor, Mechanical Engineering

044-2257-4699; samuelgl@iitm.ac.in

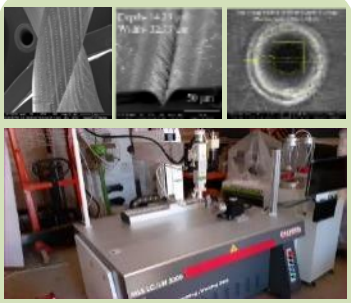
https://home.iitm.ac.in/samuelgl/

https://www.calm-iitm.com/

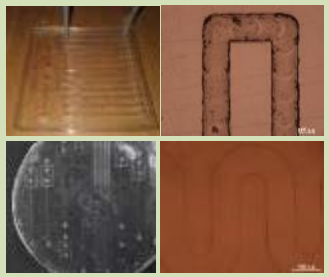
- **Mechanical Micro machining - milling and turning**
- **Hybrid machining techniques - µ-EDM and Laser Micromachining**
- **Application of Lasers in machining, 3D printing and material processing**
- **Fabrication of polymeric microfluidic devices**
- **Computer Aided Drawing/ Design**

Mechanical Micromachining

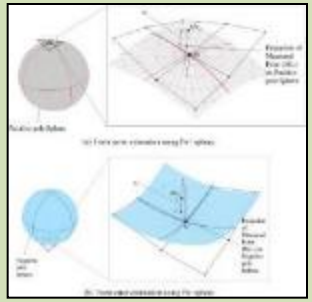
Hybrid machining technique



Laser applications in material processing



Polymer microfluidic devices



Computer aided drawing

Micromachining, Laser applications and Computer Aided Drawing

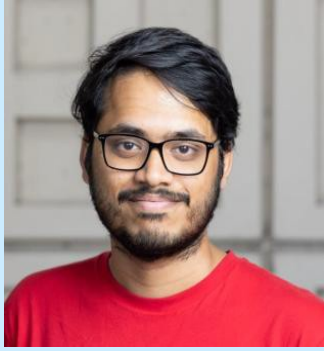
Dr. Samya Sen

Ph.D., University of Illinois Urbana-Champaign, USA

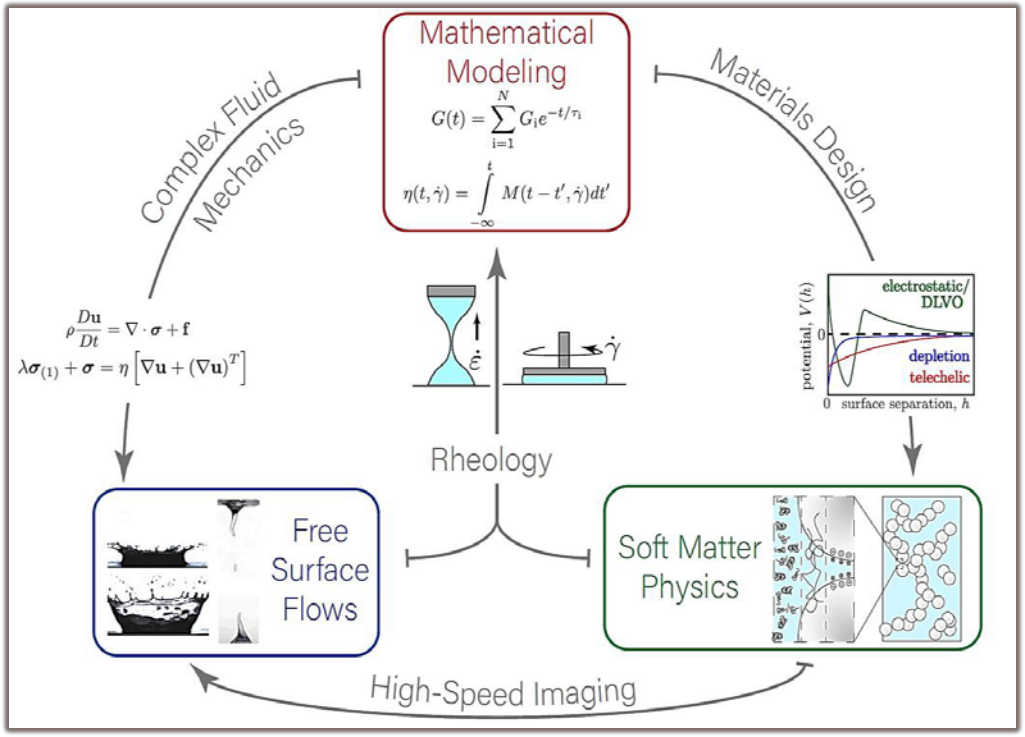
Assistant Professor, Dept. of Mechanical Engineering

M: +91 62898 45450; E: samya@iitm.ac.in

W: sites.google.com/smail.iitm.ac.in/complexfluidslab

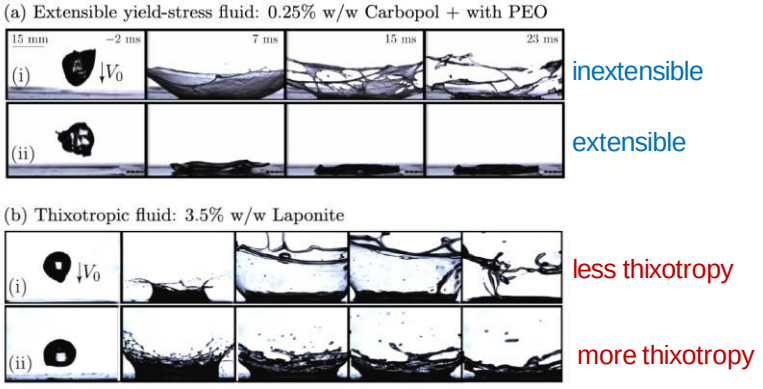


Design, Mechanics, and Rheology of Non-Newtonian Fluids and Soft Materials for Industrial and Environmental Applications

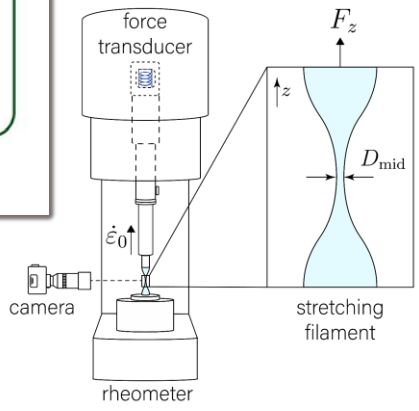


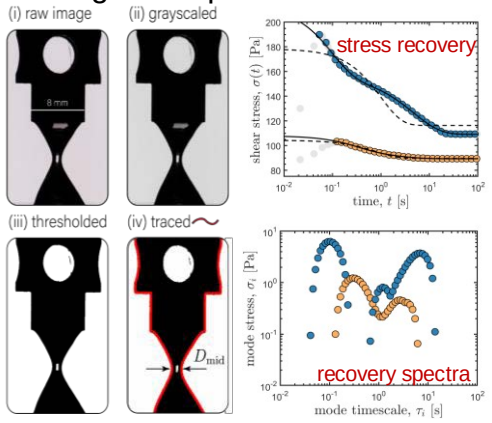
Summary of research foci

High-speed imaging of droplet impacts and free-surface flows



Novel characterization and modeling of complex fluids





Sen et al, J Fluid Mech (2020)
Sen and Ewoldt, J Rheol (2022)
Sen et al, ACS Appl Mater Int (2024)
Song et al, Adv Healthcare Mater (2025)

Sen et al, Phys Rev Fluids (2021)
Sen et al, Soft Matter (2024)
Dong et al, Adv Mater (2024)
Saengow et al, Adv Funct Mater (2025)

Dr. Sarit Kumar Das

PhD, Sambalpur University, India

Professor, Mechanical Engineering

044-2257-4655; skdas@iitm.ac.in

Major Areas of Research

- **Heat applications like nanofluids**
- **Biological heat transfer microfluidics**
- **Nanoparticle mediated drug delivery in cancer cells**

Source: Faculty website

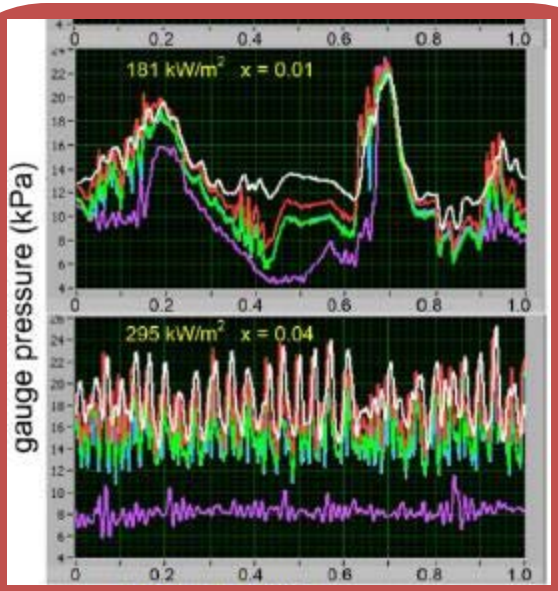
Dr. Sateesh Gedupudi

PhD, IIT Madras, India

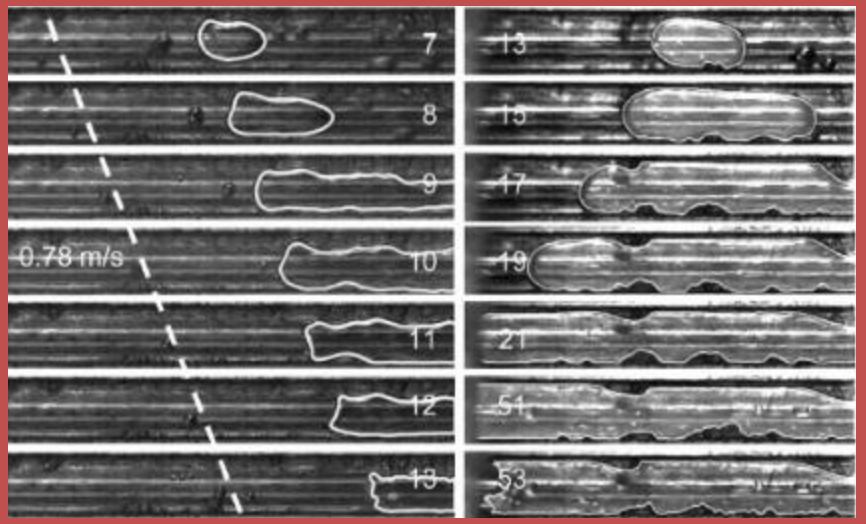
Associate Professor, Mechanical Engineering

044-2257-4721; sateeshg@iitm.ac.in

- Phase-change heat transfer(flow boiling and pool boiling) and flow instabilities
- Heat exchangers
- Non-conventional energy sources



Local pressure fluctuations at different axial positions in a microchannel



Video images of bubble growth in a 0.6 mm D_h channel (a)without inlet compressibility and (b) with inlet compressibility (flow reversal)

Dr. Sathyan Subbiah

PhD, IIT Madras, India

Professor, Mechanical Engineering

044-2257-4669; sathyans@iitm.ac.in

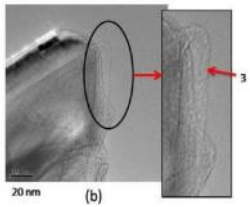
Expertise

- Machining (at all scales (meso, micro to nano)
- Abrasive polishing
- Experimental and process simulation

Industry Related Experiences

- Worked in US-Automotive manufacturing industry for 3 years
- While in academia, collaborated/ing with following industries:
- Aerospace (Rolls Royce Singapore)
- Reliance Petrochemical
- Ace Micromatic Grinding
- Saint Gobain Research India
- SVP Laser
- Titan

Machining (at all scales (meso, micro to nano)



Graphene

Exfoliation

Thin sheet film

micro-machining

Large ship

propeller

Dr. A Seshadri Sekhar

PhD, IIT Madras, India

Professor, Mechanical Engineering

044-2257-4709; as_sekhar@iitm.ac.in

http://www.iitm.ac.in/component/faculty/78/as_sekhar/

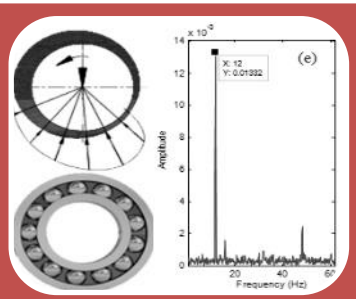
- Rotor Dynamics
- Fault Identification and Condition Monitoring
- Tribology- Rolling element bearings and Hydro dynamic bearings

Rotating machinery:

Composite shafts dynamics; Fault modeling and detection; MCSA

Wind turbine:

Gearbox dynamics and condition monitoring



Bearings & Seals:

RE bearing defects; Fluid film bearing roughness effects ; CFD of Seals

Dr. Shaligram Tiwari

PhD, IIT Kanpur, India

Professor, Mechanical Engineering

044-2257-4729; shaligt@iitm.ac.in

https://home.iitm.ac.in/shaligt/about.html

Major Areas of Research

- **Fluid-structure Interaction.**
- **Flow Transitions and Heat Transfer Enhancement**
- **Rayleigh-Benard and Marangoni convection; Interfacial instabilities**
- **Heat and Mass Transfer in Refrigeration and Air-conditioning systems**
- **Vortex Flows: Kinematics and interaction; Chaotic advection and mixing.**
- **Bird flight simulation.**
- **Numerical simulation of human circulation system.**

Source: Faculty website

Dr. Shamit Bakshi

PhD, IISc Bangalore, India

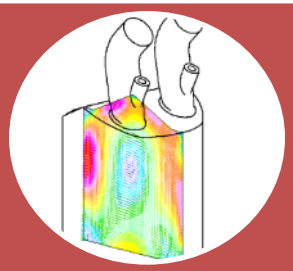
Professor, Mechanical Engineering

044-2257-4700; shamit@iitm.ac.in

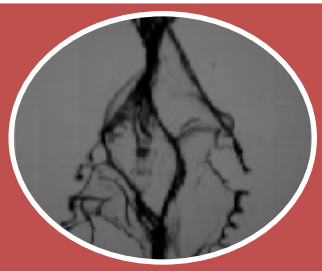
http://www.iitm.ac.in/component/faculty/78/shamit/

- Droplet processes (Droplet Evaporation, Droplet Impact)
- IC Engine process simulation
- Atomization and sprays

Marangoni convection during droplet evaporation can be utilized in micro-mixing



Simulation of flow and mixing processes in a gasoline direct injection engine



Atomization of liquid sheet from a impinging jet injector

DROPLET AND SPRAY PROCESSES IN ENGINES AND OTHER APPLICATIONS

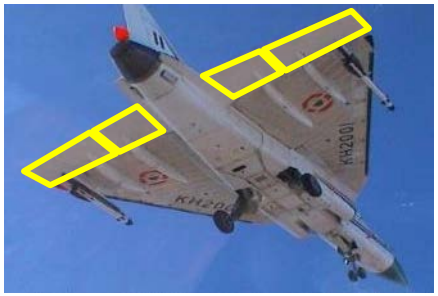
Dr. Shankar Krishnapillai

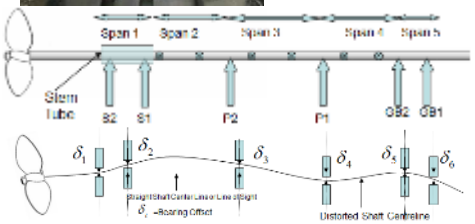
PhD, University of Oxford, UK

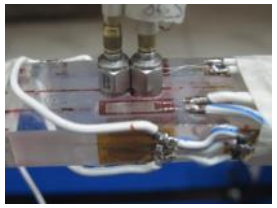
Professor, Mechanical Engineering

044-2257-4701; skris@iitm.ac.in

- Optimization Methods
- Vibrations
- Machine Design
- Socially Relevant Technology







Optimization Methods:

1. Multi-Objective Optimization
2. Improved Algorithms
3. Hybrid methods
4. Applications to Machine Design, Dynamics problems

Vibrations:

1. Structural Dynamics
2. Machine Dynamics
3. Vibration Control
4. Inverse problems and Health Monitoring

Machine Design:

1. General Machine Design
2. Design for Socially Relevant Applications
3. Alternative Energy for Rural applications

Dr. Shyama Prasad Das

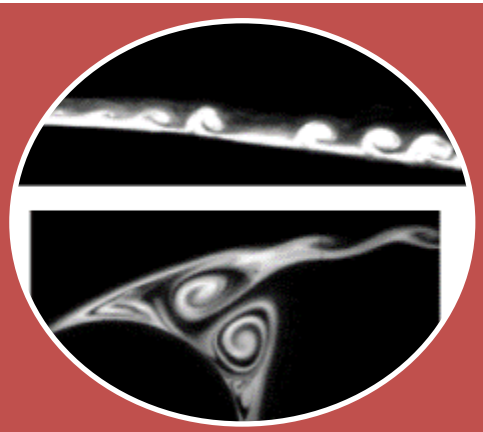
PhD, Indian Institute of Science, India

Associate Professor, Mechanical Engineering

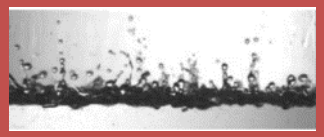
044-2257-4667; spdas@iitm.ac.in

http://mech.iitm.ac.in/Faculty/sydas/home.php

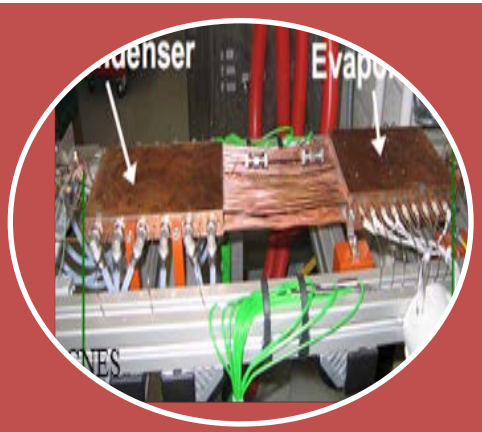
- Unsteady Hydrodynamics, Aerodynamics and Turbomachines
- Interfacial Hydrodynamics and Transport
- Phase Change Heat Transfer in Mini System



Hydrodymaic instability and boundary layer separation a



Gravity and capillary waves



Pulsating heat pipe

Dr. Sivasrinivasu Devadula

PhD, IIT Madras, India

Associate Professor, Mechanical Engineering

044-2257-4704; devadula@iitm.ac.in

https://mech.iitm.ac.in/meiitm/personnal/dr-sivasrinivasu-devadula/

Major Areas of Research

- **Machining of 3D-surfaces on advanced engineering materials (super alloys, shape memory alloys, high entropy alloys, diamond, engineering ceramics, engineering composites)**
- **Abrasive waterjet machining,**
- **Novel tool path strategies,**
- **Optimization,**
- **Process modelling and simulation,**
- **Machine tools, and in general – conventional unconventional machining processes,**
- **Machine tool metrology,**
- **Micro machining.**

Source: Faculty website

Dr. Somashekhar S Hiremath

PhD, IIT Madras, India

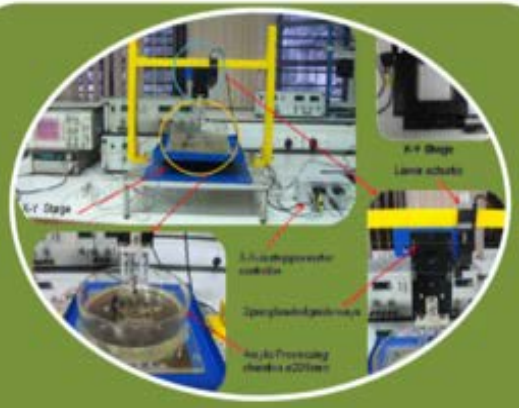
Professor, Mechanical Engineering

044-2257-4681; somashekhar@iitm.ac.in

http://mech.iitm.ac.in/PEIL%20HOME%20PAGE/Members/Prof.Somasekhar/Soma%20sekhar.html

- Fluid Power System : Electro hydraulic Servovalves, Autonomous Actuators, Hydraulic Hybrids
- Micromachining : Micro-EDM, Micro ECSM, Micro-AJM, Micro-HAJM
- Mechatronic System : Sensor and Actuator Integration to Precision Mechanical System
- Robotics : Trajectory Planning and Control, Obstacle Avoidance etc
- Modeling & Simulation : Optimization of process parameters

Abrasive Flow Machine for Producing Nano level Finish on Complex and Inaccessible Internal Features



Micro-ECSM: Hybrid Machining Approach for Machining a Non-conducting Engineering Materials

Micro-EDM for Micro-machining of Holes and Channels for Micro Fluidic Applications & New Approach for Nano Particle Generation

Cutting-edge Interdisciplinary Research Activities and Provide Technology Transfer and Consultancy Services to Industry and Governmental agencies

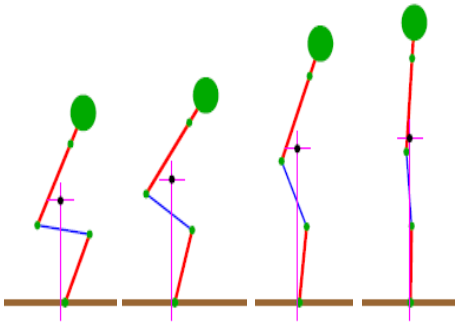
Dr. Sourav Rakshit

Associate Professor, Mechanical Engineering

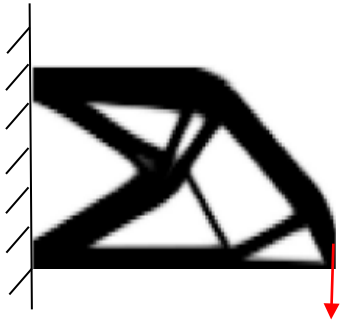
044-2257-4693; srakshit@iitm.ac.in

https://mech.iitm.ac.in/meiitm/personnal/sourav-rakshit/

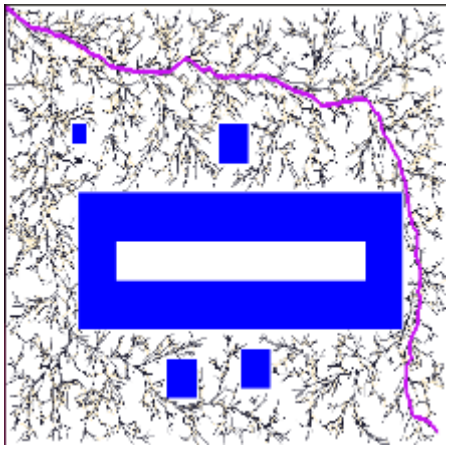
Optimization in biomechanics



Topology optimization



Robotics and motion planning



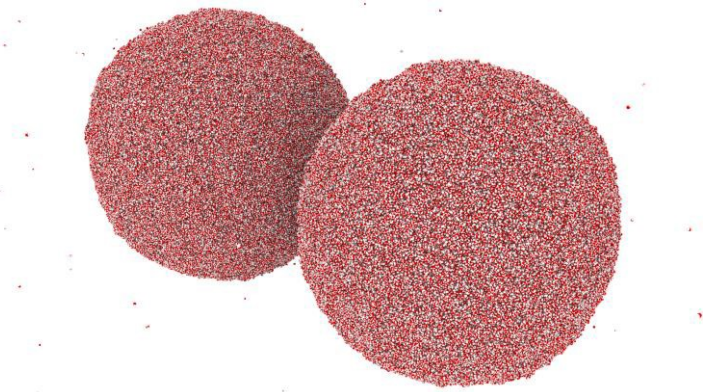
Dr. Sree Hari P. D.

PhD, University of Edinburgh, UK

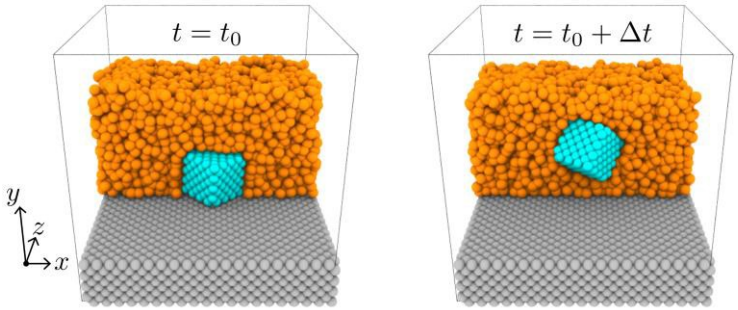
Assistant Professor (Grade-I); Mechanical Engineering

044-2257-4665; sreehari@iitm.ac.in

- Computational nanofluidics
- Molecular dynamics of interfaces
- Interfacial fluid flow and heat transfer
- Fluctuating hydrodynamics



Nanodroplet dynamics



Self-cleaning surfaces

Wetting at nanoscale

Dr. Srikrishna Sahu

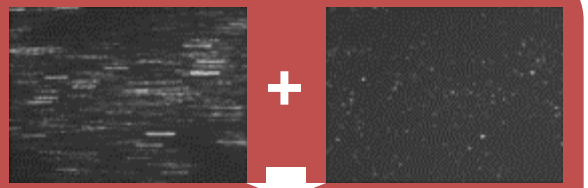
PhD, Imperial College London, UK

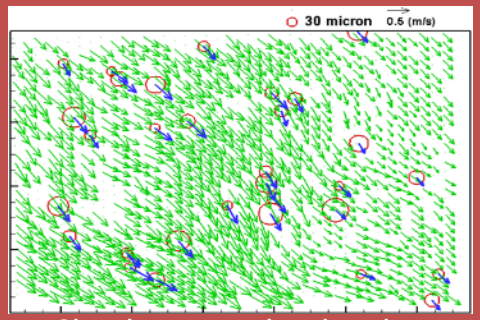
Associate Professor, Mechanical Engineering

044-2257-4713; ssahu@iitm.ac.in

- Optical experimental methods for two-phase flow and combustion research: ILIDS, PIV, PLIF, Optical Connectivity
- Spray-turbulence interaction, spray evaporation, liquid jet atomization
- Image processing, POD analysis

ILIDS PIV

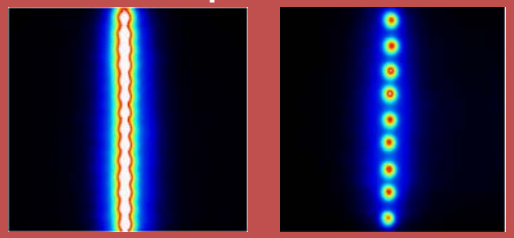




Simultaneous droplet size, velocity, number density and gas velocity around each droplet in a spray

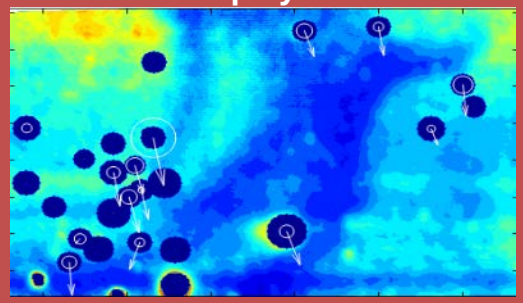
Droplet Evaporation

Droplet stream



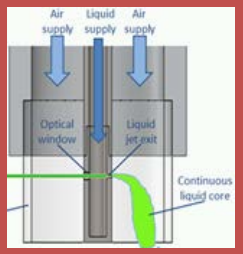
D : 200 µm D : 50 µm

Spray

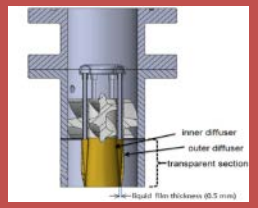


D : 15-100 µm

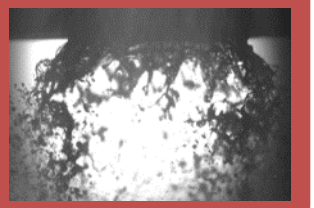
Liquid jet atomization



Cross flow atomizer



Swirling flow atomizer



Dr. K Srinivas Reddy

PhD, IIT Delhi, India

Professor, Mechanical Engineering

044-2257-4702; ksreddy@iitm.ac.in

http://mech.iitm.ac.in/Faculty/ksr/home.php

- Solar Energy Conversion/ Concentration Solar Power Technologies
- Estimation & Measurement of Thermo-physical Properties/Thermal Conductivity
- Energy & Environment/ 4E (Energy–Exergy–Environmental–Economic) Analyses

Design and Development of Solar Parabolic Dish Cavity Receiver Systems for Power Generation and Hydrogen Production

Integration and Optimization of High Performance Solar Concentrating Photovoltaic Systems for Cogeneration and Tri-generation

Estimation of effective thermal conductivity of two-phase engineering materials

Dr. K Srinivasan

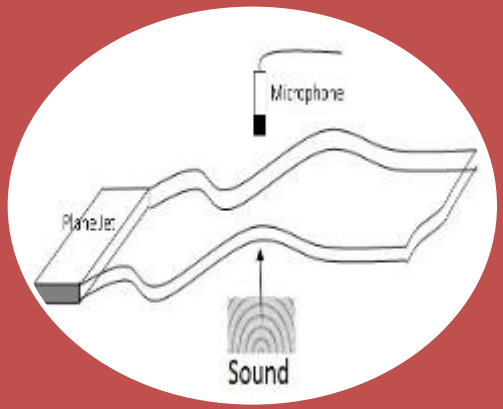
PhD, IIT Kanpur, India

Professor, Mechanical Engineering

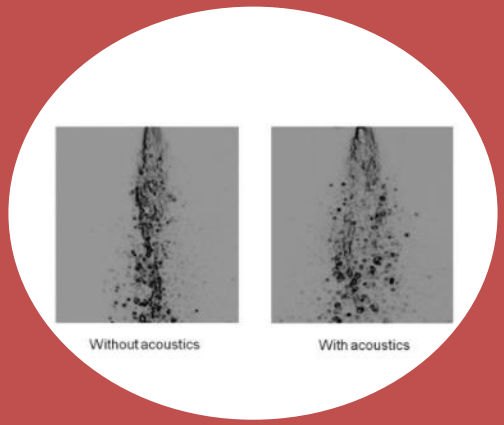
+91 (44) 2257-4703; ksri@iitm.ac.in

http://goo.gl/w6f6x

- Jet Flow and Noise
- Active and Passive Control of Flow, Noise and Combustion
- Resonant Acoustics



JET FLOW & ACOUSTICS



FLOW CONTROL

RESONANT ACOUSTICS

Dr. Sujatha Srinivasan

PhD, The Ohio State University, USA

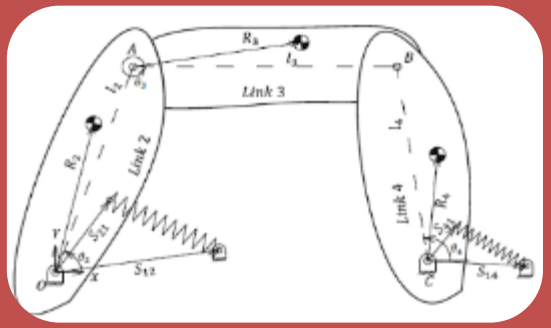
Professor, Mechanical Engineering

044-2257-4728/5695; sujsree@iitm.ac.in

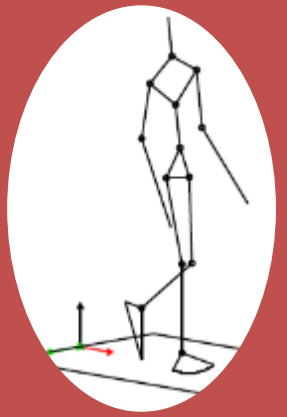
https://r2d2.iitm.ac.in/

- Prosthetics, Orthotics and Assistive Devices
- Mechanisms
- Movement Biomechanics

Standing Wheelchair



Mechanisms



Biomechanics

FOCUS: Rehabilitation Research and Device Development (R2D2)

Dr. Sundararajan Natarajan

PhD, Cardiff University, Wales, UK

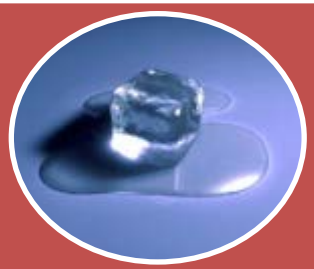
Professor, Mechanical Engineering

044-2257-4656; snatarajan@iitm.ac.in

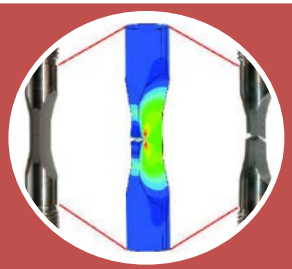
http://home.iitm.ac.in/snatarajan

Major Areas of Research

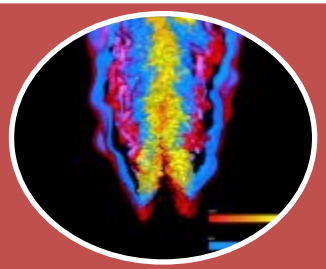
- Free and moving interfaces
- Multi-field coupled problems
- Computational Mechanics (FEM, XFEM, Meshless, Isogeometric analysis, Polygonal FEM, Scaled Boundary FEM)
- Multiscale methods



Melting/Solidification



Growth of flaw leading to complete failure



Flame front propagation

Leverage the centrality of mathematical formulations to have an impact in variety of fields

Dr. Sushanta Kumar Panigrahi

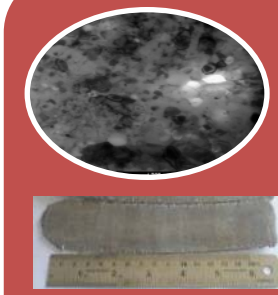
PhD, IIT Roorkee, India

Professor, Mechanical Engineering

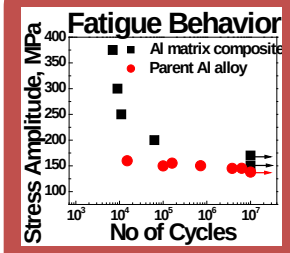
044-2257-4742; skpanigrahi@iitm.ac.in

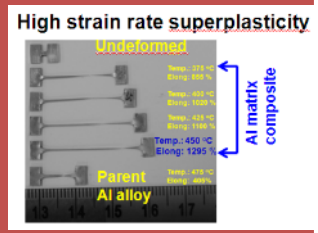
http:// http://mech.iitm.ac.in/Faculty/ssk/home.php

- **Development /manufacturing of advanced materials**
  (Bulk ultrafine/nano grained materials, metal matrix composites, nano composites, high strain rate superplastic materials, advanced materials as per design etc.)
- **Fundamental behavior of advanced materials**
  (Materials characterization, mechanical properties and machining related studies)
- **Joining and processing of similar and dissimilar materials**

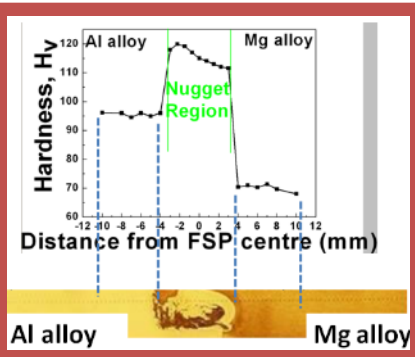


Properties of Bulk UFG/Nano Materials





Behavior of Metal Matrix Nano Composites



Joining and Processing of Similar & Dissimilar Materials by Solid State Processes

Dr. S Varunkumar

Associate Professor, Mechanical Engineering

044-2257-4717; varuns@iitm.ac.in

Major Areas of Research

- Biomass gasification and combustion
- CO kinetics and emission prediction
- Combustion instability in solid rocket motors

Source: Faculty website

Dr. G Venkatarathnam

Professor, Mechanical Engineering

044-2257-4685; gvenkat@iitm.ac.in

Major Areas of Research

- Development of new generation of refrigerators and liquefiers
- Mixed refrigerant processes, refrigerant mixtures, low GWP refrigerants
- High efficiency heat exchangers, Thermodynamics, Process Simulation

Patents on Mixtures, new mixed refrigerant liquefiers, refrigerators

Organic Rankine Cycle based small power plants

Cooling of telecom equipment

Development of next generation Refrigeration Systems and Refrigerants

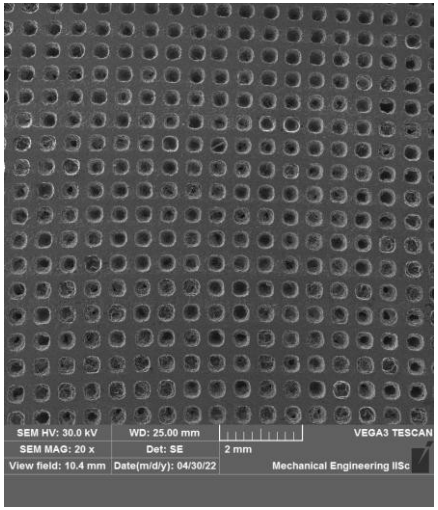
Dr.Vimal Edachery

Ph.D., Indian Institute of Science, India

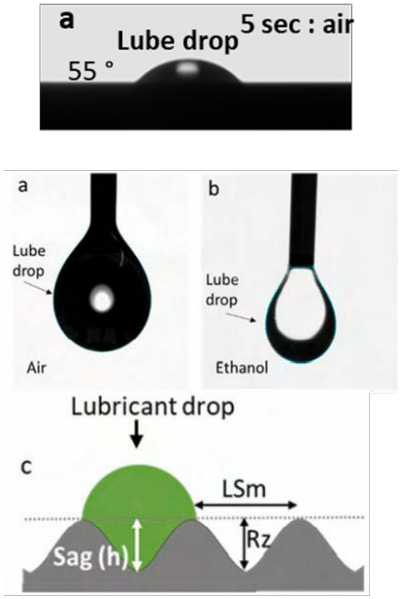
Assistant Professor, Mechanical Engineering

044-2257-4687; vimal@iitm.ac.in

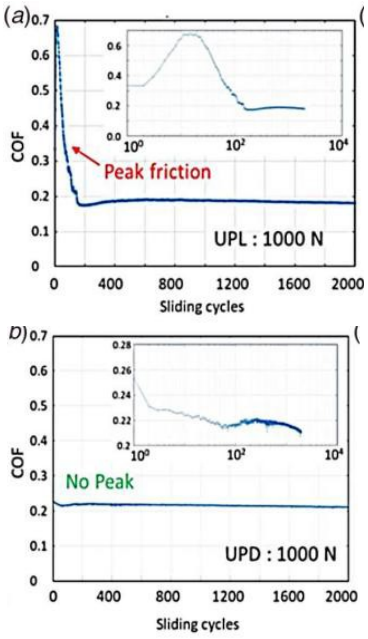
- Tribology, Micro-Nano Surface Engineering and Metrology
- Lubrication (Eco-friendly and Electric vehicle lubricants)
- Corrosion and Implant biomaterials



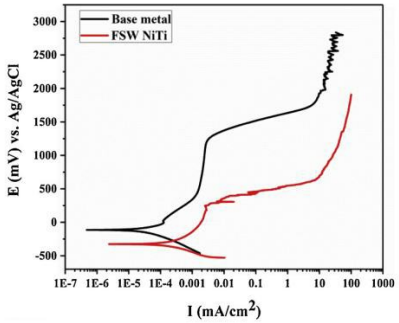
Developing Micro-Nano Surfaces



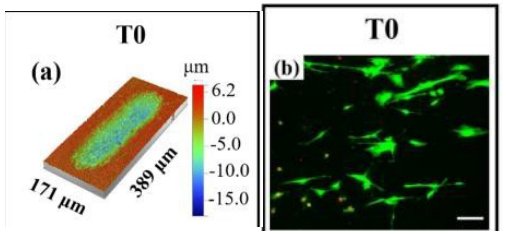
Development and Lubrication performance evaluation



Tribological performance evaluation and analysis



Corrosion, performance evaluation and analysis



Implant Biomaterials, development and testing

Dr. Vishal V R Nandigana

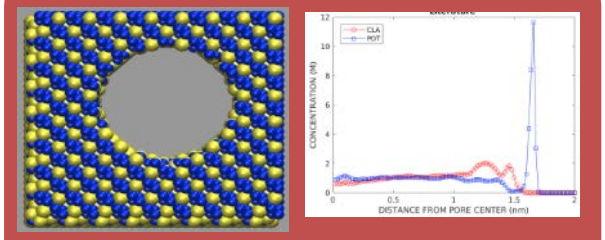
PhD, University of Illinois at Urbana-Champaign,USA

Associate Professor, Mechanical Engineering

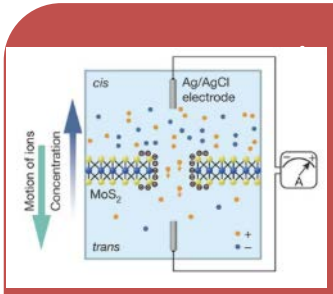
044-2257-4668; nandiga@iitm.ac.in

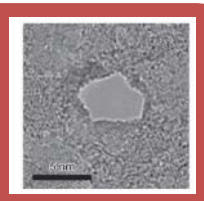
https://home.iitm.ac.in/nandiga/index.html

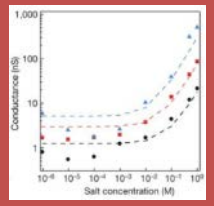
- Computational Nanofluidics – Understanding fundamental ion transport in solid-state nanochannels and nanopores
- Nanomaterials – Energy harvesting using advanced 2D MoS_2 nanomaterials
- Nano circuits - Nanofluidic based circuits like nanofluidic diodes for sensor applications



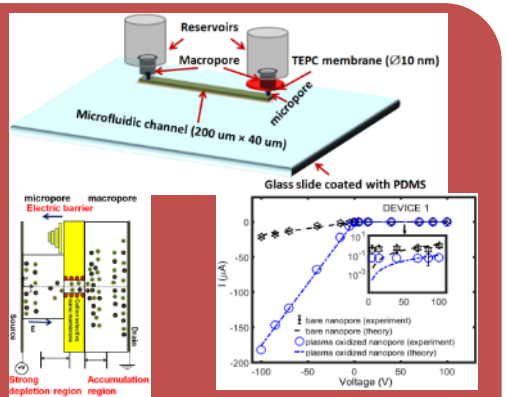
Computational nanofluidics







Nanomaterials



Nano circuits

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

Dr. Viswanath K

Assistant Professor, Mechanical Engineering

044-2257-4664; viswanathk@iitm.ac.in

Major Areas of Research

Turbomachines

Source: Faculty website

INDIVIDUAL FACULTY PROFILE

DEPARTMENT OF MEDICAL SCIENCE AND TECHNOLOGY

LIST OF FACULTY

- Anubama Rajan
- Boby George
- Muraki K
- Pradeeba Sridar
- Rupsa Bhattacharjee
- Sanjukta Patra
- Srikanth Vedantam
- Srinivasa Chakravarthy V
- Sunil Kumar Boda

Dr. Anubama Rajan

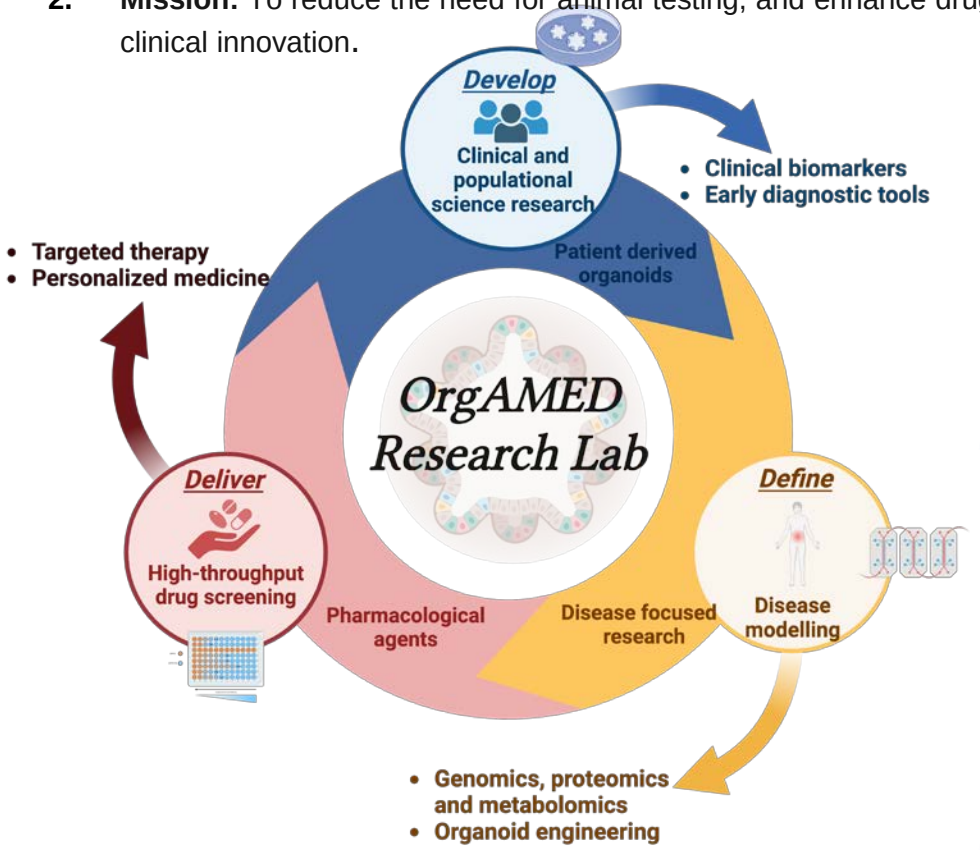
PhD, Baylor College of Medicine, USA

Assistant Professor, Medical Sciences and Technology

+91-8667062535; anu@zmail.iitm.ac.in

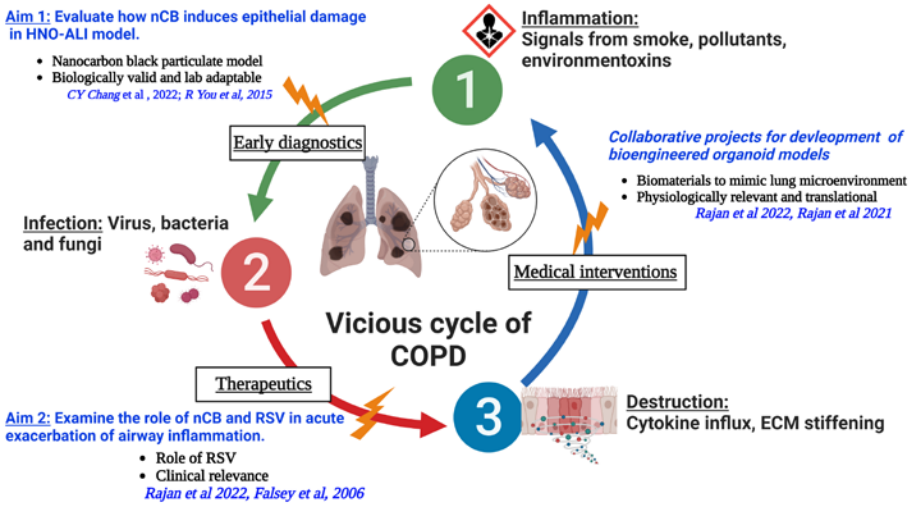
*Organoid Assisted Medicine and Enhanced Drug discovery Laboratory: (*ORGAMED lab)

1. **Vision:** Developing advanced pre-clinical models using stem-cell-derived mini-organs for understanding human diseases and help develop therapeutics.
2. **Mission:** To reduce the need for animal testing, and enhance drug development and discovery rates, for effective, and efficient pre-clinical innovation.



Funded India Alliance Wellcome DBT ECF Project

Mechanisms of nanocarbon black and RSV mediated inflammation in COPD using human airway organoid model.



Dr. Boby George

PHD- IITM, Post-doc.-TU Graz, Austria

Professor, Medical Science and Technology

044-2257-4465; boby@ee.iitm.ac.in

http://www.ee.iitm.ac.in/facs_boby

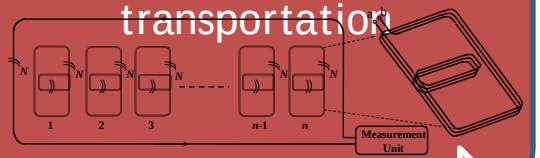
- Sensors and Instrumentation for
  - Automotive and Transportation Applications
  - Biomedical Applications/Healthcare Technologies
  - Industrial Applications

Seat Occupancy Sensor for air bag control

Brake wear sensor

Non contact ECG

New Loop sensor for intelligent transportation



Sensors and Electronic Instrumentation

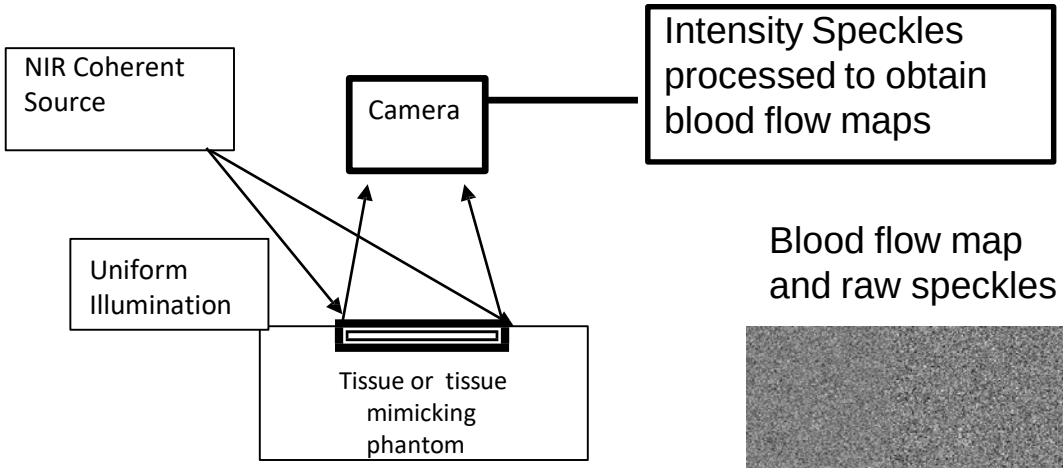
Dr. Murali K

PhD, Indian Institute of Technology Bombay

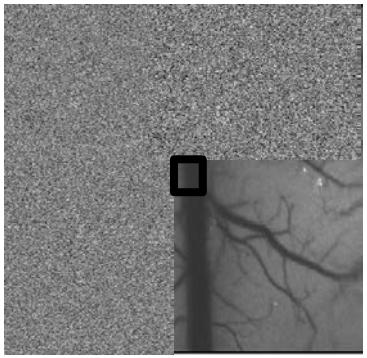
Assistant Professor, Dept. of Medical science and Technology

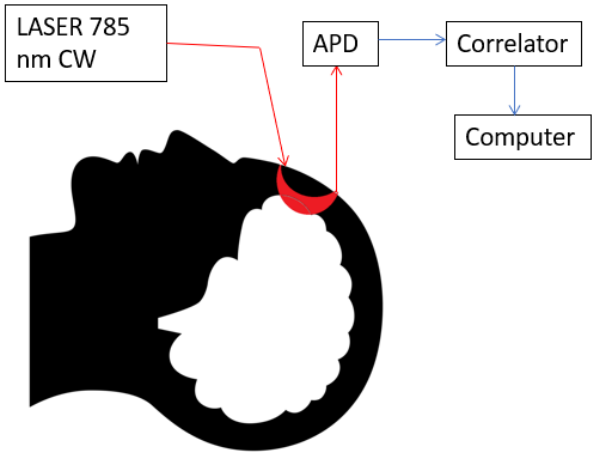
+91-9790006158; k_murali@iitm.ac.in

- System development for Intraoperative cancer imaging using exogenous contrast agents
- Non-invasive blood flow monitoring system using laser speckles – preclinical and clinical translation.



Blood flow map and raw speckles





Measures blood flow non-invasively in brain

Dr. Pradeeba S

PhD – IIT Madras, India

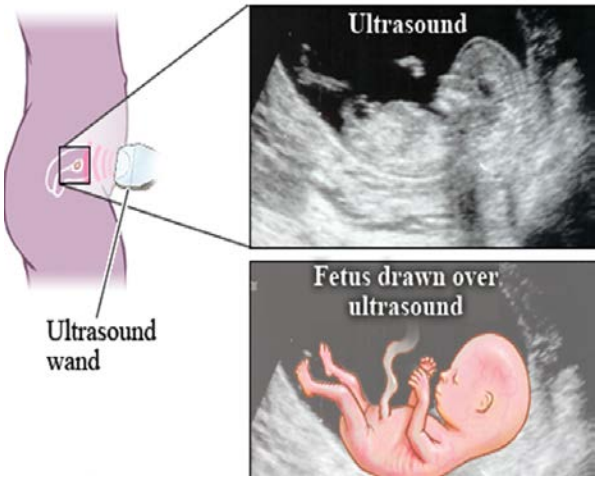
Honorary Associate of Sydney Medical School Nepean

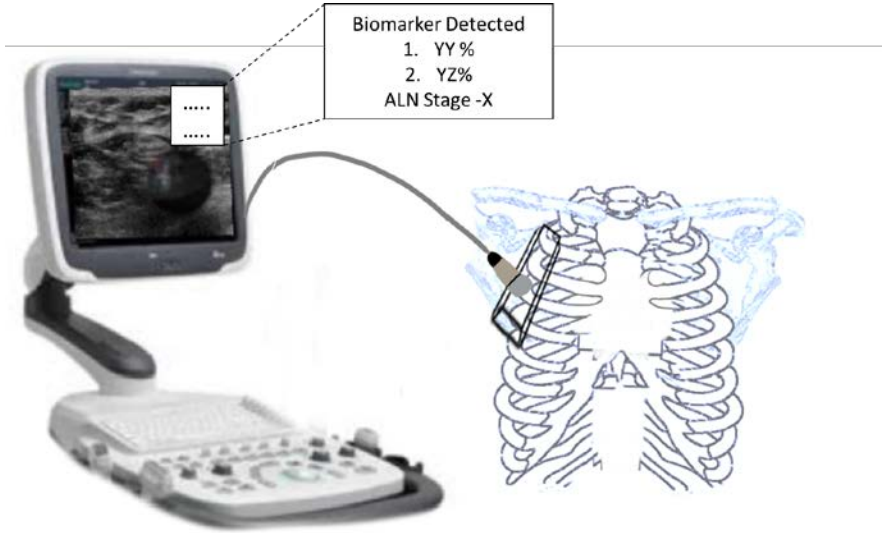
Assistant Professor, Dept. of Medical Sciences and Technology

8098489016; spradeeba@iitm.ac.in

Research Interest: Fetal Ultrasound; Biomarker identification in neuro developmental disorders; Retinal image analysis; Imaging mass cytometry/ Mammogram analysis;

Expertise: Medical image analysis, Machine learning, Medical informatics, Translational Engineering.





Detection of fetal abnormalities in the first & second trimester of pregnancy

Biomarker identification of Axillary lymph node metastasis in breast cancer patients using ultrasound.

Dr. Rupsa Bhattacharjee

PhD at IIT Delhi, Postdoc at UC San Francisco

Assistant Professor, Dept. of Medical Science & Technology

8800172999; rupsabh@iitm.ac.in

https://sites.google.com/view/rupsa-bhattacharjee-phd/bio

- Magnetic Resonance Imaging (MRI) Acquisition, Post-processing, Analysis, Computational methods (low-0.55T, mid-1.5T, high-3.0T fields)
- Specializes in Neuro, Body and Musculoskeletal Imaging Research: Glioma & Acute Ischemic Stroke, Osteoarthritis, Pain, Degenerative Diseases
- Utilizing Deep-Learning for Quantitative Biomarker evaluation, and disease detection

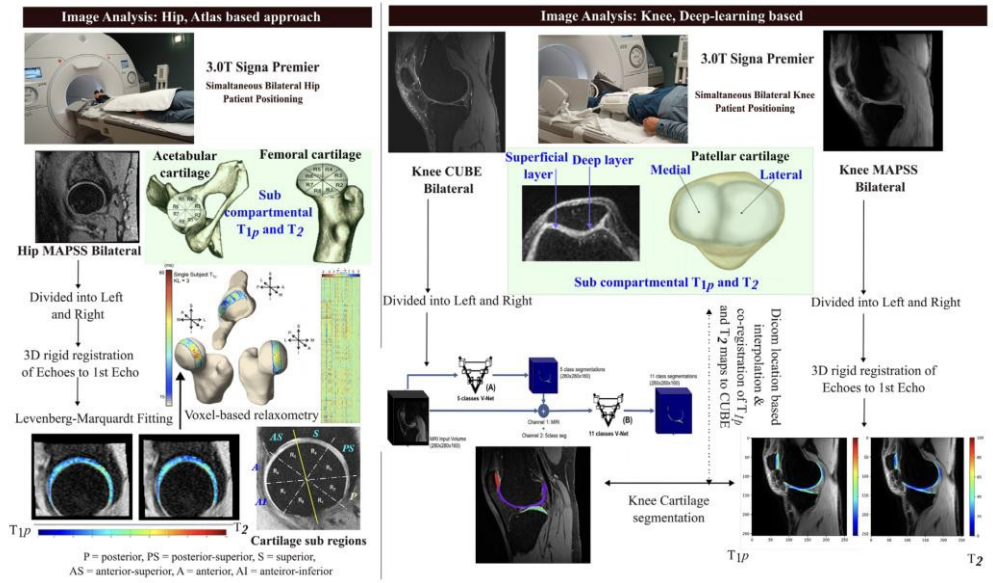
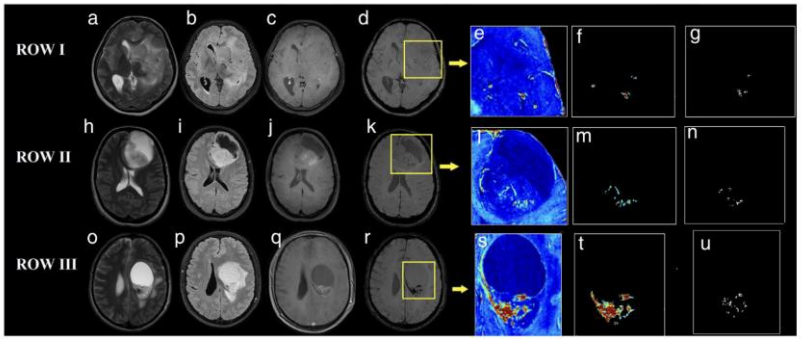
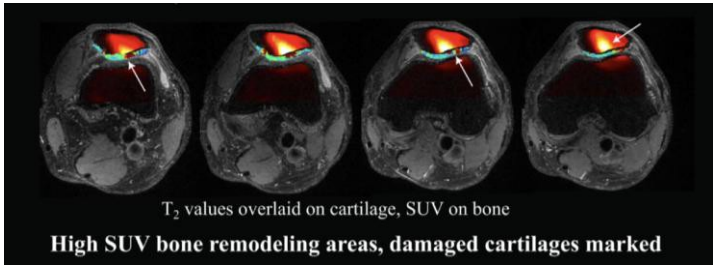


FIGURE 1: Schema of methodology: Image acquisition, processing, segmentation, analysis, and evaluation.





Computational & Quantitative Medical Imaging Techniques and Health Informatics

Dr. Sanjukta Patra

PHD, CFTRI-CSIR, Mysore, India

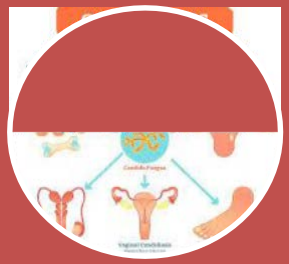
Assistant Professor, Dept. of Medical Sciences and Technolo

044-2257-2111; sanjukta@iitm.ac.in

http://www.iitm.ac.in/ - https://mst.iitm.ac.in/faculty/

- Development of sensors and PoCs for disease diagnosis and health monitoring.
- Process development for efficient production of biomolecules for healthcare.
- Design of multi-targeted therapeutic strategies for addressing drug resistance.

Multitargeting and development of diagnosis platforms for Tuberculosis



Design of novel biosensors for the Point-of-Care diagnosis of Candidiasis

Innovative platforms for recombinant production of biomolecules for healthcare: addressing existing challenges

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

Dr. Srikanth Vedantam

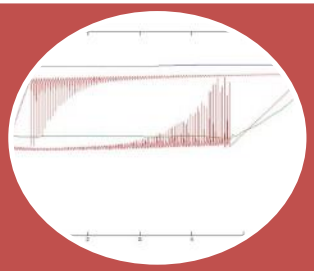
SCD, Massachusetts Inst. of Technology, USA

Professor, Medical Science and Technology

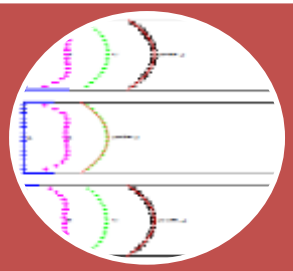
044-2257-4739; srikanth@iitm.ac.in

http://ed.iitm.ac.in/~srikanth

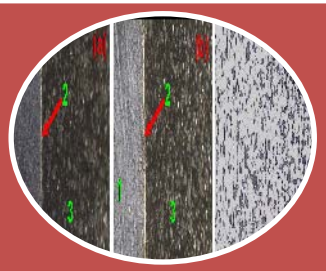
- Mechanics of Smart Materials and Functionally Graded materials
- Hydrodynamics of flow in microchannels
- Discrete computational mechanics



Shape memory reinforced composites for impact resistant structures



DNA separation and manipulation of biological cells in microchannels



Functionally graded materials for brake applications

Dr. V Srinivasa Chakravarthy

PhD, University of Texas at Austin, Austin, USA

Professor, Medical Science and Technology

044-2257-4115; schakra@iitm.ac.in

http://www.biotech.iitm.ac.in/faculty/CNS_LAB/home.html

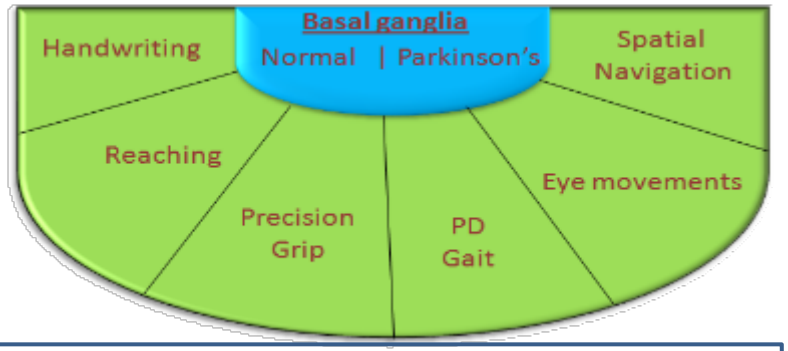
Research Area: Computational Neuroscience

Objective 1:
Develop a comprehensive Computational model of Basal Ganglia, a part of the brain affected in Parkinson's Disease

Application:
The model developed has potential Application in Deep Brain Stimulation Surgery for PD.

Objective 2:
Using computational modeling, study the role of vascular dynamics on neural activity.

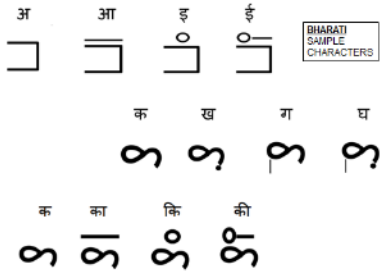
Application: Leads to the radical notion of vascular computation



Research Area:

Indian Language Technology

Develop a new script called Bharati. The script can represent 9 major Indian scripts. Simple and easy to learn.



Dr. Sunil Kumar Boda

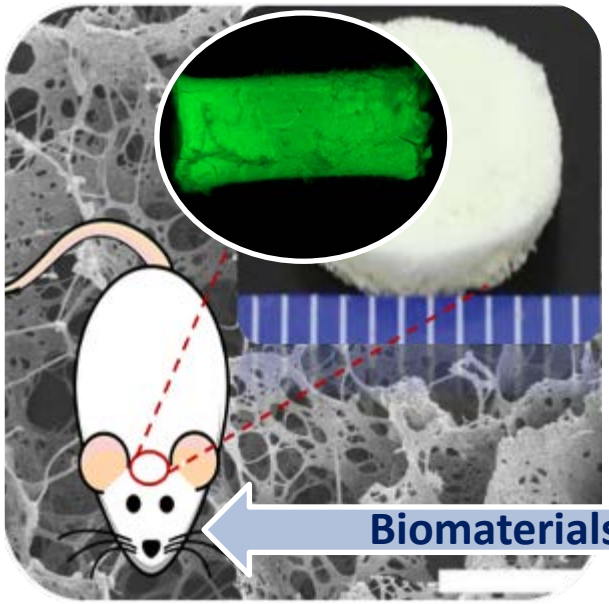
Ph.D., Indian Institute of Science, Bangalore, India

Assistant Professor, Dept. of Medical Science & Technology, IITM

+91-9363615301; sunilboda@iitm.ac.in

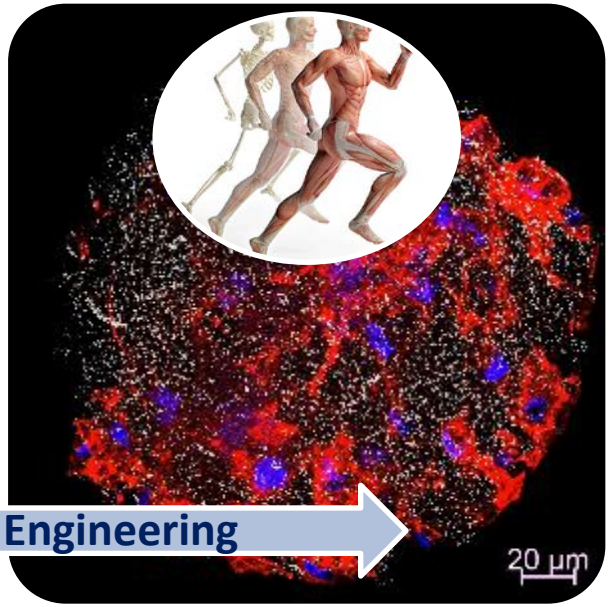
https://mst.iitm.ac.in/faculty/

- Orthopedic Biomaterials and Biomechanics
- Hard and Soft Tissue Integration of Percutaneous Bone Anchored Prostheses
- Musculoskeletal Tissue Engineering



Synthetic Resorbable Bone Grafts

Percutaneous Bone Anchored Metallic Prostheses



Musculoskeletal Tissue Engineering

Biomaterials for Bone, Joint and Soft Tissue Engineering

INDIVIDUAL FACULTY PROFILE

DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING

LIST OF FACULTY

- Ajay Kumar Shukla
- Anand K Kanjarla
- Balasubramanian M
- Bhattacharya S S
- Bhuvanesh Srinivasan
- Gandham Phanikumar
- Ganesh Sundara Raman S
- Hari Kumar K C
- Hema Prabha E
- Kamaraj M
- Ravi Sankar Kottada
- Lakshman Neelakantan
- Manas Mukherjee
- Murty B S
- Murugaiyan Amirthalingam
- Parasuraman Swaminathan
- Pradeep K G
- Prathap Haridoss
- Ranjit Bauri
- Ravikumar N V
- Rohit Batra
- Sabita Sarkar
- Sankaran Shanmugam
- Satyesh Kumar Yadav
- Somnath Bhattacharyya
- Sreeram Krishnamoorthy Kalpathy
- Srinivasa Rao Bakshi
- Subramanya Sarma V
- Surendra Babu Anantharaman
- Tiju Thomas
- Uday Chakkingal

Dr. Ajay Kumar Shukla

Professor, Metallurgical and Materials Engineering

044-2257-4762; shukla@iitm.ac.in

Major Areas of Research

- Process modeling, control and optimization of iron and steelmaking
- Computational thermodynamics and its application to high temperature metallurgical processes
- Application of Artificial Intelligence (ANN, GA) to metallurgical processes

Source: Faculty website

Dr. Anand K Kanjarla

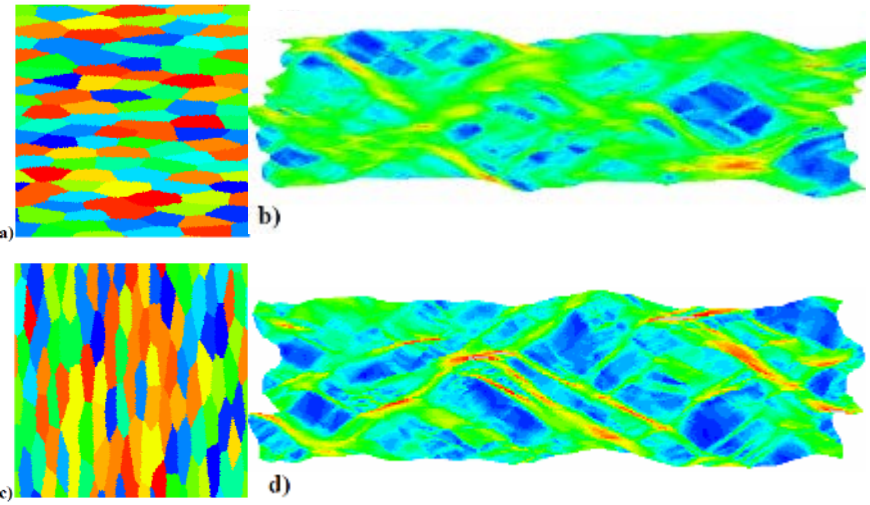
Associate Professor, Metallurgical and Materials Engineering

044-2257-4753; kanjarla@iitm.ac.in

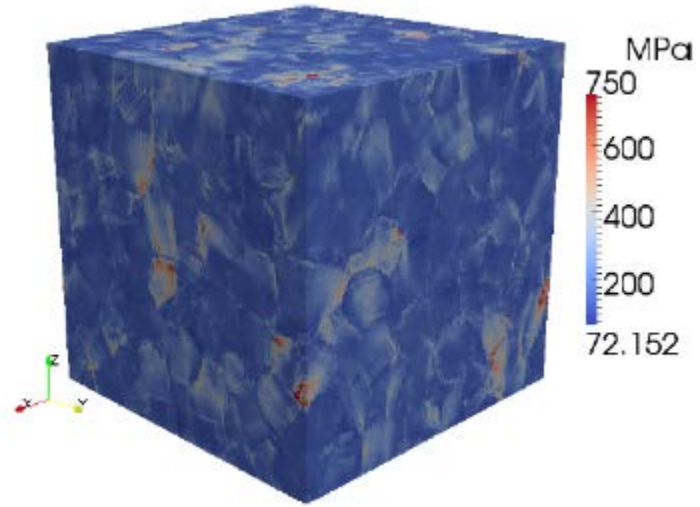
Major Areas of Research

- Micromechanical modelling of polycrystalline materials.
- Mechanical anisotropy of materials : crystallographic texture
- Mechanics of irradiated microstructures

Effect of grain morphology on shear band formation in an Aluminum alloy



Occurrence of stress concentrations close to grain boundaries in deformed Zirconium sample



Dr. M Balasubramanian

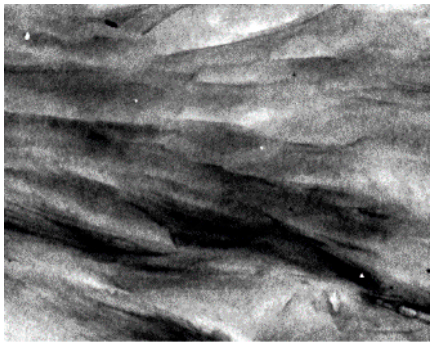
Professor, Metallurgical and Materials Engineering

044-2257-4767; mbala@iitm.ac.in

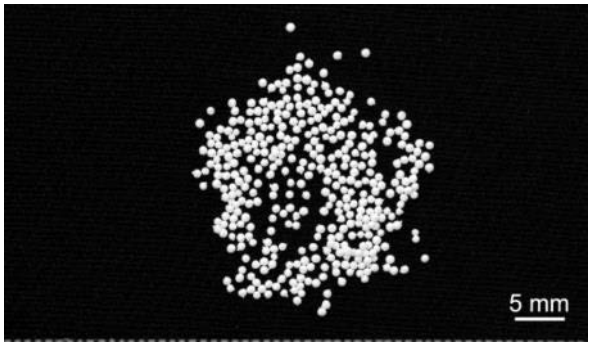
https://mme.iitm.ac.in/mbala/

Major Areas of Research

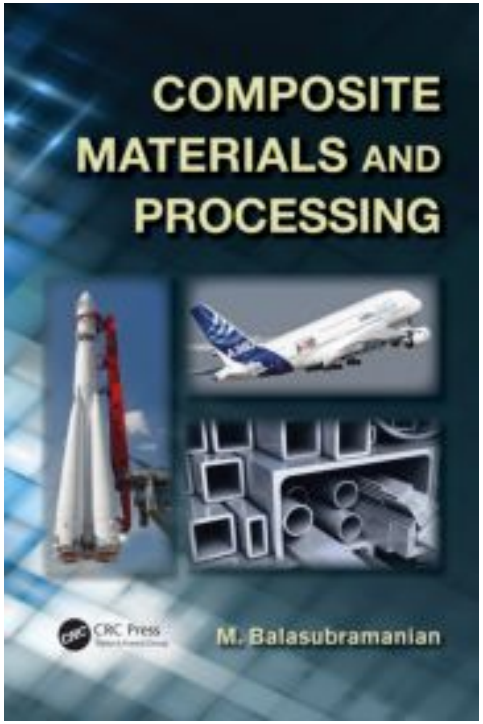
- Processing of advanced ceramics
- Processing of composite materials including nanocomposites

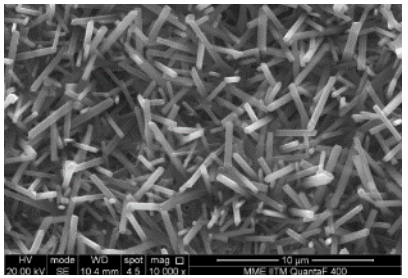


Clay-polyester nanocomposite

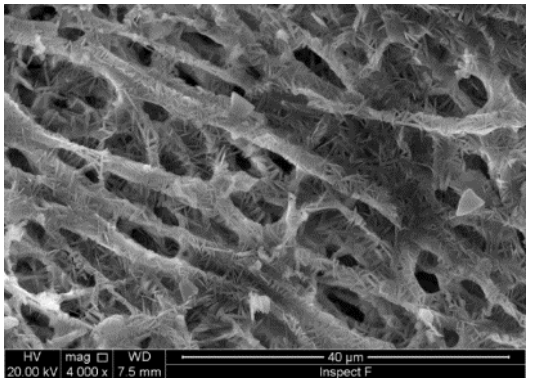


Alumina-zirconia minispheres





Microstructure of porous mullite



Alumina platelets formed on egg-shell membrane bio-template

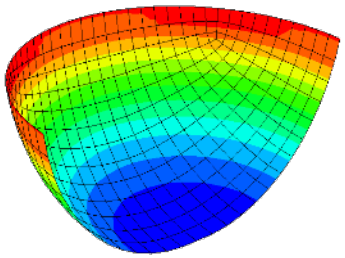
Dr. S S Bhattacharya

Professor, Metallurgical and Materials Engineering
Nano Functional Materials Technology Centre,
Materials Testing Facility – Materials Forming Lab
044-2257-4765; ssb@iitm.ac.in
http://mme.iitm.ac.in/ssb

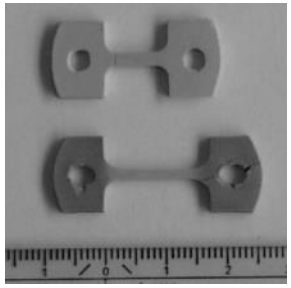
Major areas of research

- Synthesis, Consolidation and Sintering of nanostructured materials
- Characterisation of Structural and Functional Nanocrystalline Ceramics
- Super plasticity (SP) and Superplastic Forming (SPF) of Materials
- Metal Forming and Mechanical Behaviour of materials

SPF of Ti-6Al-4V

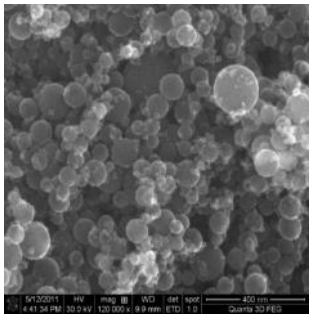


SPF – FE Modeling

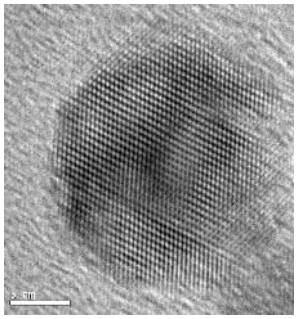


SP of nano zirconia

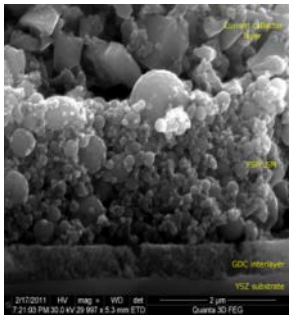
SPF/DB of nanoceramics



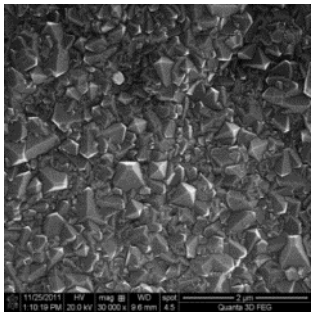
Nanocrystalline alumina



A nanotitania particle



Nano LSM for fuel cells



NCD coating on tool

Chemical vapour synthesis set-up (top)
Flame synthesis set-up (bottom)

Dr. Bhuvanesh Srinivasan

PhD, CNRS – University of Rennes 1, France

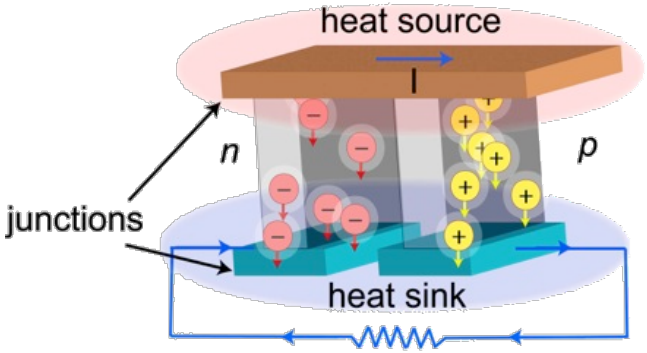
Assistant Professor, Metallurgical and Materials Engineering

044-2257-4783; bhuvanesh.srini@iitm.ac.in

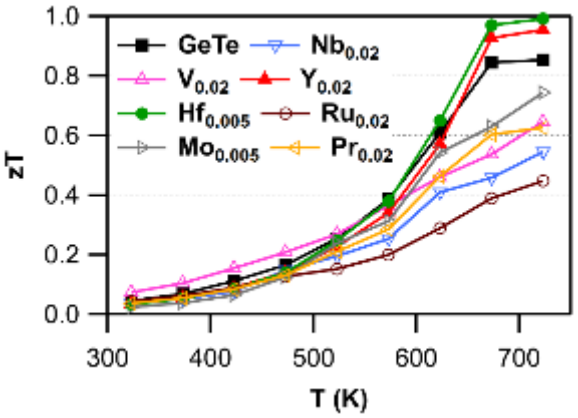
Research Area 1: Thermoelectric Materials for waste heat recovery/energy harvesting

Research Area 2: Material Processing

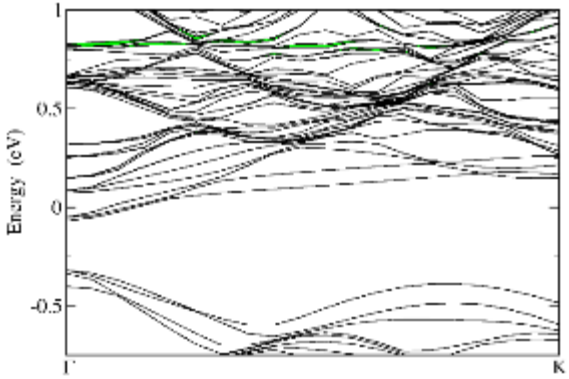
Research Area 3: Cementitious Materials



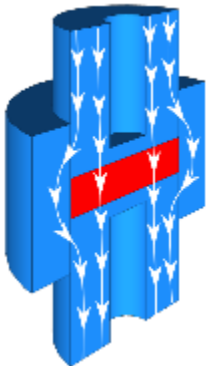
Thermoelectric module



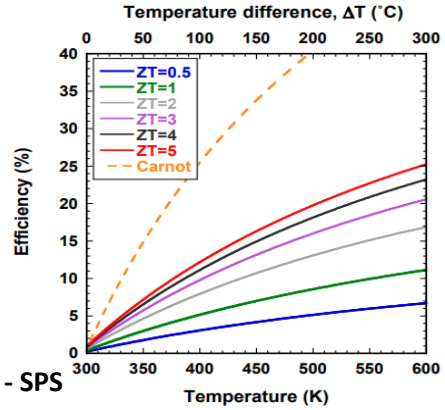
Experimental & theoretical screening of dopants



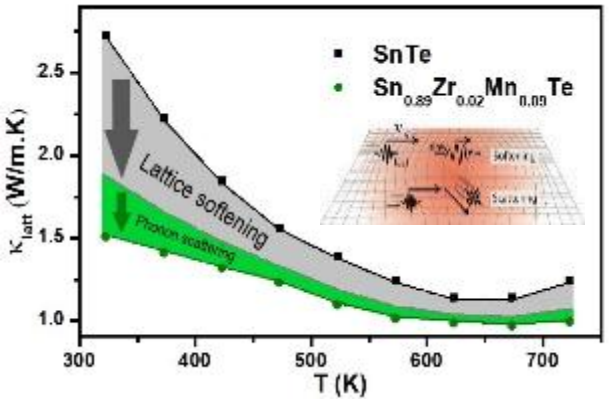
Electronic band structure engineering



Processing of materials - SPS



Efficiency depends on figure of merit (zT)



Suppression of thermal conductivity

Dr. Gandham Phanikumar

Professor, Metallurgical and Materials Engineering

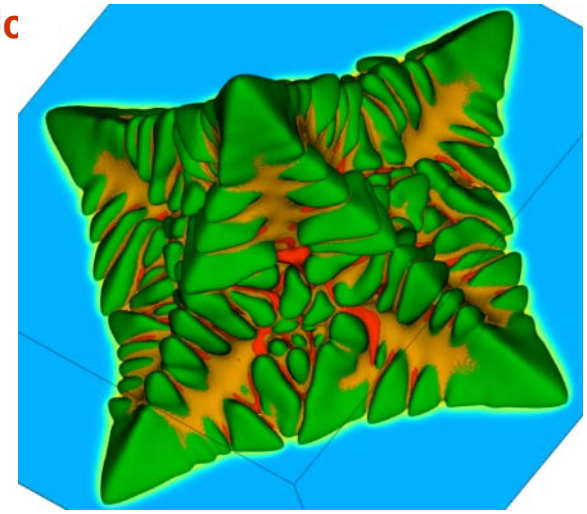
044-2257-4770; gphani@iitm.ac.in

Major Areas of Research

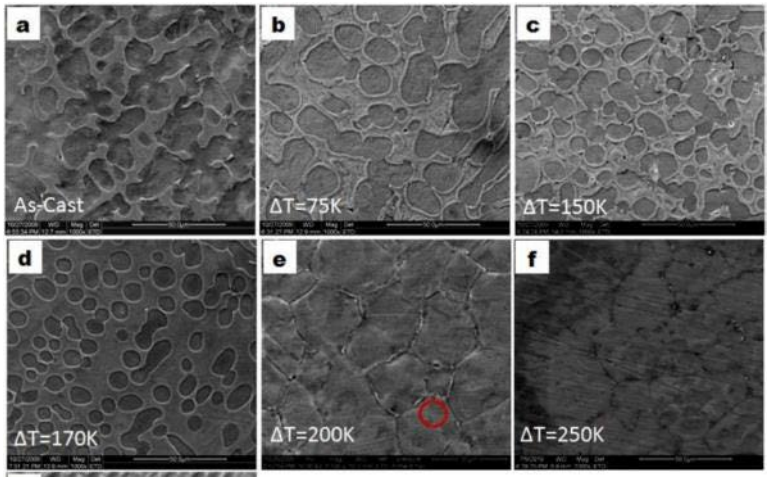
- Solidification – experiments & modeling
- Phase field simulation of microstructure evolution
- Materials Joining

Electromagnetic Levitatic for under cooling

3D simulation of dendrite



Microstructure evolution

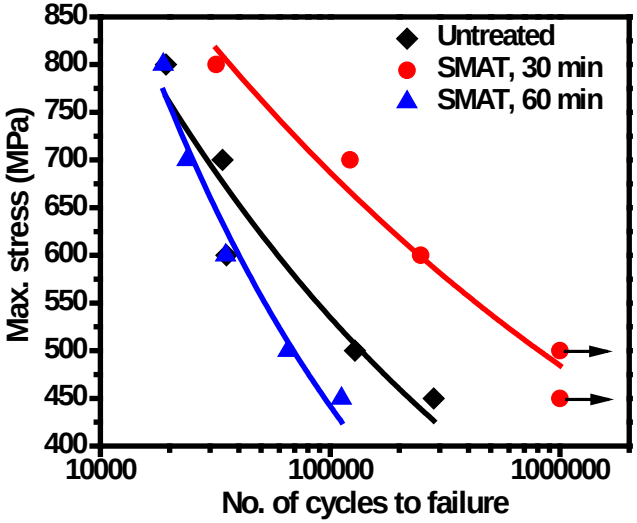


Dr. S Ganesh Sundara Raman

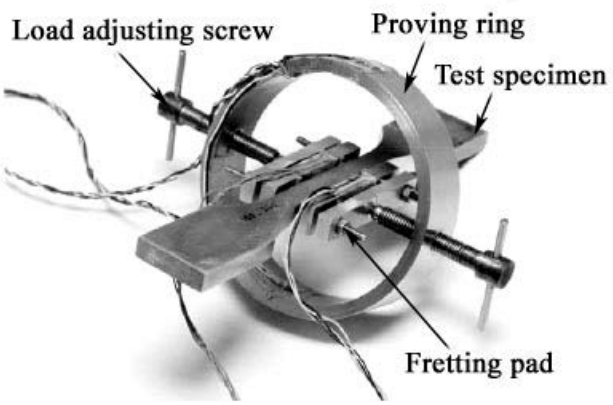
Professor, Metallurgical and Materials Engineering

044-22574768; ganesh@iitm.ac.in

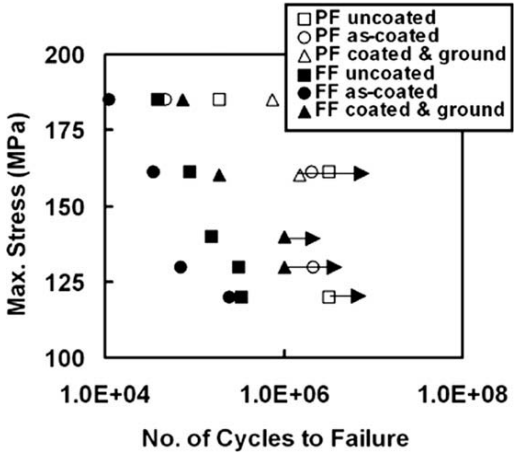
- **Fatigue Behaviour of Materials and Weldments**
- **Fretting Fatigue and Fretting Wear**
- **Surface Modification, Coatings and Thermal Spray Processing**



Effect of Surface Mechanical Attrition Treatment (SMAT) on Fatigue Lives of Ti-6Al-4V



Fretting Pads and Proving Ring Assembly used in Fretting Fatigue Testing



Effect of Grinding on Plain Fatigue (PF) and Fretting Fatigue (FF) Lives of AA 6061

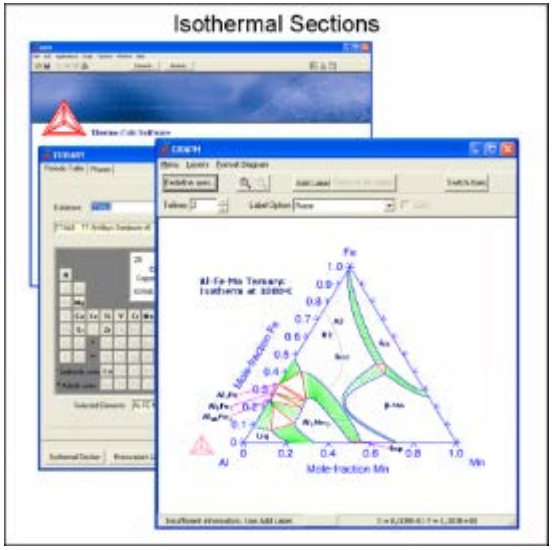
Dr. K C Hari Kumar

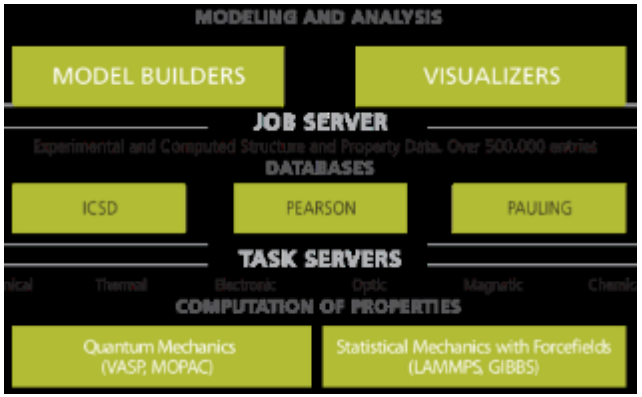
Professor, Metallurgical and Materials Engineering

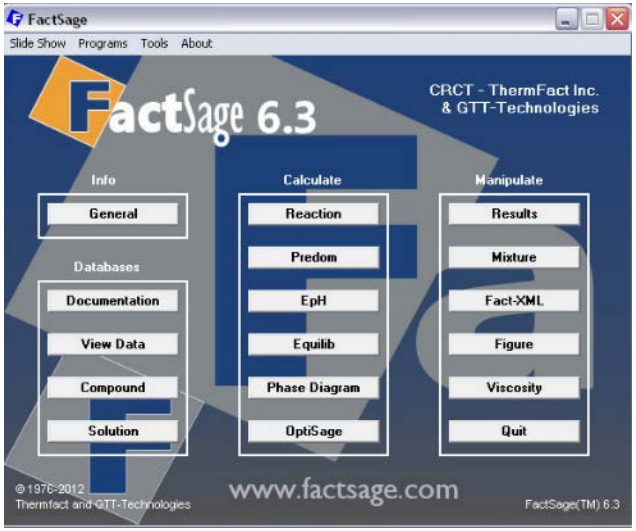
044-2257-4766; kchkumar@iitm.ac.in

Major Areas of Research

- **Gibbs Energy Modelling of Materials Employing Calphad**
- **Applications of Density Functional Theory in Materials Science**
- **Modelling of Diffusion Controlled Transformations in Ferrous and Non-ferrous Alloys**







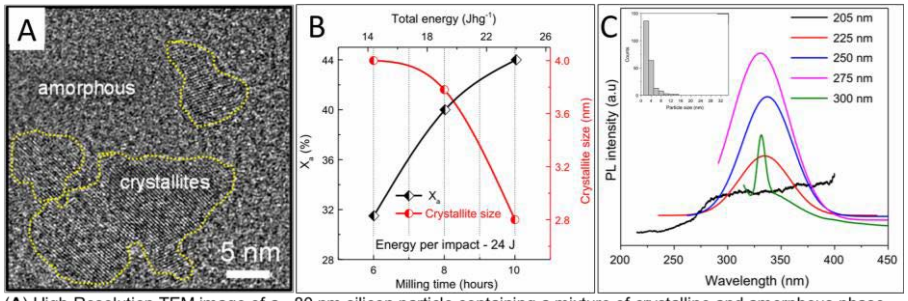
Dr. E Hemaprabha

PhD, IISc Bangalore, India

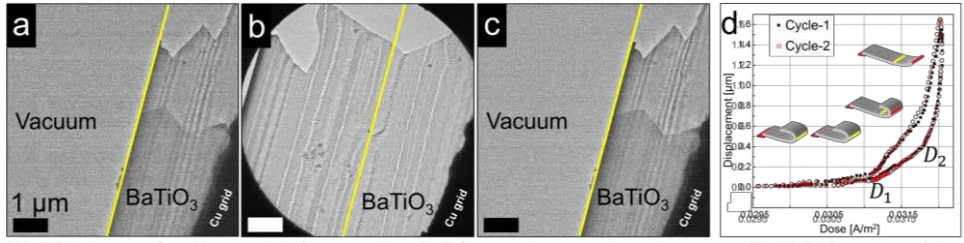
Assistant Professor, Metallurgical and Materials Engineering

044-2257-4758; gettu@iitm.ac.in

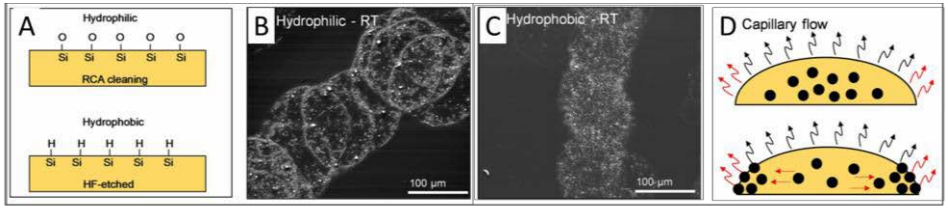
- *In situ* electron microscopy,
- Functional nanomaterials and thin films,
- Atomic to device-scale functionality investigation,
- Phase transformation studies
- Electronic device fabrication and characterization



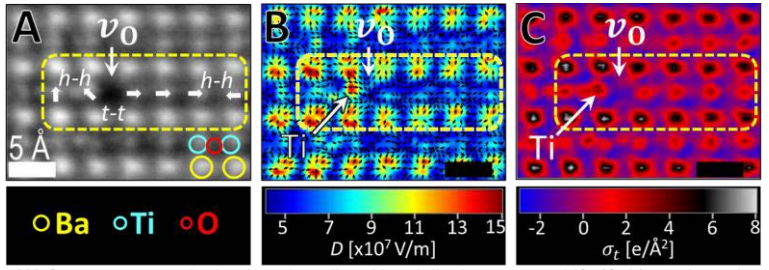
(**A**) High-Resolution TEM image of a ~80 nm silicon particle containing a mixture of crystalline and amorphous phase, (**B**) Milling energy map (**C**) UV-range photoluminescence from silicon quantum dots.



(**A**) TEM image of a 30 nm thick free standing $BaTiO_3$ membrane at its native state, (**B**) Unfolded state of the membrane under 0.0337 A/m^2 electron dose (**C**) Membrane returned to native upon reduction of dose exposure. (**D**) Quantified repeatable and reversible electromechanical effect.



(**A**) Si-O termination leads to hydrophilic, HF-treatment leads to hydrophobic substrate, (**B**) Coffee-ring effect when printed on hydrophilic surface (**C**) No significant coffee rings on a hydrophobic surface, (**D**) Schematic of the capillary flow, causing coffee ring formation.



(**A**) Oxygen vacancy in the domain wall and local dipole-moment shift, (Sub)atomic-scale (**B**) Electric-field and (**C**) Charge density. Material: $BaTiO_3$.

Dr. M Kamaraj

Professor, Metallurgical and Materials Engineering

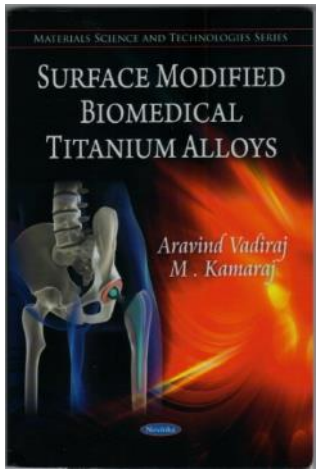
044-2257-4768; kamaraj@iitm.ac.in

Major Areas of Research

- **Life enhancement of power plants (thermal/hydro/nuclear) components by surface coatings**
- **Development of coatings for Bio-implants**
- **Wear properties: Correlations of Microstructure-process parameters**

Slurry erosion wear test

Sliding wear test (Pin-on-Disc



Dr. Ravi Sankar Kottada

Professor, Metallurgical and Materials Engineering

+91 44 2257 4779; ravi.sankar@iitm.ac.in

Primary research interests:

- High temperature deformation of advanced materials
- Multi-component high entropy alloys and their deformation behavior
- High temperature life-term prediction of advanced materials
- Creep of magnesium-base alloys

Source: Faculty website

Dr. Lakshman Neelakantan

Professor, Metallurgical and Materials Engineering

044-2257-4786; nlakshman@iitm.ac.in

Major Areas of Research

- Corrosion characteristics of engineering materials and coatings
- Electrochemical behaviour of NiTi, NiTi-X Shape Memory Alloys (SMAs)
- Smart coatings for corrosion protection
- Electro-dissolution, -planarization and -deposition
- Micro and mechano electrochemistry
- Corrosion behaviour of Metallic Bipolar Plates

Source: Faculty website

Dr. Manas Mukherjee

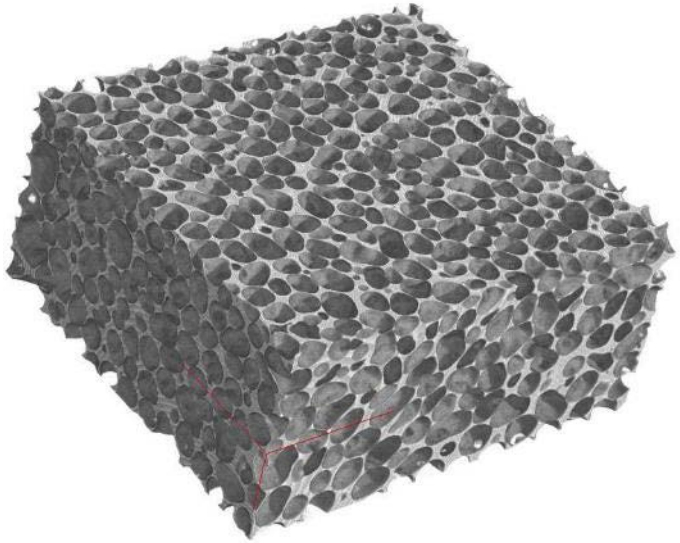
Associate Professor, Metallurgical and Materials Engineering

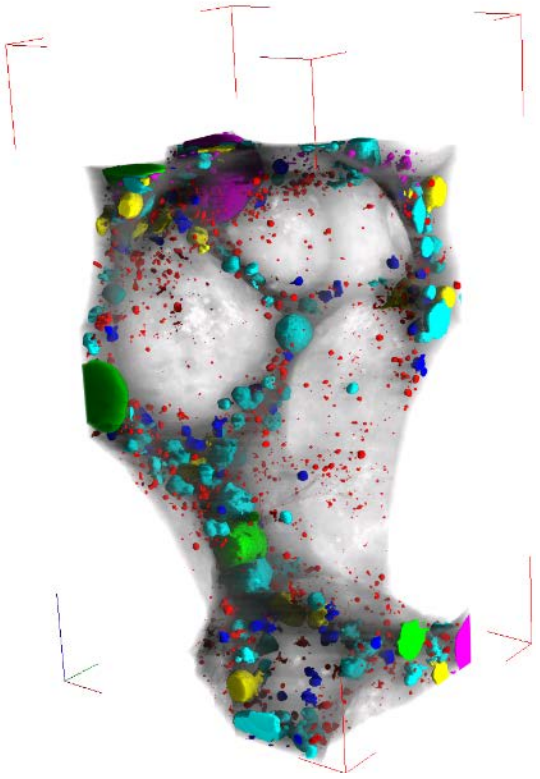
+91-44-2257-4782; manas.mukherjee@iitm.ac.in

http://mme.iitm.ac.in/manas.mukherjee/

Major Areas of Research

- **Metal foams - processing and characterization**
- **Physics of metal foaming**
- **X-ray tomography-based structural analysis**





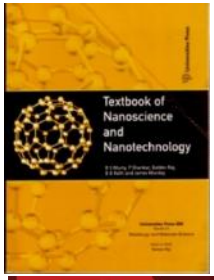
Dr. B S Murty

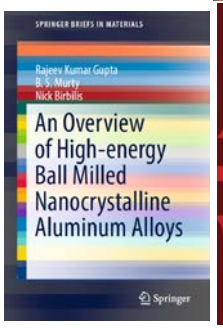
Institute Professor, Metallurgical and Materials Engineering

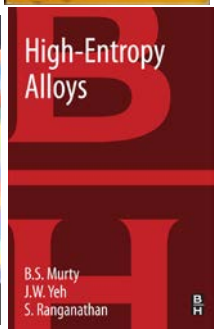
044-2257-4754; murty@iitm.ac.in; www.mme.iitm.ac.in/murty

Major Areas of Research

- Development of structural and functional nano materials
- Development of high entropy alloys and bulk metallic glasses
- In-situ metal matrix composites and metal foams







Research Facilities in the Group

- Fritsch P-5 and Simoloyer high energy ball bills
- Spark plasma sintering and microwave sintering furnace
- Local Electrode Atom Probe (LEAP)
- TEM (Tecnai T12, T20)
- Dual Beam FIB (Helios)
- XRD (Panalytical)
- Nanoindentor (Hysitron)
- Dilatometer (up to 1650^{o}C)
- DSC/TGA (up to 1500^{o}C)

Local Electrode Atom Probe

Spark Plasma Sintering

Dr. Murugaiyan Amirthalingam

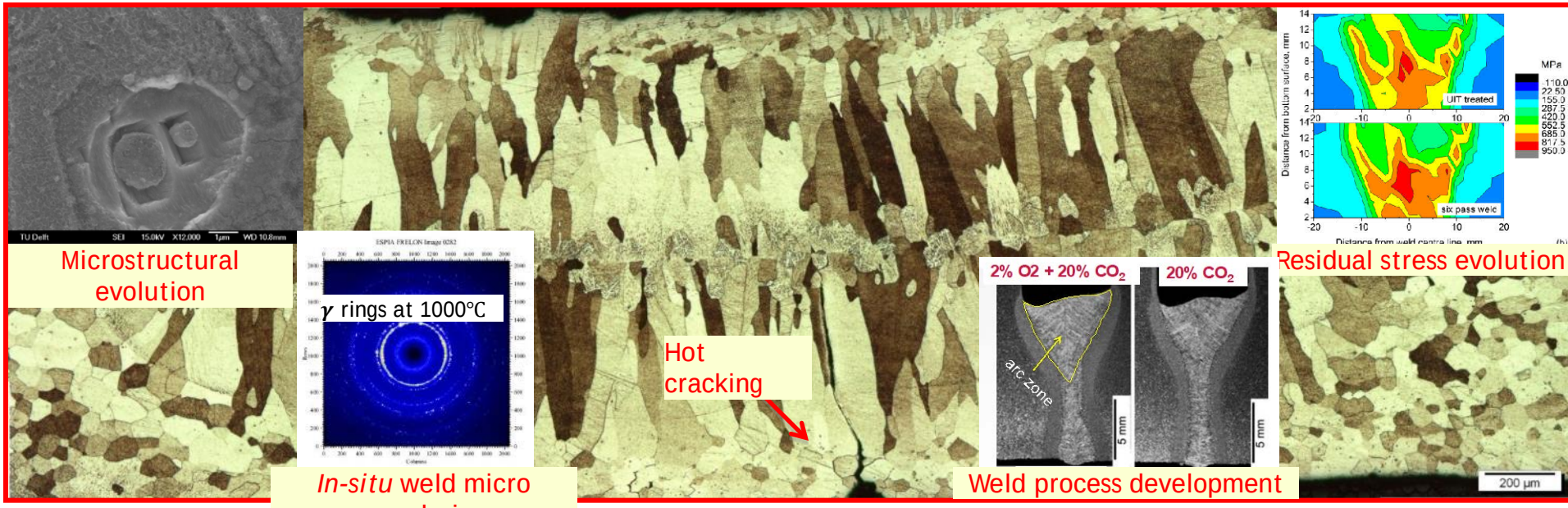
Associate Professor, Metallurgical and Materials Engineering

044-2257-4784; murugaiyan@iitm.ac.in

https://home.iitm.ac.in/murugaiyan/

Major Areas of Research

- Welding metallurgy and welding processes modelling
- Steel product development and thermomechanical processing
- *In-situ* 3D synchrotron X-ray diffraction and
- Additive manufacturing



Dr. Parasuraman Swaminathan

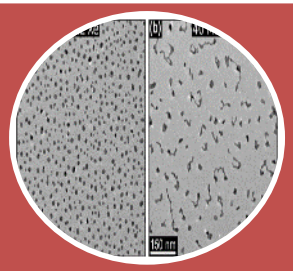
PhD, University of Illinois at Urbana Champaign, USA

Professor, Metallurgy and Materials Engineering

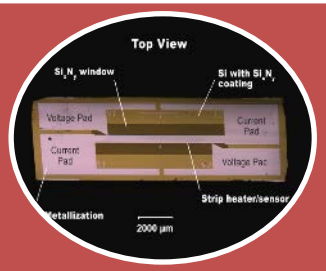
swamnthn@iitm.ac.in

- Electronic Materials – semiconductor quantum dots
- Nanoparticle assembly by physical vapour deposition
- Nanocalorimetry - Phase transformation in thin metal/alloy films

LEDs, LASERs



Catalyst arrays



Nanocalorimetry – enthalpy measurements

Dr.-Ing K G Pradeep

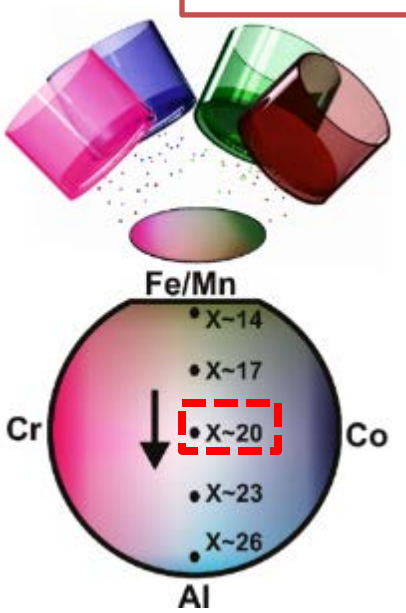
PhD, RWTH Aachen University, Germany

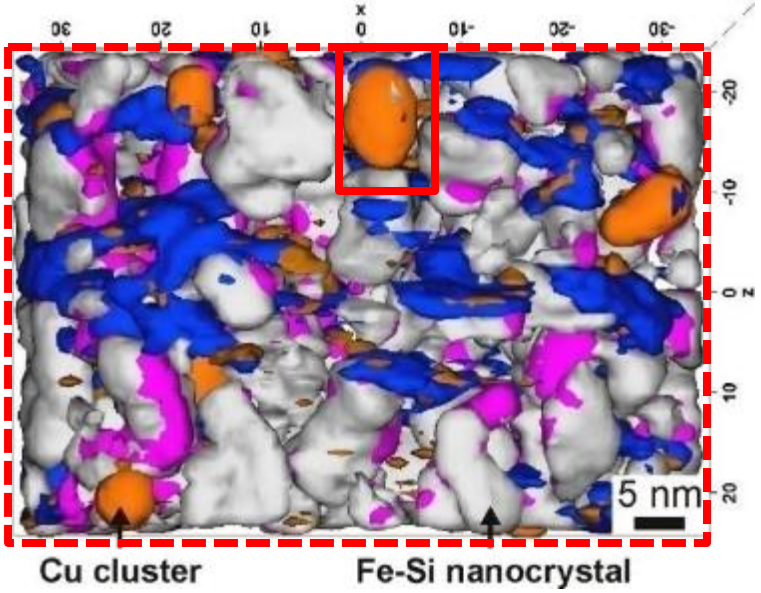
Associate Professor, Metallurgical and Materials Engineering

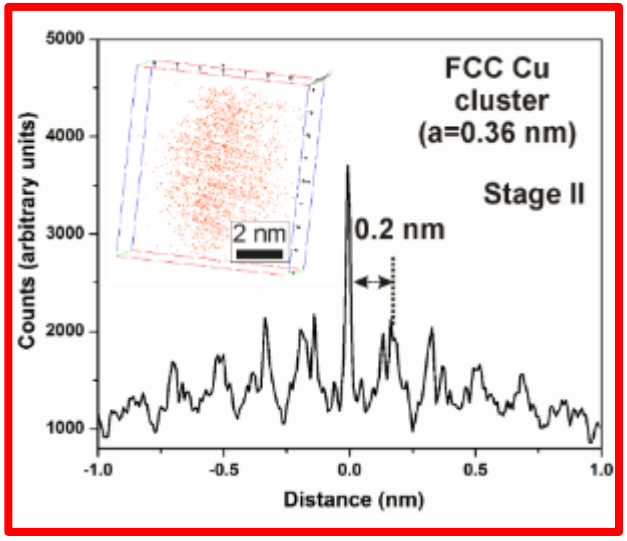
Tel: +91-(0)44-2257-4764; kgprad@iitm.ac.in

- Combinatorial alloy design - Development of advanced, high strength materials
- Magnetic materials - Rare-earth free permanent magnets and nanocrystalline soft magnets
- Correlative microscopy - Methods for hierarchical nano-scale characterisation involving atom probe tomography and multiple electron microscopy methods

Combinatorial alloy design and near atomic scale characterization







Dr. Prathap Haridoss

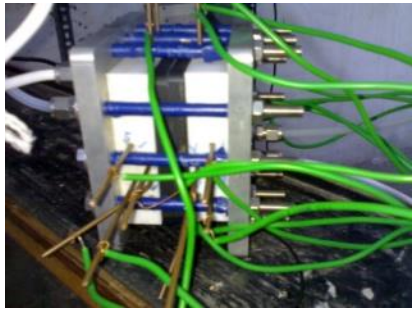
Professor, Metallurgical and Materials Engineering

044-2257-4771; prathap@iitm.ac.in

Major Areas of Research

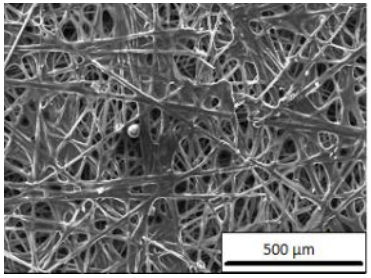
- Proton Exchange Membrane (PEM) Fuel Cells: Materials and Technology
- Carbon Nanotubes (CNTs): Synthesis and Applications

PEM Fuel Cells



Segmented fuel cell testing

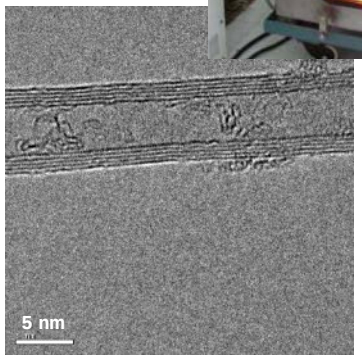
Fuel cell powered bicycle, using commercially available components

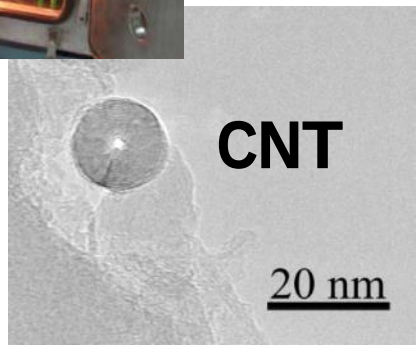


Enhanced Gas Diffusion Layer

Carbon Nanotubes

Modified Arc Discharge method for synthesis of Carbon Nanotubes





Carbon Nanotubes in different orientations

Dr. Ranjit Bauri

Professor, Metallurgical and Materials Engineering

044-2257-4778; rbauri@iitm.ac.in

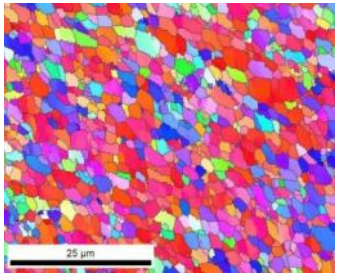
Major Areas of Research

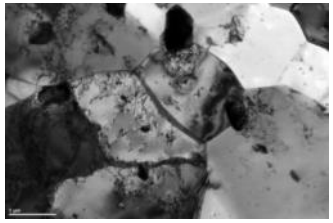
- Solid Oxide Fuel Cells (SOFC)
- Al and Ti based Metal Matrix Composites
- Friction Stir Processing (FSP)
- EBSD, Microstructure-Property Correlation

Impedance Analyzer

SOFC anode

FSP Microstructure of Al





Mini tensile tester

Dr. Rer. Nat. Ravi Kumar, N V

Professor, Metallurgical and Materials Engineering

044-2257-4777; nvrk@iitm.ac.in

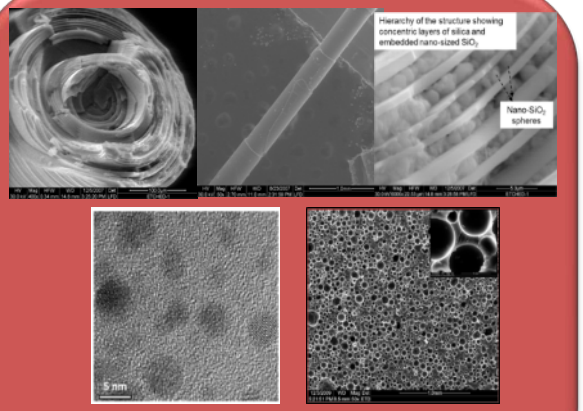
http://mme.iitm.ac.in/nvrk

Major Areas of Research

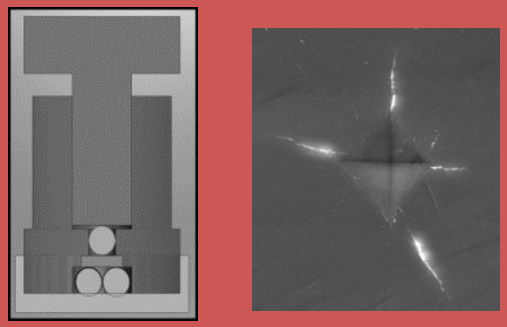
- Processing/design of molecular precursors for structural and functional applications (*Eg: UHT ceramics, transparent ceramics, thermoelectrics, coatings*)
- Biomaterials & biomimetics for technological applications *(Eg: Superhydrophobicity, adhesion studies)*
- Spectrochemical characterization (NMR, FTIR), structural characterization *(XRD, X-ray residual stress analysis, SEM, AFM, TEM)*
- Evaluation of properties: Creep, thermal shock, indentation fracture mechanics, novel mechanical testing techniques

Design of molecular precursors & ceramics

Materials Chemistry



Structural Characterization



Mechanical properties

Dr. Rohit Batra

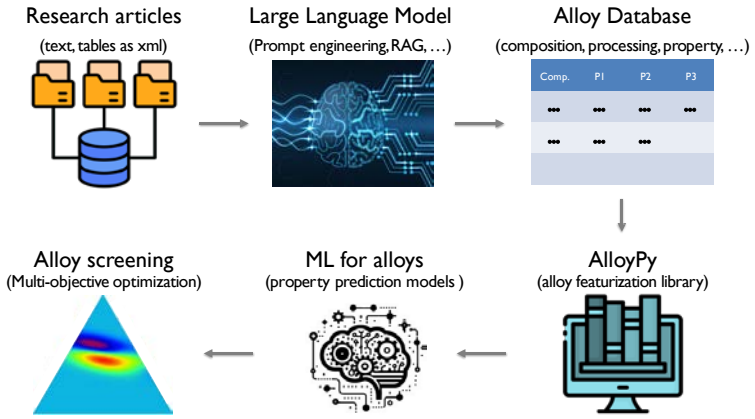
PhD, University of Connecticut, USA

Assistant Professor, Dept. of Metallurgical & Materials Engineering

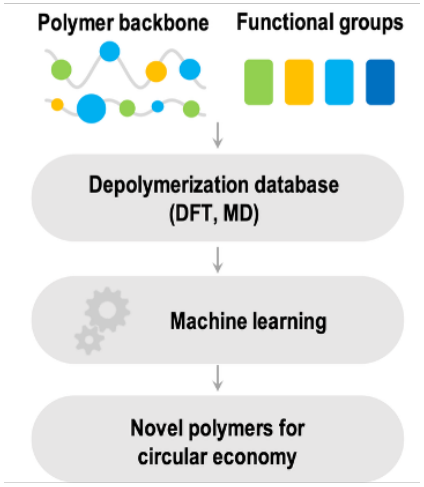
044-2257-4780; rbatra@iitm.ac.in

- Materials Informatics and Machine Learning based Materials Design and Optimization
- Fusion of quantum-mechanical methods (e.g., DFT) with AI/ML for accelerated discovery of materials
- AI/ML methods for design of:
  - Polymers for electronic and optical applications
  - High entropy alloys, inorganic oxides
  - Materials manufacturing optimization
  - Self-driving autonomous labs

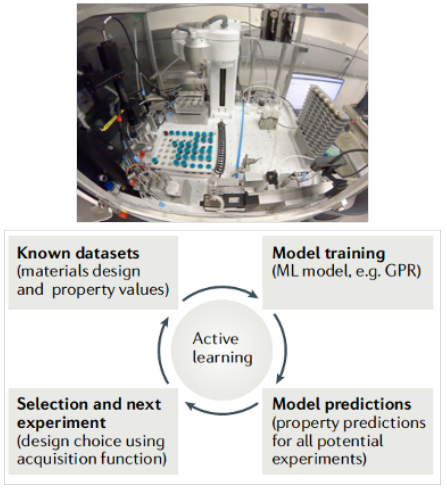
ALLOY DESIGN AND DATABASE DEVELOPMENT USING LLMs



POLYMER INFORMATICS



ML-DRIVEN AUTONOMOUS LABS



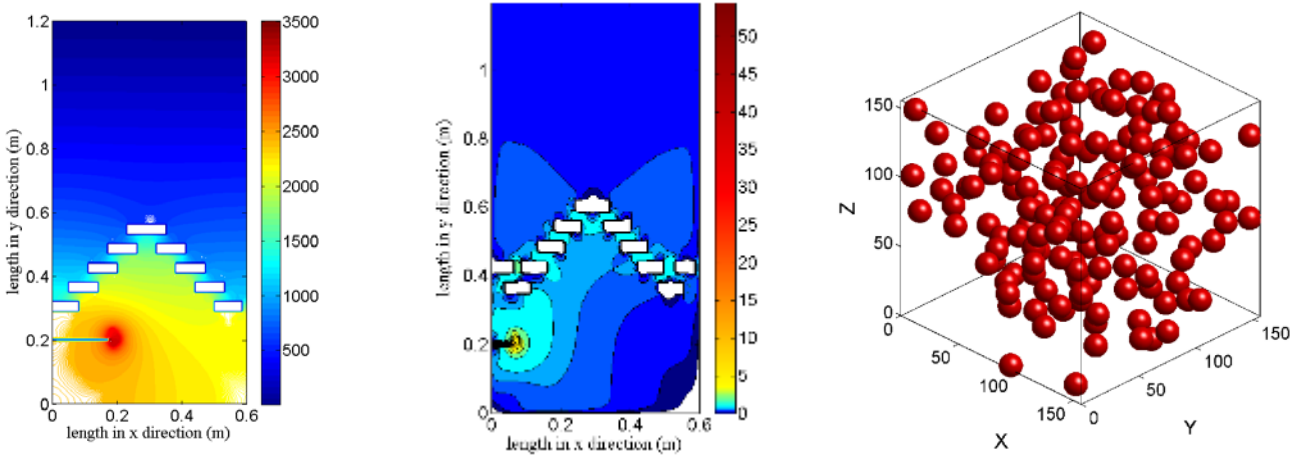
Dr. Sabita Sarkar

Professor, Metallurgical and Materials Engineering

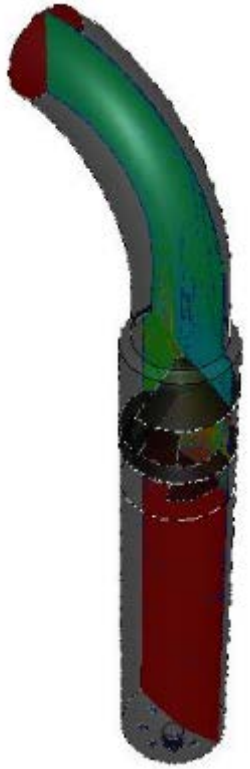
044-2257-4755; sabita.sarkar@iitm.ac.in

Major Areas of Research

- Process modeling/design/intensification of metallurgical and chemical processes
- Modelling and simulation of
  - Flow through packed bed, fluidized bed
  - Heat and mass transfer
  - Granular flow, multi-phase flow, reacting flow etc



Simulation of flow through randomly packed particle



Reactor design and optimization

Dr. S Sankaran

Professor, Metallurgical and Materials Engineering

044-2257-4776; ssankaran@iitm.ac.in

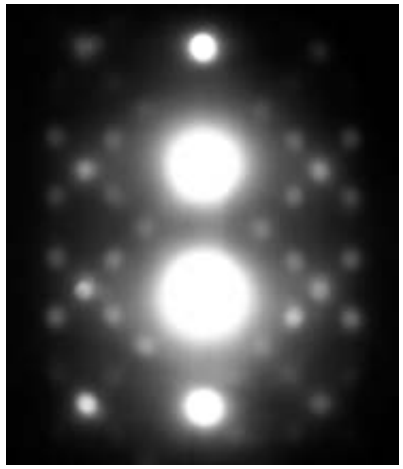
Major Areas of Research

- Structural materials processing through deformation and solidification techniques
- Microstructure-mechanical behaviour relationships
- Electron microscopy

Deformation processing (rolling mill)

Metal foams

Electron microscopy



Dr. Satyesh Kumar Yadav

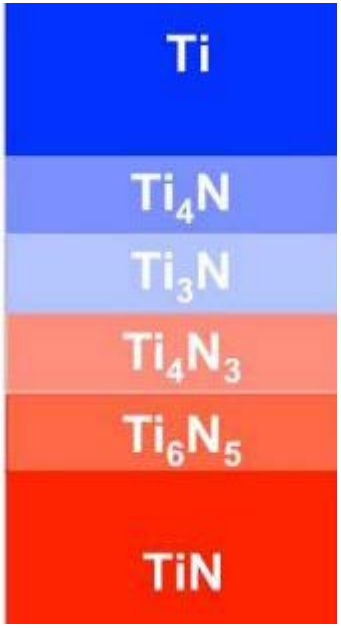
PhD, University of Connecticut, USA

Associate Professor, Metallurgical and Materials Engineering

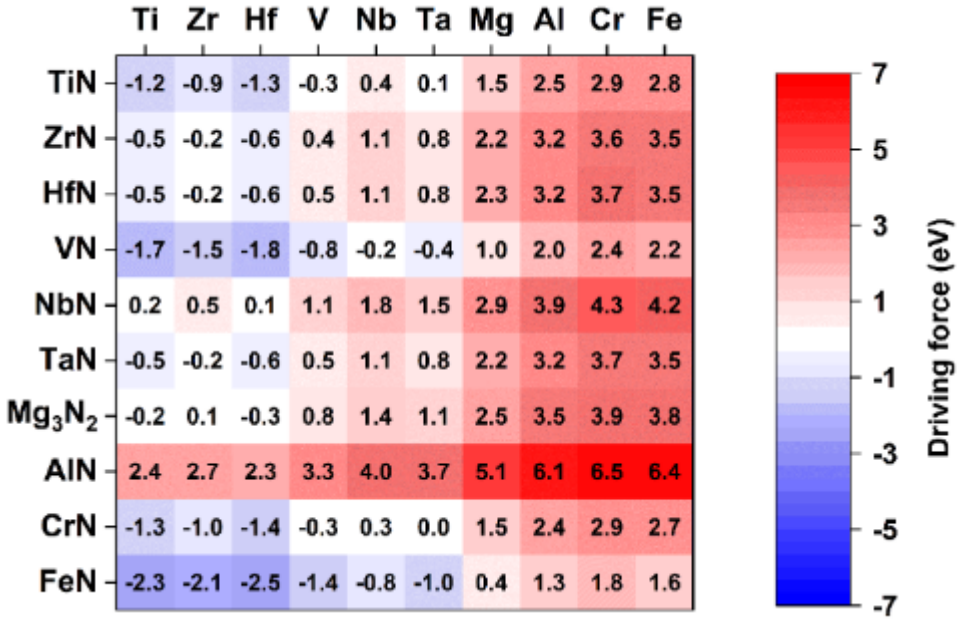
044-2257-4789; satyesh@iitm.ac.in

http://www.iitm.ac.in/satyesh

- Materials design from quantum mechanical modeling
- Machine learning to accelerate materials development
- Device materials modeling and visualization

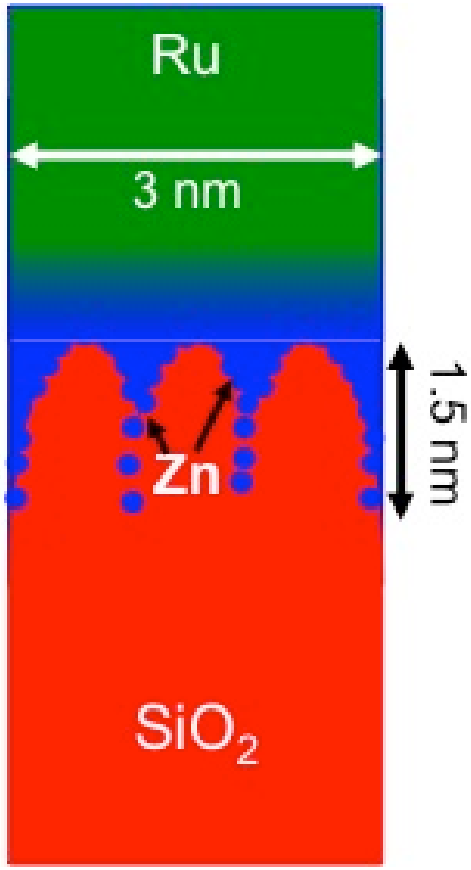


Diffused Interface



	Ti	Zr	Hf	V	Nb	Ta	Mg	Al	Cr	Fe
TiN	-1.2	-0.9	-1.3	-0.3	0.4	0.1	1.5	2.5	2.9	2.8
ZrN	-0.5	-0.2	-0.6	0.4	1.1	0.8	2.2	3.2	3.6	3.5
HfN	-0.5	-0.2	-0.6	0.5	1.1	0.8	2.3	3.2	3.7	3.5
VN	-1.7	-1.5	-1.8	-0.8	-0.2	-0.4	1.0	2.0	2.4	2.2
NbN	0.2	0.5	0.1	1.1	1.8	1.5	2.9	3.9	4.3	4.2
TaN	-0.5	-0.2	-0.6	0.5	1.1	0.8	2.2	3.2	3.7	3.5
Mg_3N_2	-0.2	0.1	-0.3	0.8	1.4	1.1	2.5	3.5	3.9	3.8
AlN	2.4	2.7	2.3	3.3	4.0	3.7	5.1	6.1	6.5	6.4
CrN	-1.3	-1.0	-1.4	-0.3	0.3	0.0	1.5	2.4	2.9	2.7
FeN	-2.3	-2.1	-2.5	-1.4	-0.8	-1.0	0.4	1.3	1.8	1.6

High-throughput Computation



Device Materials

Dr. rer. nat. Somnath Bhattacharyya

Professor, Metallurgical and Materials Engineering

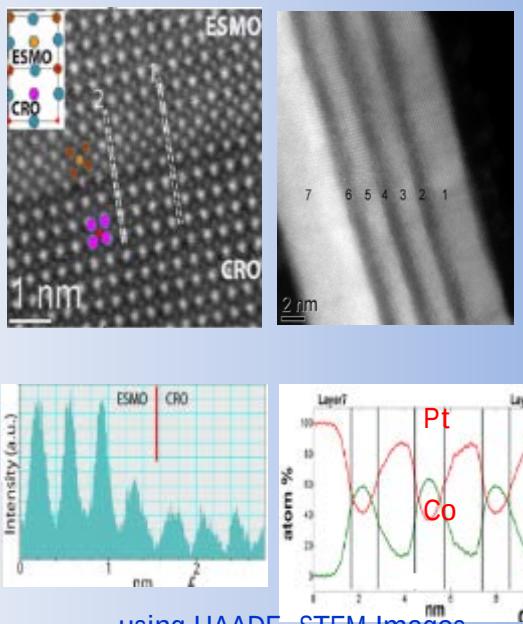
044-2257-4760; somnathb@iitm.ac.in

https://sites.google.com/site/nanoscopytem/home/

Major Areas of Research

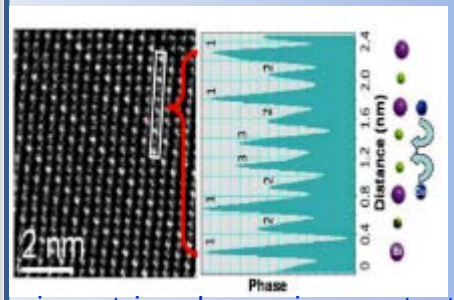
- Studying correlation of the structure and chemistry of materials at atomic scale with physical properties using Transmission Electron Microscopy
- Development of new methodology related to TEM/STEM to study materials
- Studying nano-bio conjugation using electron probe

Extent of Diffusion across interfaces



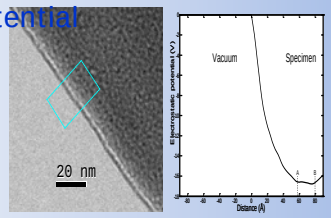
using HAADF –STEM Images

Presence of different elemental column



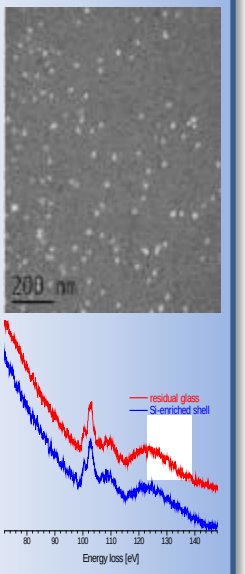
using retrieved mean inner potential

Retrieval of mean inner potential



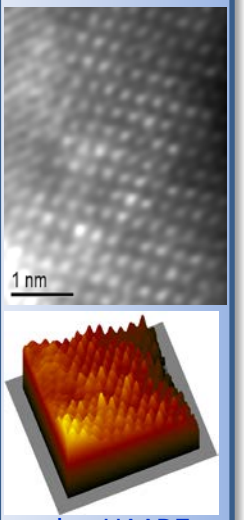
Using focal series bright field images

Proof of core shell structure



using EFTEM & EELS

Presence of atomic vacancy



using HAADF – STEM Images

Dr. Sreeram K Kalpathy

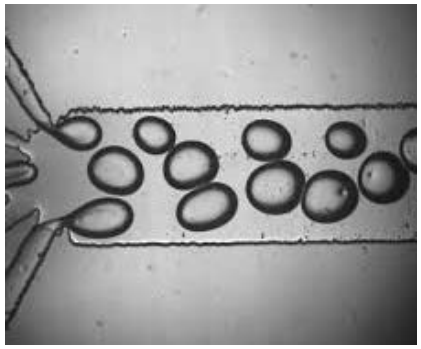
Associate Professor, Metallurgical and Materials Engineering

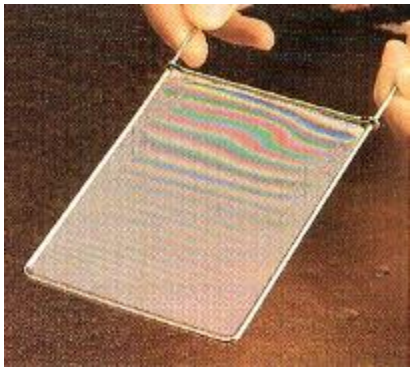
044-2257-4761; sreeram@iitm.ac.in

https://www.iitm.ac.in/info/fac/sreeram

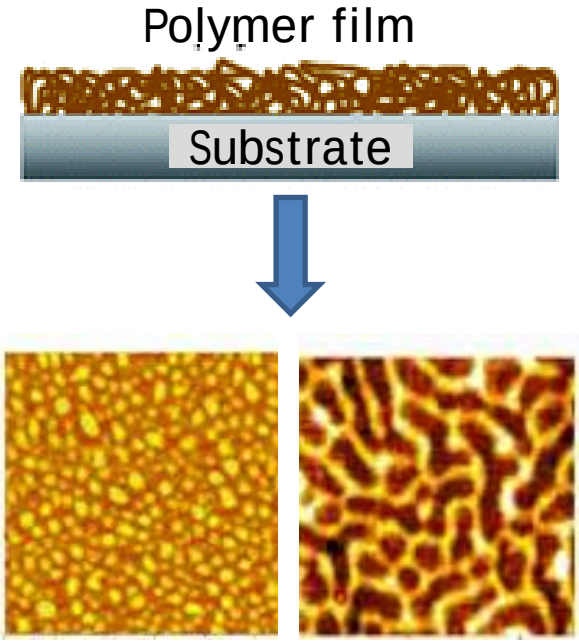
Major Areas of Research

- **Colloids, Polymers, Soft Matter**
- **Interfacial Fluid Mechanics**
- **Physical Chemistry of Surfaces**
- **Coating and Printing Methods**





Dynamics of Colloidal Foams, Bubbles, Drops, Films



Morphological patterns from polymer film dewetting

Dr. Srinivasa Rao Bakshi

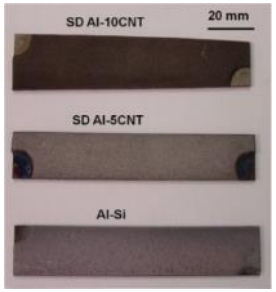
Professor, Metallurgical and Materials Engineering

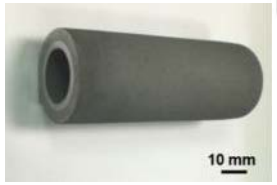
+91 44 2257 4781; M: 8056073710; sbakshi@iitm.ac.in

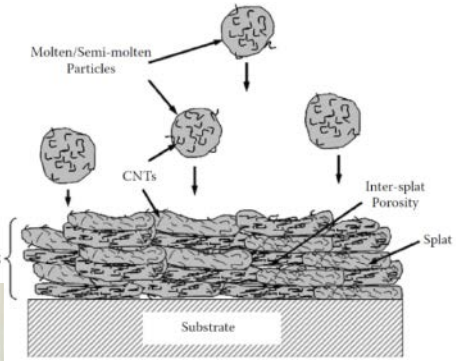
http://www.mme.iitm.ac.in/sbakshi

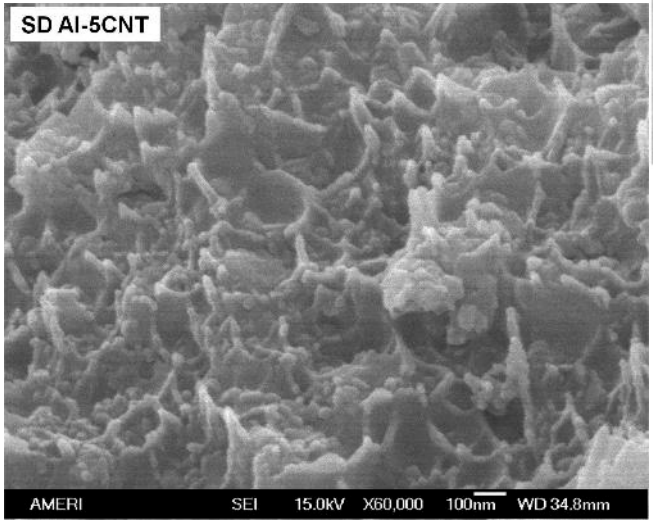
Major Areas of Interest

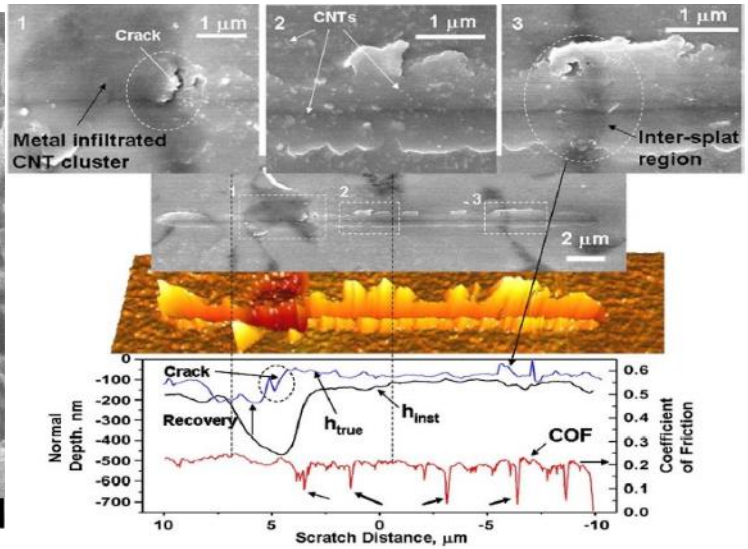
- Carbon nanotube reinforced metal matrix composites
- Thermal spray coatings and bulk structures
- Ultra-high temperature ceramic composites
- Hard metal matrix nanocomposites by reaction sintering
- Nanomechanical testing of materials

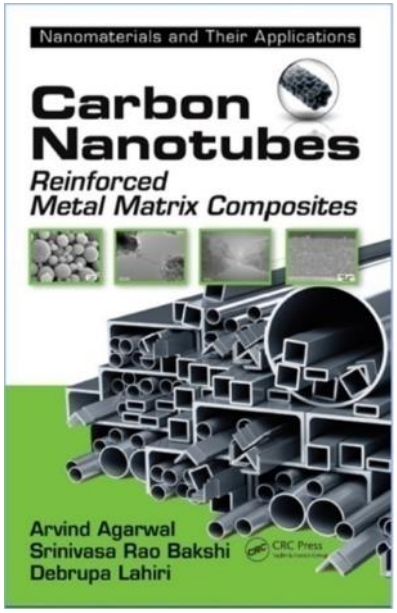












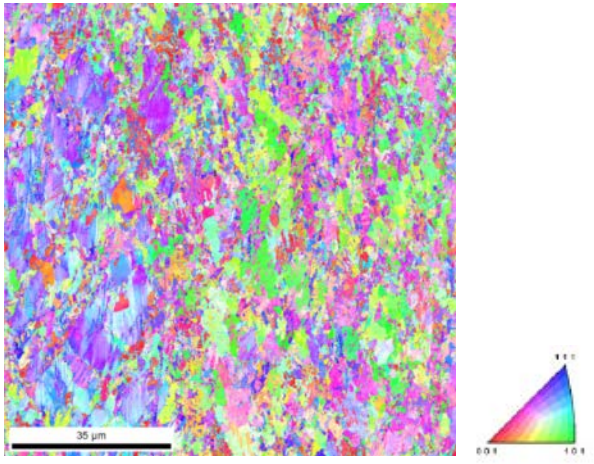
Dr. V. Subramanya Sarma

Professor, Metallurgical and Materials Engineering

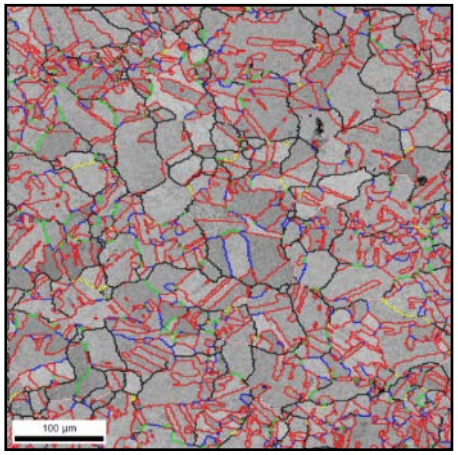
044 2257 4774; vsarma@iitm.ac.in

Major Areas of Research

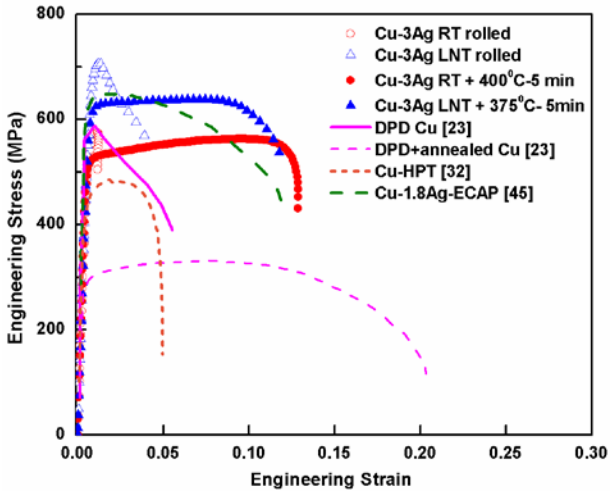
- Thermo-mechanical processing
- Bulk ultra fine grained / nanostructured metals and alloys
- Crystallographic texture and grain boundary engineering



Orientation imaging microscoscopy of ultrafine grained Cu-Al alloy



Grain boundary engineered austenitic stainless steel,



Tensile properties of ultra fine grained high strength and ductile Cu-Ag alloy

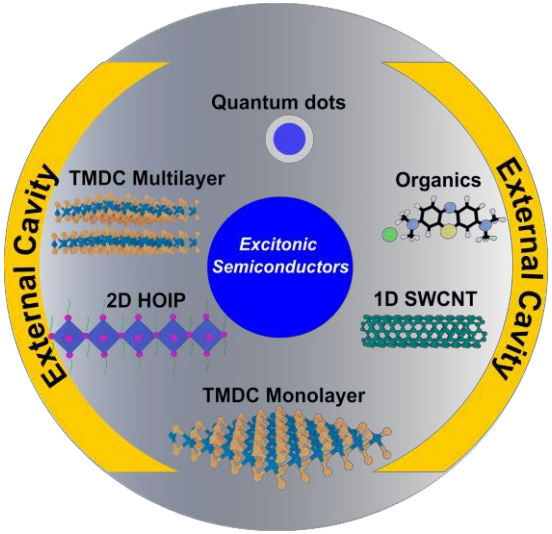
Dr. Surendra Babu Anantharaman

PhD, Swiss Federal Institute of Technology Lausanne (EPFL), Switzerland

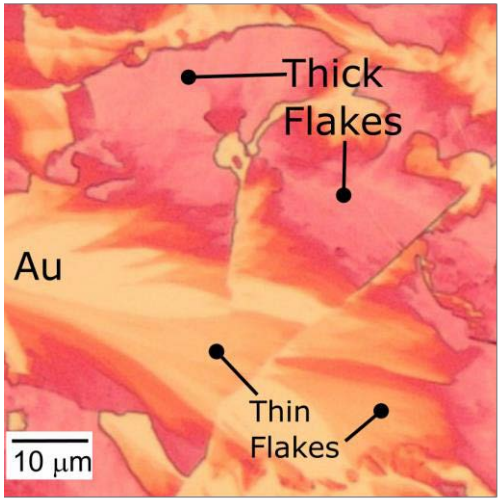
Assistant Professor – Grade 1, Metallurgical and Materials Engineering

044-2257-4791; sba@iitm.ac.in

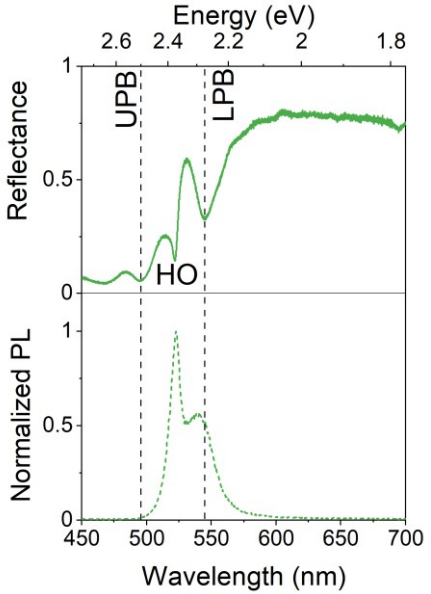
Low-dimensional excitonic semiconductors



Optical micrograph of exfoliated 2D perovskites



Room-temperature polariton absorption and photoluminescence



Research interest

1. Excitonic Semiconductors (0D, 2D, and 3D)
2. Light-emitting devices
3. On-chip Lasers
4. Strong light-matter interactions
5. Nanophotonics

- Presence of upper (UPB) and lower polariton branch (LPB) confirms the strong light-matter interaction.
- Further, photoluminescence from the hybrid state shows the possibility to achieve electrically driven polariton lasing at room temeprature

Dr. Tiju Thomas

Professor, Metallurgical and Materials Engineering

044-2257-4757; tijuthomas@iitm.ac.in

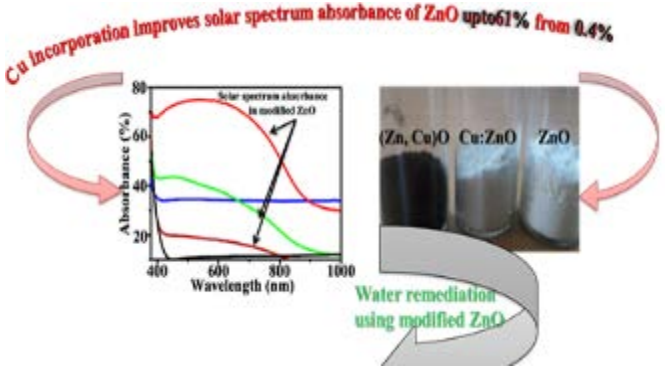
http://mme.iitm.ac.in/tijuthomas

www.tijuthomas.net

Major Areas of Research

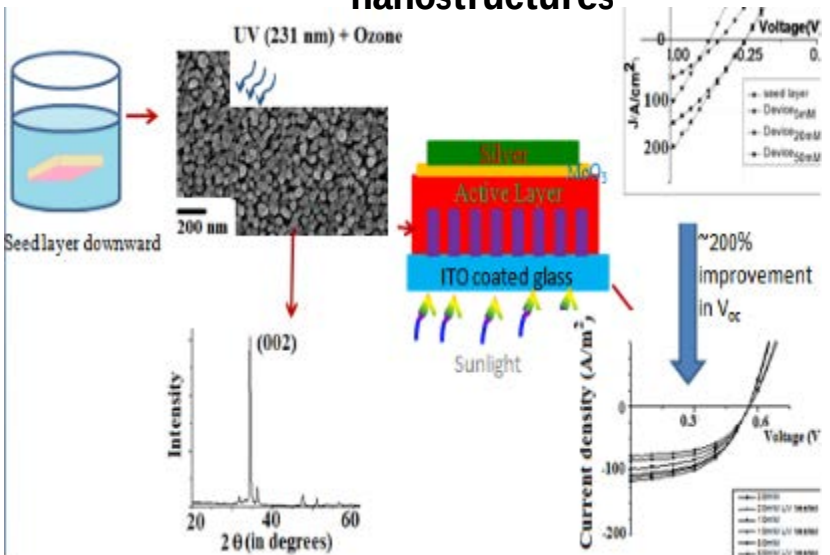
- Energy materials
- Environmental remediation materials
- Nitrides, oxynitrides, oxides (in nano- , meso- and bulk forms)
- Photofunctional materials (for solar cells, photocatalytic applications)
- Optical materials and devices
- Surfaces, interfaces and transformation of nanostructures
- Green approaches to functional nanomaterials

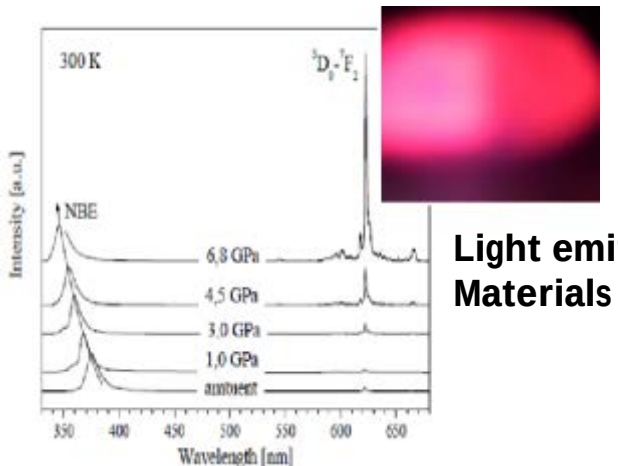
Photofunctional & optical materials



Energy devices

Engineered nanostructures





Light emitting Materials & devices

Dr. Uday Chakkingal

PhD, Rensselaer Polytechnic Institute, USA

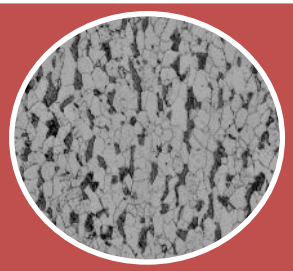
Professor, Metallurgical and Materials Engineering

044-2257-4775; udaychak@iitm.ac.in

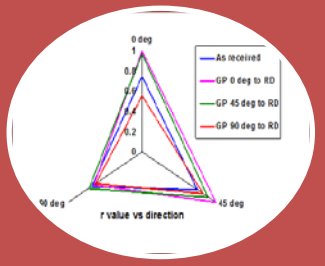
http://mme.iitm.ac.in/udaychak

- Metal Forming Processes
- Severe Plastic Deformation Processes
- Sheet Metal Forming
- Advanced High Strength Steels

Production of Ultra fine grained Al, Ti and Mg alloys



Forming of Advanced High Strength Steel Sheets



Improvement in drawability of Al alloy sheets

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

INDIVIDUAL FACULTY PROFILE

DEPARTMENT OF OCEAN ENGINEERING

LIST OF FACULTY

- Abdus Samad
- Abhilash Somayajula
- Ananthakrishnan P
- Arjun Jagannathan
- Barasha Deka
- Bithin Ghorai
- Deepak Kumar
- Murali Kantharaj
- Nallayarasu S
- Narendran Kumar
- Nilanjan Saha
- Panneer Selvam R
- Poguluri Sunny Kumar
- Rajesh R Nair
- Rajiv Sharma
- Sannasiraj S A
- Shanmugam P
- Srinivasan Chandrasekaran
- Sriram V
- Suresh Kumar G
- Suresh Rajendran
- Tarun K Chandrayadula
- Thejesh Kumar Garala
- Vijay K G
- Vijyakumar Ragagobalan

Dr. Abdus Samad

PhD, Inha University, South Korea

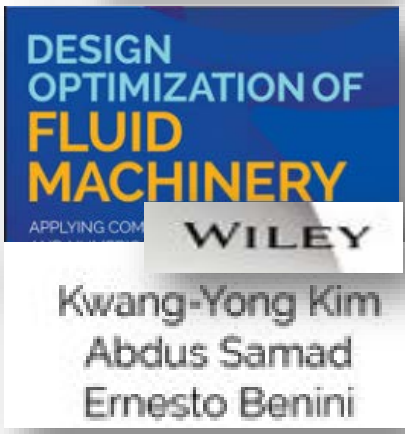
Professor and Head, Dept. of Ocean Engineering

044-2257-4826; *samad@iitm.ac.in*

http://www.doe.iitm.ac.in/abdus/

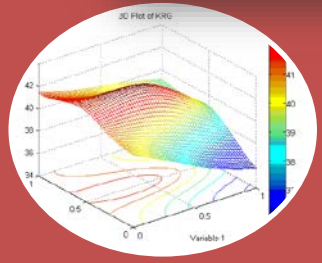
- Wave Energy, Tidal Energy
- Turbomachinery, CFD
- AI-Based Design Optimization

Authored book



A Wave Energy Converter (**Sindhuja-I**) to produce electricity and water, and H2, and to power an unmanned ocean surveillance system.

Turbomachinery: Design and Optimization of turbine systems to harness marine energy through numerical modeling and experiments.



CFD and AI based Design Optimization to design better-performing fluid machines.

Renewable Energy, Fluid Machinery, Optimization with AI, CFD

Dr. Abhilash Somayajula

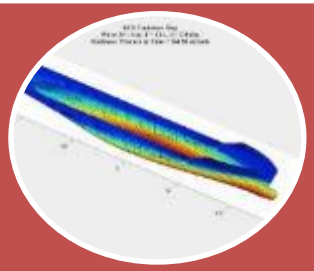
PhD, Texas A&M University, USA

Assistant Professor, Ocean Engineering

044-2257-4823; abhilash@iitm.ac.in

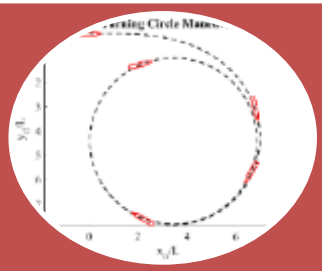
http://www.doe.iitm.ac.in/abhilash

- Marine autonomy
- Hydrodynamics of ships and offshore structures
- Data driven methods for ship motion control



SIMDYN – Hydrodynamic Response of Ships and Offshore Structures

In-house development of an Autonomous Scaled Model Ship



Reinforcement Learning for Control of Underactuated Ships

Hydrodynamic Response Estimation and Control of Marine Structures

Dr. Ananthakrishnan P

Professor, Ocean Engineering

044-2257-4811; ananthakrishnan@iitm.ac.in

Major Areas of Research

- Water Wave Mechanics
- Ship Hydrodynamics
- Dynamical Oceanography
- Ocean Energy Conversion
- Air-Sea Interaction
- Hydro-Elasticity
- Numerical Methods for Nonlinear Wave-Body Interaction Problems
- Computational Ocean Acoustics

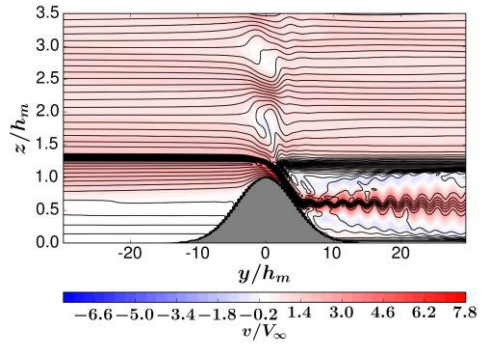
Dr. Arjun Jagannathan

PhD, UC San Diego, USA

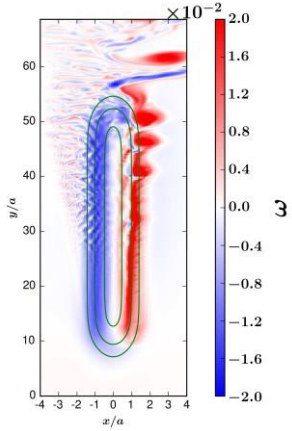
Assistant Professor, Ocean Engineering

044-2257-4811; arjunj@iitm.ac.in

- Physical Oceanography and Ocean Modelling
- Turbulent boundary layers and their separation
- Dynamic analysis of floating platforms
- Internal waves and energetics
- Vortex dynamics



Hydraulically controlled overflow exciting large amplitude internal waves above the thermocline



Vorticity generation in currents encountering bottom bathymetry

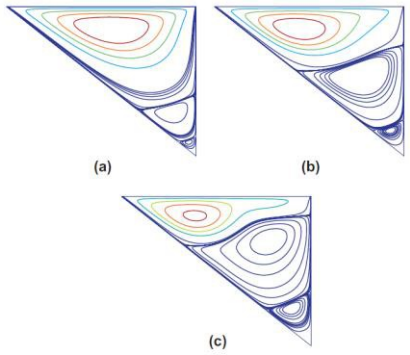


Fig. 3. Streamline contours for flow in a right triangular driven cavity. (a) $Re = 100$; (b) $Re = 500$; and (c) $Re = 1000$.

Laminar flow in a triangular cavity

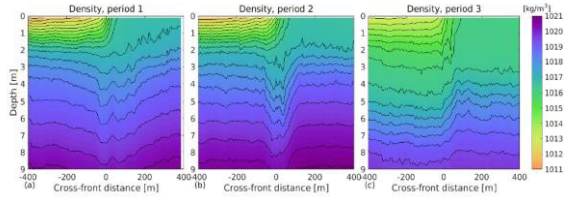


FIG. 4. TIA density data vs depth and (5-meter binned) cross-front distance. Composites for sections from periods 1-3 (11:00-12:30, 12:30-13:30, and 13:30-15:00, respectively) are shown in panels a-c, respectively. Contour interval = 0.5 kg/m^2.

Front-locked internal wave

Dr. Barasha Deka

PHD, IIT (ISM) Dhanbad, India and Curtin University, Australia

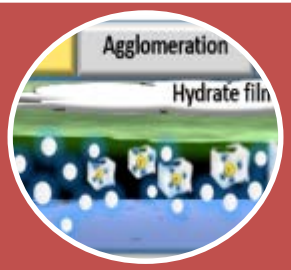
Assistant Professor, Ocean Engineering

044-2257-4832; barasha.deka@iitm.ac.in

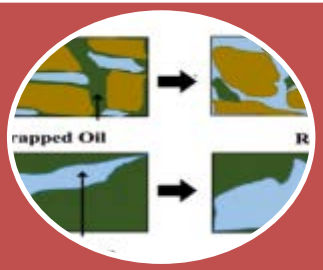
https://doe.iitm.ac.in/barashadeka

- Research Area 1: ***Flow Assurance*** - Preventing gas hydrate formation during hydrocarbon transportation and in surface facilities
- Research Area 2: ***Flow Assurance*** - Mitigating wax deposition during hydrocarbon transportation and in surface facilities
- Research Area 3: ***Chemical Enhanced Oil Recovery*** - Polymer flooding, surfactant flooding, alkaline flooding.

Mitigating wax deposition during hydrocarbon transportation and in surface facilities



Preventing gas hydrate formation during hydrocarbon transportation and in surface facilities



Polymer flooding, surfactant flooding, alkaline flooding.

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

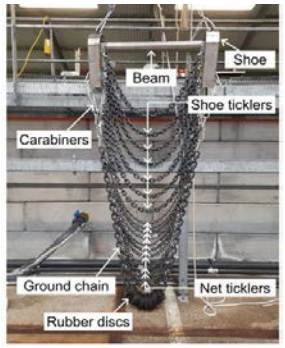
Dr. Bithin Ghorai

Ph.D., Indian Institute of Technology Bombay

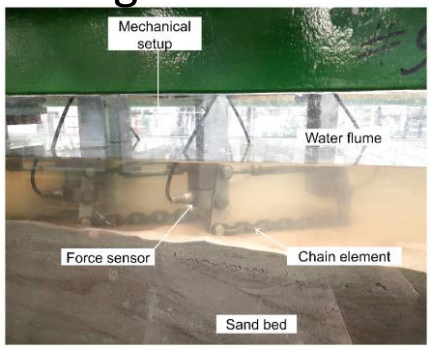
Assistant Professor, Ocean Engineering

044-2257-4815; bghorai@iitm.ac.in

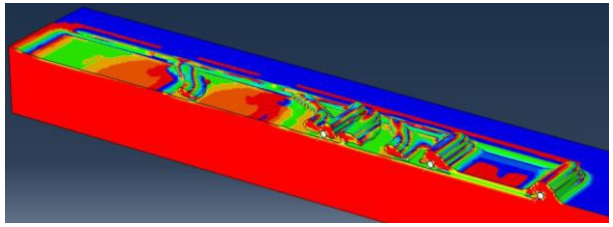
- Marine geotechnics
- Offshore foundation systems
- Large deformation modeling in soil
- Demersal trawling



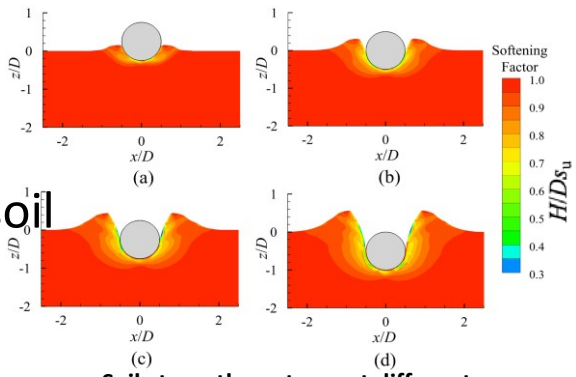
Beam trawl gear



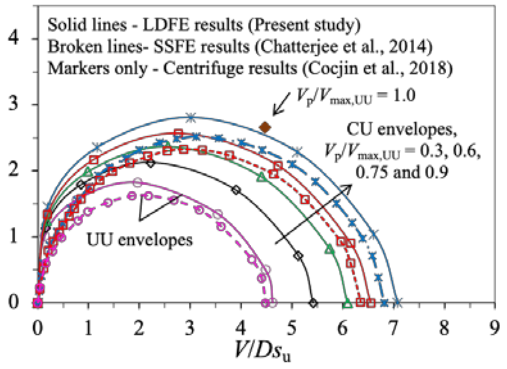
Experimental setup with model trawl gear elements



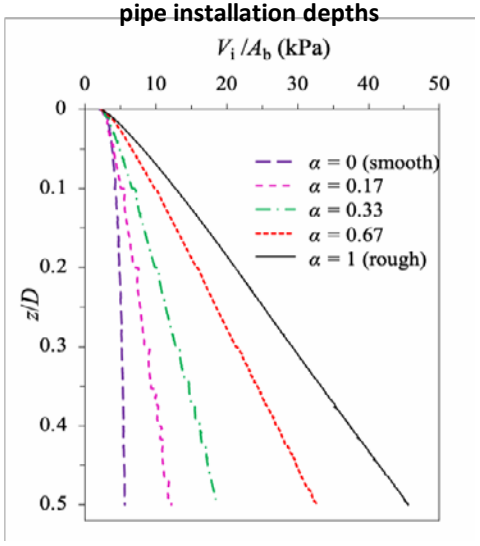
Finite element modeling of trawl gear-seabed interaction



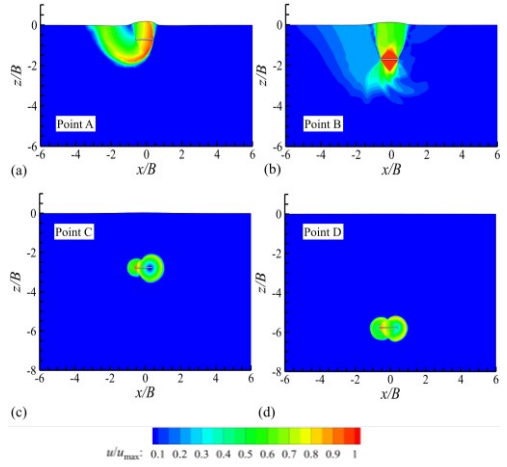
Soil strength contours at different pipe installation depths



Consolidated break-out response of marine pipelines



Installation resistance of suction buckets



Failure mechanism of plate anchors at different depths

Dr. Deepak Kumar

PhD, IIT DELHI, INDIA

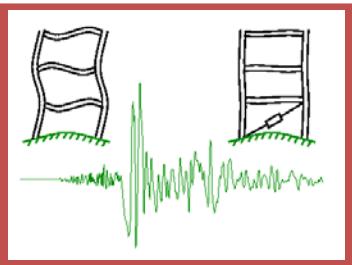
Professor, Ocean Engineering

044-2257-4828; deepakkumar@iitm.ac.in

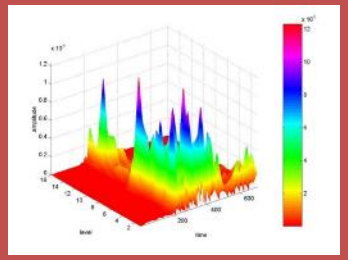
http://www.oec.iitm.ac.in/Asst_prof_deepak.html

- Stochastic dynamics, control, stability of structure
- Time frequency analysis of nonlinear systems
- Experiments related to structure dynamics and control

Dynamic control of onshore and offshore structures for earthquake, wind, hydrodynamic loadings



Controlling the nature of response of onshore and offshore structures



Development and modification of techniques for analysis of system

Dr. Murali Kantharaj

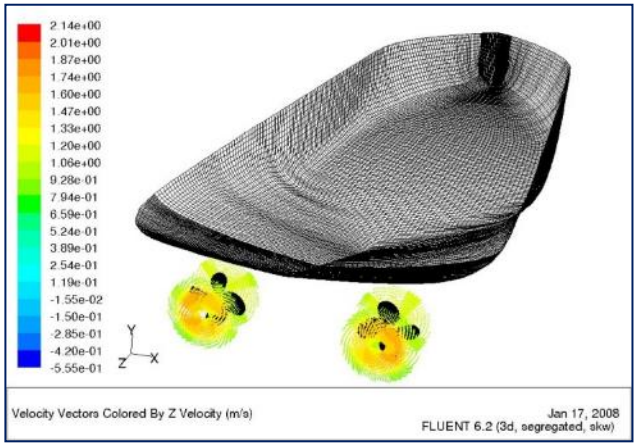
PhD, IIT Madras, INDIA

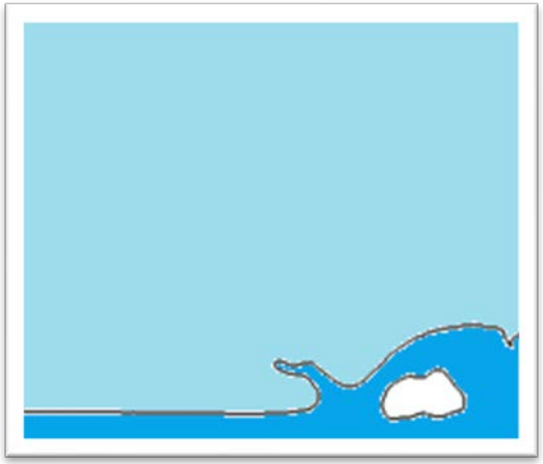
Professor, Ocean Engineering

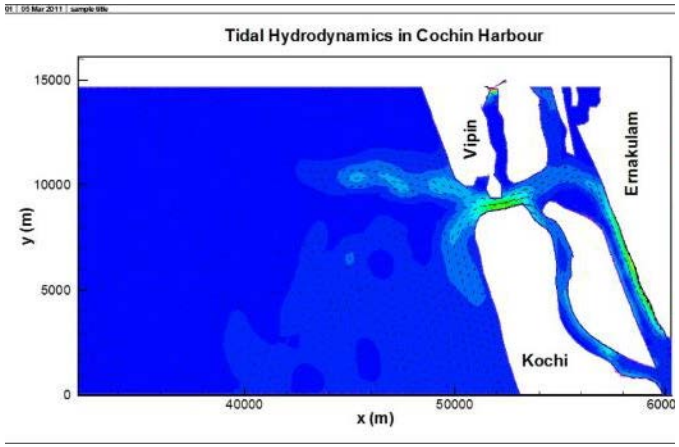
044-2257-4816; murali@iitm.ac.in

http://www.oec.iitm.ac.in/Faculty_murali.html

- Computational Hydrodynamics using Potential flow and RANS approaches
- Free surface / dynamic boundary hydrodynamics – ALE FEM & Level sets
- Coastal hydrodynamics – tsunami – storm surge – flow vegetation interaction – morphodynamics







Dr. S Nallayarasu

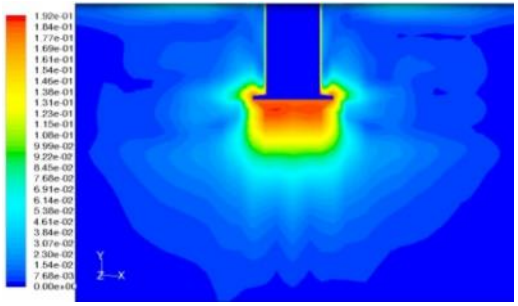
PhD, National University of Singapore

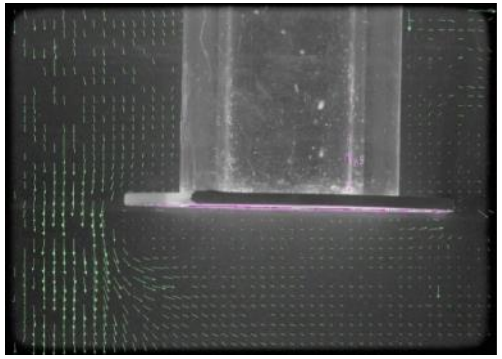
Professor, Ocean Engineering

044-2257-4819; nallay@iitm.ac.in

http://www.oec.iitm.ac.in/prof_nallayarasu.html

- Hydrodynamic response of Spar hulls
- Offshore wind energy
- Reliability in offshore structures
- Effect of heave damping plates
- Flow visualisation and VIV
- Deep water risers





Dr. K. Narendran

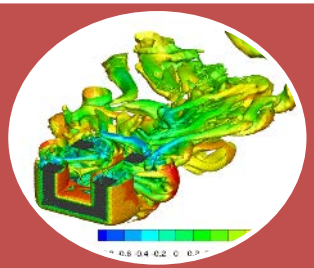
PhD, IIT Madras

Assistant Professor, Ocean Engineering

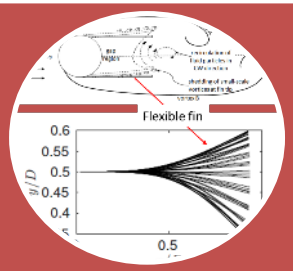
044-2257-4831; knaren@iitm.ac.in

https://doe.iitm.ac.in/knaren/

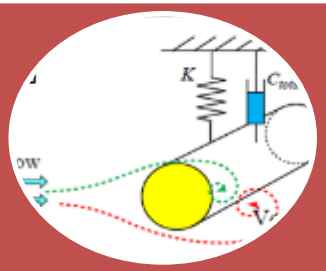
- Fluid- & Wave- Structure Interaction
- Experimental & Computational Hydrodynamics
- Marine Renewable Energy



OFFSHORE FLOATING PLATFORM



FLAPPING DYNAMICS



HYDROKINERTIC & WAVE ENERGY SYSTEMS

OFFHORE ENGINEERING SYSTEMS AND MARINE RENEWABLE ENERGY

Dr. Nilajan Saha

PhD., IISc. Bangalore, India

Professor, Ocean Engineering

044-2257-4827; nilanjan@iitm.ac.in

http://www.doe.iitm.ac.in/nilanjan/

Major Areas of Research

- Offshore wind and wave energy
- Dynamics of offshore structures
- Extreme value statistics and fatigue
- Nonlinear methods in ocean engineering
- Offshore soil-structure interaction
- Stochastic processes, filtering and identification

Source: Faculty website

Dr. R Panneer Selvam

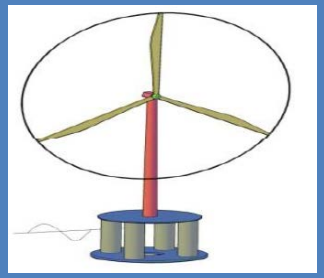
PhD., IIT Madras, India

Professor, Ocean Engineering

044-2257-4807; pselvam@iitm.ac.in

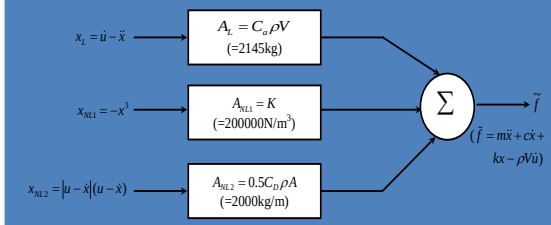
http://www.oec.iitm.ac.in/Asst_prof_PannerSelvam.html

- Hydrodynamic Analysis of Offshore Structures
- Parameter Identification of Ocean Engineering Systems
- Nonlinear Dynamic Analysis of Offshore Structures



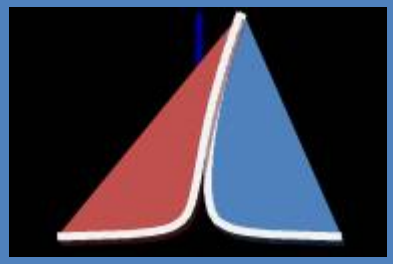
(i) Numerical and Experimental studies on Floaters for offshore wind energy

(ii) Emerging New Concepts of Offshore structures for Oil and Gas industry – Numerical and Experimental studies



(i) Identification of parameters of floating offshore structures – includes ships in waves and calm water

(ii) Simulation of motion of ships in seas and calmwater (maneuvering)



Simulation of nonlinear responses of offshore floating systems

Dr. Poguluri Sunny Kumar

PhD, IIT Madras, India

Assistant Professor, Ocean Engineering

044-2257-4805; pskumar@iitm.ac.in

http://www.iitm.ac.in/

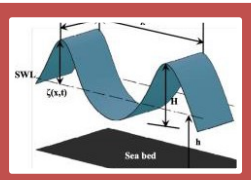
Research Area: Hybrid Coupling of Finite Element Method-Fully Nonlinear Potential flow Theory (FEM-FNPT) and Navier-Stokes (NS) viscous solver using moving overlapping zone interface

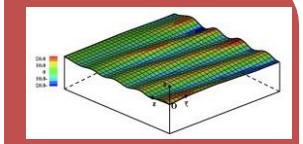
Focus 1: Nonlinear wave body interaction

- FEM-FNPT and NS solvers coupling.
- Validation of the developed software for typical regular 2D non-breaking and breaking wave generation and compared against the published results.

Focus 2: Coupling and overlapping zone

- Fixed boundary interface (Grilli, 2008 and Sitanggang, 2008).
- Moving boundary interface (Sueyoshi et al. 2007).
- Fixed overlapping zone interface (Grilli, 2008, Sitanggang, 2008 and Kassiotis, 2011).
- Moving overlapping zone interface (Sriram et al. 2014).

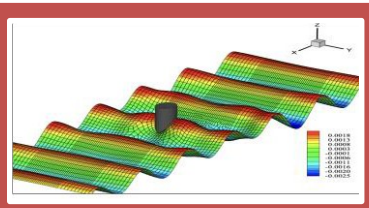




Nonlinear wave generation

APPLICATION 1

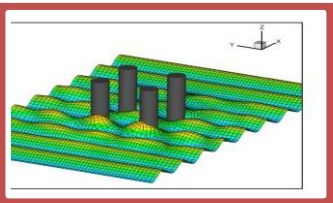
- Regular wave generation
- Biochromatic waves
- Directional waves



Nonlinear wave interaction on fixed cylinder

APPLICATION 2

- Fixed body
- Nonlinear wave force estimation
- Nonlinear moment estimation



Nonlinear wave interaction on multiple cylinder

APPLICATION 3

- Floating body
- Multiple wave-body interaction

Developed code will be applied to various wave and wave-body interaction problems

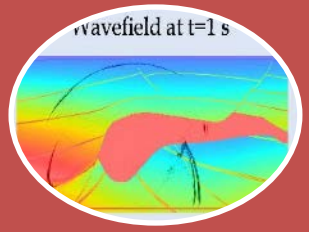
Dr Rajesh R N

Professor, Ocean Engineering

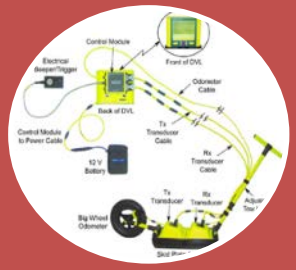
044-2257-4824; rajeshnair@iitm.ac.in

http://www.iitm.ac.in/component/faculty/80/rajeshnair/

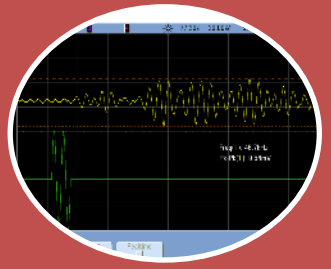
- Seismic Data Analysis & Subsurface reservoir characterization for Oil and Gas
- Ground Penetrating Radar analysis and Shallow subsurface characterization
- Laser Doppler Vibrometer measurements, Hydrofraking (Shale, Coal) and rock anisotropy



Seismic Imaging & Data analysis for oil and Gas reservoirs



GPR Data analysis



LLDV &HYDROFRAKING STUDIES (SHALE, COAL)

Subsurface characterization : Shallow and Deep(Seismics and GPR) & Lab scale Hydrofraking & Rock anisotropy studies (Shale, Coal)

Dr. Rajiv Sharma

PhD., IIT Kharagpur, India

Professor, Ocean Engineering

+91-44-2257-4822; rajivatri@iitm.ac.in

http://sites.google.com/site/rajivatri/

- Computer-aided design; Design of deepwater drilling solutions and floating structures;
- Computational geometric mechanics; Computer aided geometric design, computational geometry, visualization, and their applications in design, robotics and manufacturing;
- Dynamic data driven forecasting systems; Participatory/democratic economy; and
- Iso-geometric analysis for fluids and structures.

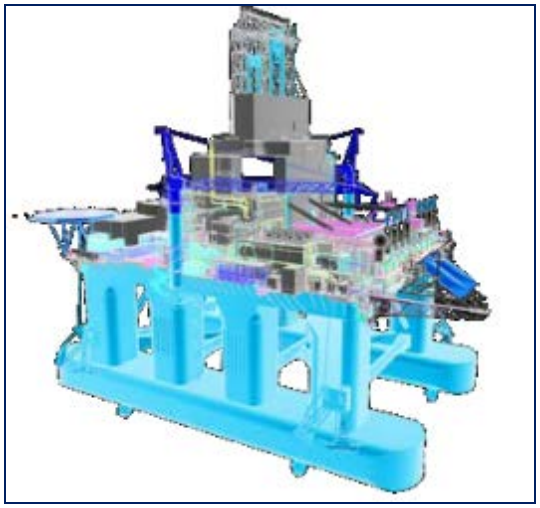


Figure 1: Designed optimum semi-submersible

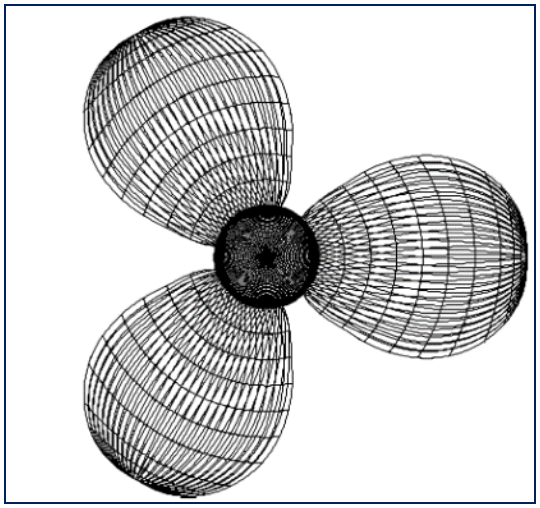


Figure 2: CAD model of a propeller.

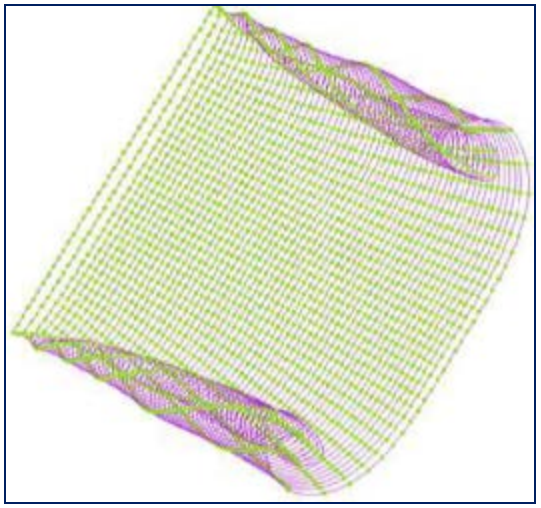


Figure 3: Computed wake behind a propeller.

Dr. S A Sannasiraj

BE (Civil Engg.), ME (Civil-Structural Engg.), PhD., (Ocean Engg.)

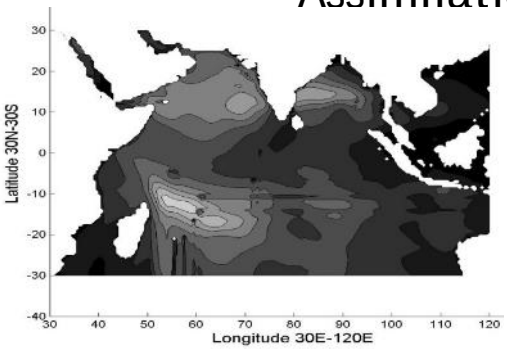
Professor & Head, Ocean Engineering

Email: sasraj@iitm.ac.in

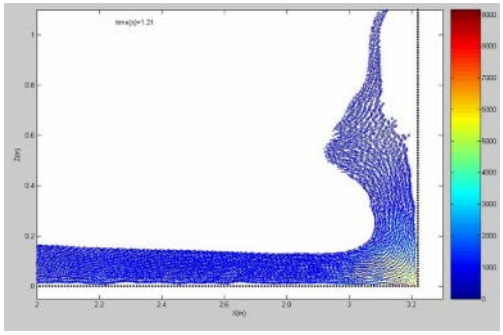
- Supervised 14 phDs
- 80 Refereed Journal papers
- Completed 16 major research projects
- Involved in 200 Industrial projects

- FEM & SPH simulation of Nonlinear free surface waves
- Laboratory investigation of Wave Breaking & Wave impact on structures
- Wind-wave modelling and Data Assimilation

Breaking wave impact on a vertical wall



Assimilated wind-wave Prediction over Indian waters



SPH simulation of Nonlinear sloshing

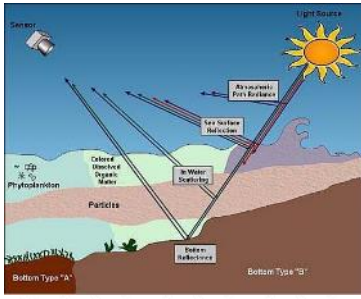
BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

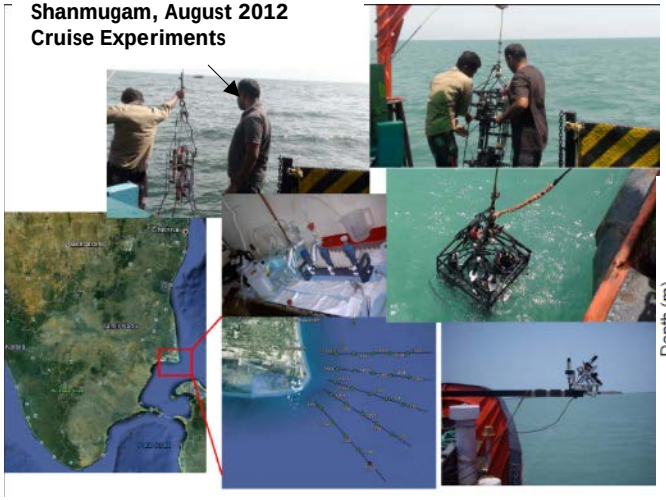
Dr. P Shanmugam

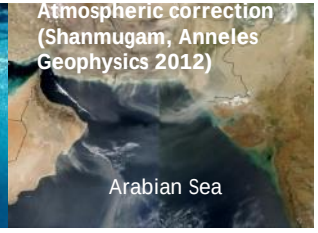
PhD, Anna University, India
Professor, Ocean Engineering
044-2257-4818; pshanmugam@iitm.ac.in
http://www.oec.iitm.ac.in/Asst_prof_Shanmugam.html

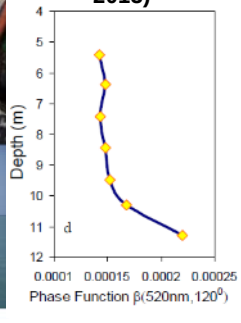
- Ocean Optics and Imaging / Focus on the study of 3-D character of underwater light fields by experiments and modelling.
- Satellite Oceanography/ Focus on the development of algorithms to retrieve ocean environmental parameters from remote sensing data.
- Ocean acoustics / Focus on the characterization of seafloor **(morphology, sediment sequence, minerals, oil seepage, buried objects)**

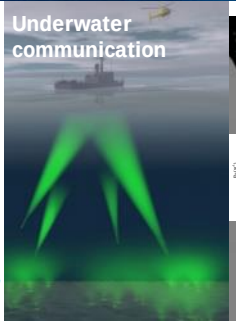
Potential applications: Underwater light fields and visibility, search and recovery, underwater optical communication, underwater object detection and image processing, sediments transport, dissolved carbon transport, detection of ocean biological hazards, Oil spill, bathymetry, internal waves, currents, eddies, fronts, and climate prediction.

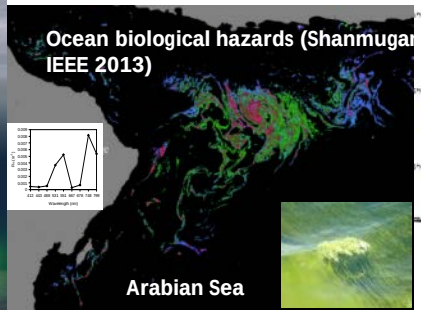


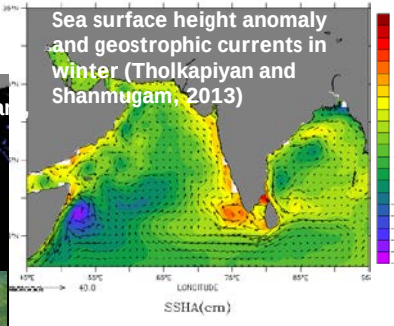












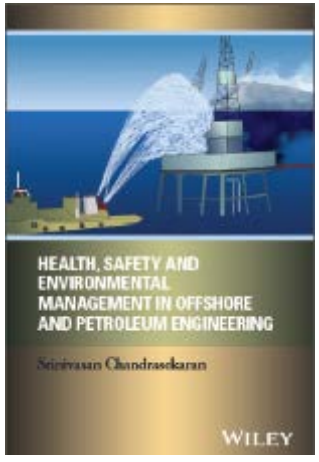
Dr. Srinivasan Chandrasekaran

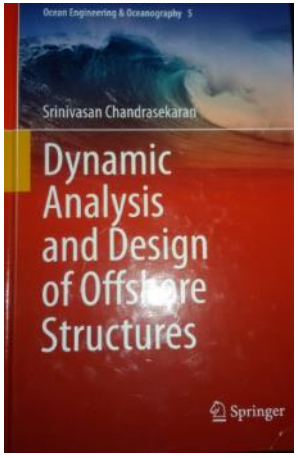
PhD, IIT DELHI, INDIA

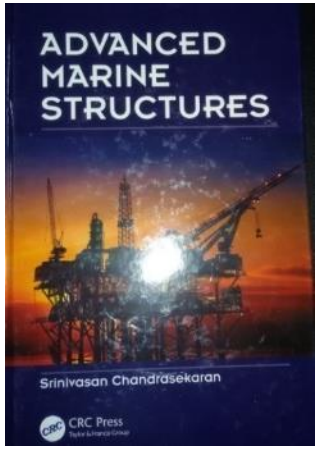
Professor, Ocean Engineering

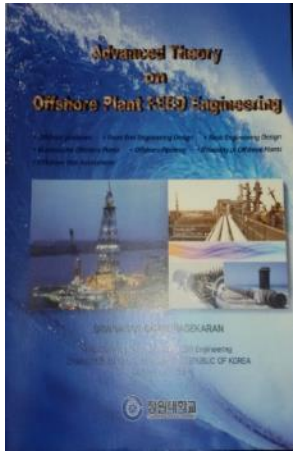
044-2257-4821; drsekaran@iitm.ac.in

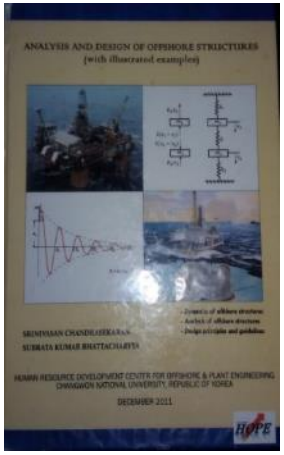
- Offshore TLPs and triceratops/ dynamic analysis of deep-water structures
- Renewable energy/Design and development of wave energy devices
- Petroleum engineering/Health, Safety and environmental management applied to oil and gas industries

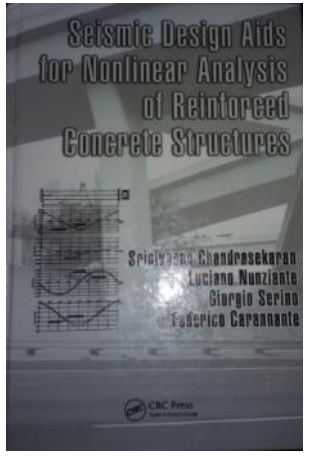












Dr. V Sriram, BE, PhD.,

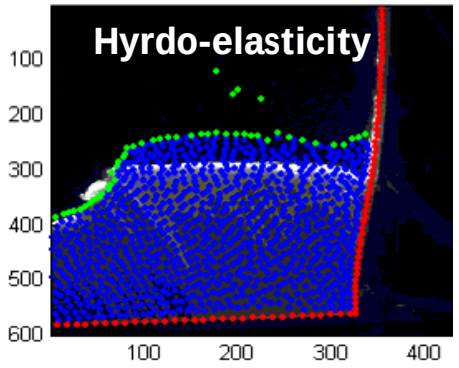
Professor, Ocean Engineering

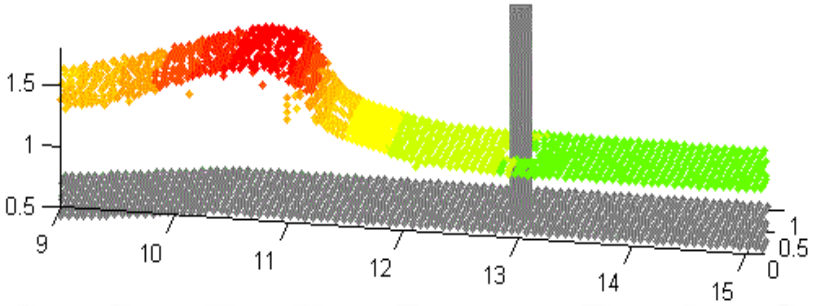
044-2257 4813; vsriram@iitm.ac.in

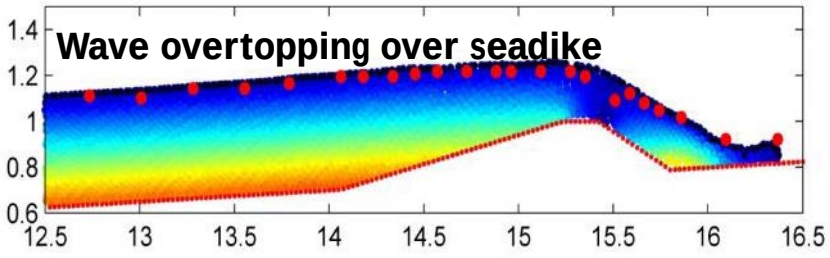
http://www.oec.iitm.ac.in/sriram.html

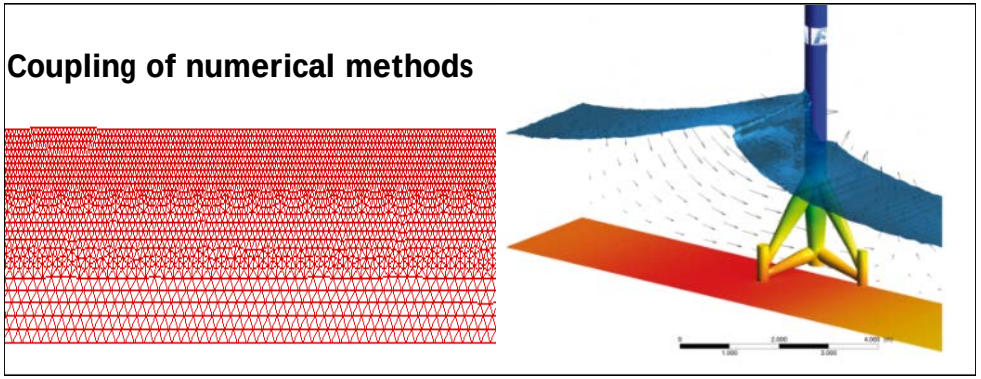
Major Areas of Research

- Numerical modeling/computational hydrodynamics, Meshfree methods
- Hydro-elasticity
- Violent wave-current-structure interactions
- Experimental wave generation/ PIV









Wave interactions with offshore wind turbine support structure

Dr. G Suresh Kumar

PhD, IISc (Bangalore), India

Professor, Ocean Engineering

044-2257-4814; gskumar@iitm.ac.in

http://www.oec.iitm.ac.in/Suresh_kumar_home.html

- Numerical Modeling of Fluid Flow through Fractured Reservoir/ Dual-Continuum
- Numerical Modeling of Coupled Heat and Mass Transfer / Enhanced Oil Recovery
- Anomalous Transport / Non-Darcian, Non-Fickian & Scale-Dependent Phenomena

Groundwater Flow and Contaminant Transport Modeling	Enhanced Geothermal Energy (EGS) System	Radio-Nuclide Transport in Geo-Sphere

Dr. Suresh Rajendran

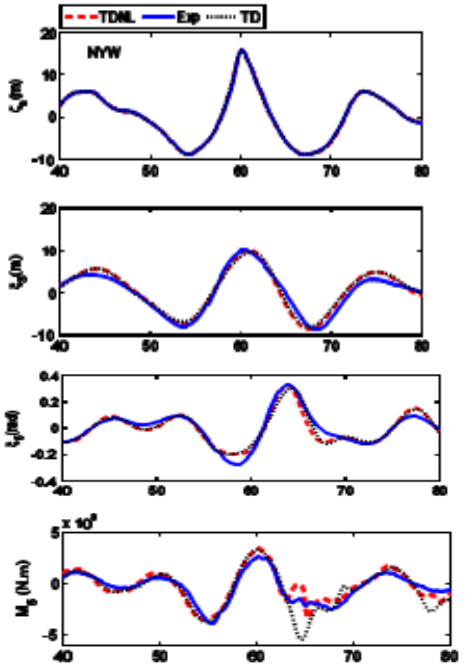
Associate Professor, Ocean Engineering

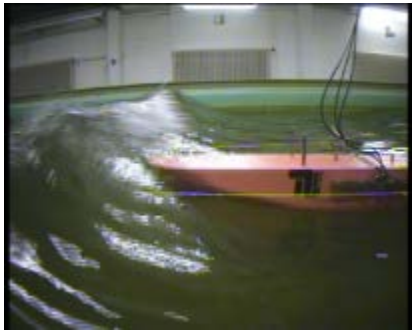
044-2257-4830; sureshr@iitm.ac.in

http://www.doe.iitm.ac.in/sureshrajendran/

Area of Specialization

1. Numerical modelling of nonlinear ship motions and Loads
2. Hydro elasticity of ships and offshore structures
3. Manoeuvring of ships in waves
4. Dynamic Instability of Ships





Dr. Tarun K Chandrayadula

PhD, George Mason University, USA

Associate Professor, Ocean Engineering

044-2257-4808; tkchandr@iitm.ac.in

http://www.doe.iitm.ac.in/tkchandr/

Major Areas of Research

- **Statistical Signal Processing**
- **Acoustic Propagation Models**
- **Inverse Methods**
- **Array spatial processing**

Source: Faculty website

Dr. Thejesh Kumar Garala

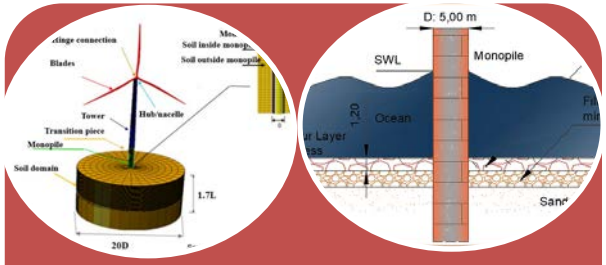
PhD, University of Cambridge, UK

Assistant Professor, Ocean Engineering

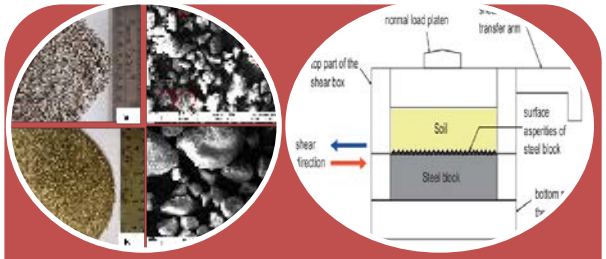
044-2257-xxxx; tkgarala@iitm.ac.in

https://doe.iitm.ac.in/tkgarala/

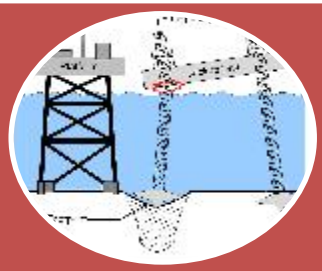
- Static and seismic soil-fluid-structure interaction for offshore structures
- Marine soil characterisation with emphasis on problematic carbonate soils and soft clays
- Jack-up – pile and jack-up – footprint interaction studies



Soil – Fluid - Structure Interaction for Offshore Structures



Problematic marine soils characterisation



Jack up – pile – footprint interaction studies

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

Dr. Vijay K G

PhD, IIT Kharagpur, India

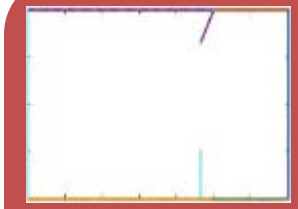
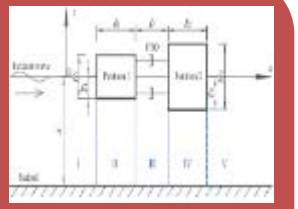
Assistant Professor, Ocean Engineering

044-2257-4812; vijaykg@iitm.ac.in

- Numerical modeling of Fluid Structure Interactions
- Floating Offshore Wind Turbines/ Solar Photovoltaics
- Wave Energy Converters

- Thin porous structures
- BEM[1], SBFEM[2], BEM-FEM

- Coupled response analysis
- Mooring investigations

- Oscillating Water Columns
- Hybrid converters

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

[1] Boundary Element Method

[2] Scaled Boundary Finite Element Method

Dr. R Vijayakumar

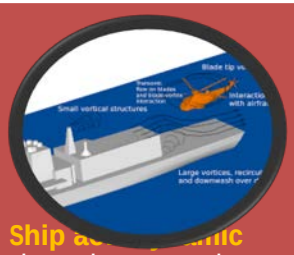
PhD, Indian Institute of Technology Delhi, INDIA

Professor, Ocean Engineering

044-2257-4829; vijay2028@iitm.ac.in

http://www.oec.iitm.ac.in/vijay2028.html

- Ship aerodynamics- smoke nuisance , ship helo interface
- Green ship initiative- Drag reduction methodology
- Autonomous underwater vehicles- Gliders
- Propeller studies- acoustic effect
- Astern Maneuvering study in shallow water

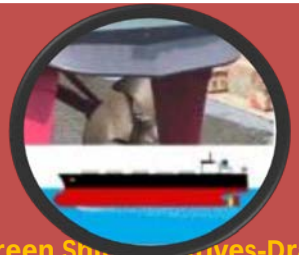


Ship a[illegible]mic

Smoke nuisance- exhaust getting into intake.

Ship helo interface- Solution to problem of helicopter landing on ships.

Ship superstructure stealth



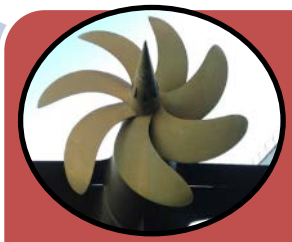
Green Ship [illegible]atives-Drag reduction studies

Effect of stern flap in increasing propulsive efficiency

Micro buble/air layer drag reduction

Autonomous underwater vehicles

Manoeuvring studies of UW glider and development of prototype



Propeller studies - acoustic effect

Low noise propeller design

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

INDIVIDUAL FACULTY PROFILE

DEPARTMENT OF PHYSICS

LIST OF FACULTY

- Abhishek Misra
- Aravind G
- Arul Lakshminarayan
- Ashwin Joy
- Athreya Shankar
- Basudev Roy
- Birabar Ranjit Kumar Nanda
- Chandra Kant Mishra
- Dawood Kothawala
- Dillip Kumar Satapathy
- Ganesan A R
- Harish Kumar N
- Ipsita Saha
- James Frederick Libby
- Jayeeta Bhattacharya
- Krishnamurthy C V
- Mahaveer Kumar Jain
- Manoj Gopalakrishnan
- Manu Jaiswal
- Murugavel P
- Nirmala R
- Panchanana Khuntia
- Pattabiraman M
- Prabat Ranjan Pujahari
- Prabha Mandayam
- Prafulla Kumar Behera
- Prahallad Padhan
- Prasanta Kumar Muduli
- Prasanta Kumar Tripathy
- Prem B. Bisht
- Rahul Vaijanath Sawant
- Raghuveer Garani Ramesh
- Rajesh Narayanan
- Rajesh Singh
- Ramachandra Rao M S
- Ravichandran Shivanna
- Samir Choudhuri
- Santhosh P N
- Sethupathi K
- Shantanu Mukherjee
- Siddharth Dattatraya Dhomkar
- Sivarama Krishnan
- Somnath Chanda Roy
- Sriramkumar L
- Subramanian V
- Sudakar Chandran
- Sunethra Ramanan
- Sunil Kumar P B
- Suresh Govindarajan
- Titas Chanda
- Vaibhav Madhok
- Vidya Praveen Bhallamudi
- Yasir Iqbal

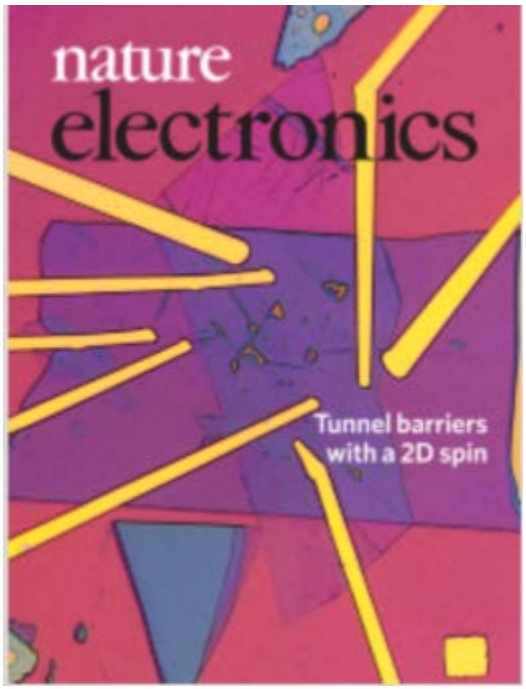
Dr. Abhishek Misra

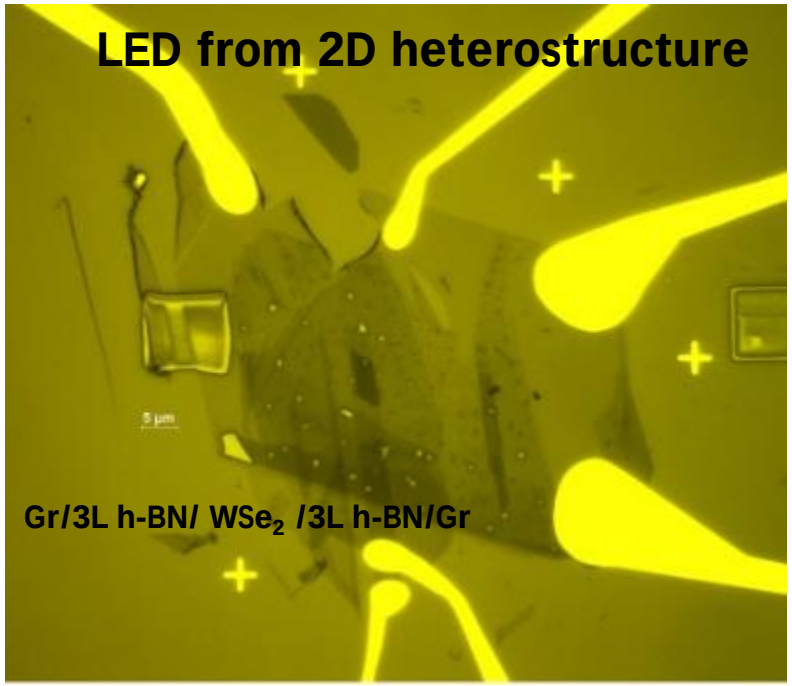
PhD, EE, IIT Bombay, India

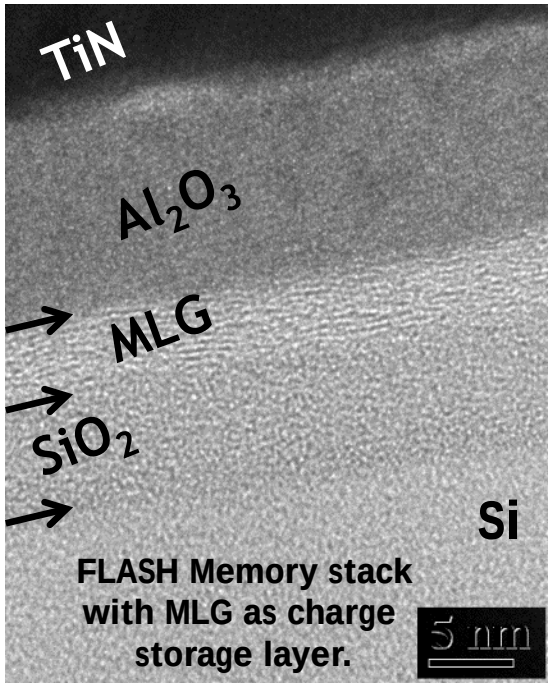
Associate Professor, Physics

044-2257-4859; abhishek.misra@iitm.ac.in

- Electronic transport in emerging quantum materials.
- Physics and applications of 2D materials and heterostructures.
- Low energy electronics for future AI and IoT based technologies.







BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

Dr. G Aravind

PhD., TIFR Mumbai, India

Professor, Physics

044-2257-4863; garavind@iitm.ac.in

- Resonances in the anions of astrophysical relevance
- Photoelectron spectroscopy and iontrap studies on interstellar anions
- Multiphoton ionization studies on interstellar molecules

Anion Resonance

The role of anion resonances in the formation of smaller anions from larger ones in space is studied.

Ion trap studies

Low energy collisions occurring in interstellar medium are studied at low temperatures using multipole iontrap

Photoelectron Spectroscopy

Photoelectron spectroscopy of anions to decipher the electronic energy levels of interstellar molecules is studied.

Atomic and molecular spectroscopy on interstellar atoms, molecules and ions

Dr. Arul Lakshminarayan

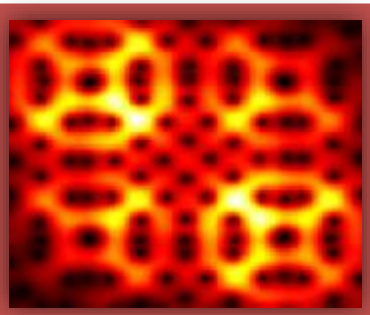
PhD, SUNY Stony Brook, NY, USA

Professor, Physics

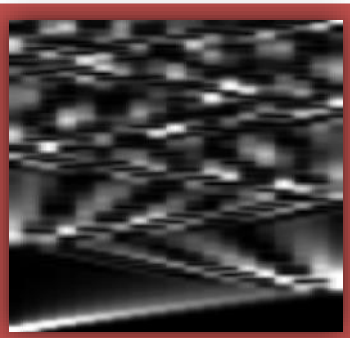
044-2257-4878; arul@iitm.ac.in

http://www.physics.iitm.ac.in/~arul

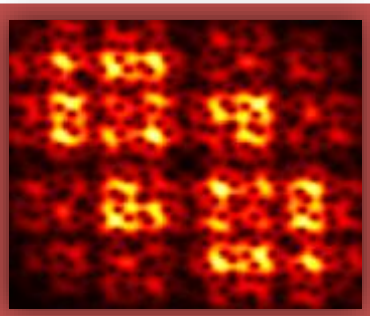
- Nonlinear Dynamics: Hamiltonian and Quantum Chaos
- Quantum Information: Entanglement. Applications to many body systems
- Statistical Mechanics: Random Matrix Theory and Extreme Value Statistics



Quantum Chaos: Simple Models to Applications



Quantum Entanglement



Random Matrix Theory and Applications

Complex Quantum Systems, Quantum Information, Random matrix theory

Dr. Ashwin Joy

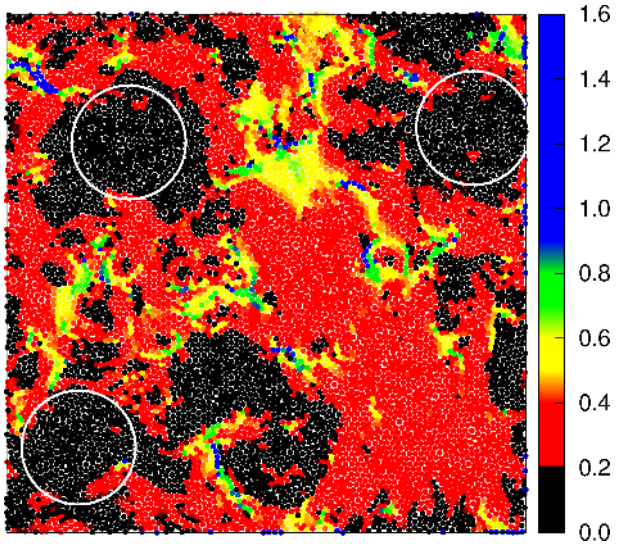
PhD, Institute for Plasma Research, Gandhinagar

Associate Professor, Physics

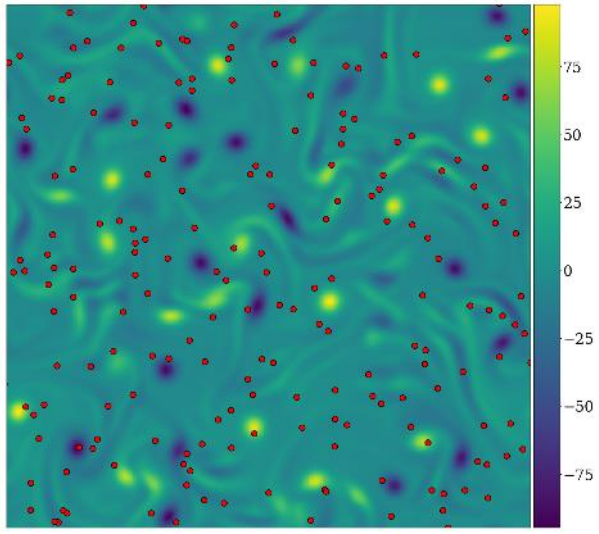
044-2257-4892; ashwin@iitm.ac.in

https://physics.iitm.ac.in/ ashwin/

I work in soft condensed matter theory and fluid mechanics



Slow Moving Clusters in an Active Liquid



Transport in Active Turbulence

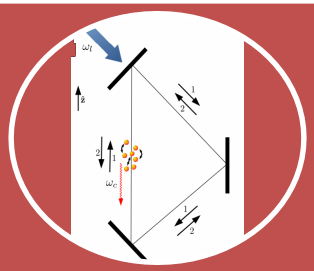
Widely Separated Scales

o o o o ←– – – – – – –→ oooooooooooo

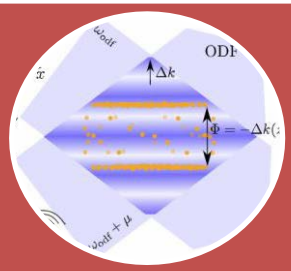
particles .. o continua ..

Dr .Athreya Shankar
PhD, University of Colorado Boulder, USA
Assistant Professor, Physics
044-2257-4877; athreya@physics.iitm.ac.in
https://physics.iitm.ac.in/faculty-inner.php?fuid=133

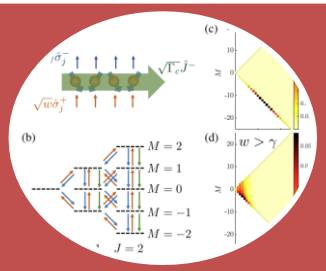
- Quantum sensing and metrology
- Quantum simulation
- Open quantum systems



Entanglement enhanced quantum sensors



Novel capabilities for quantum simulation and quantum sensing



Dissipation as a resource for entanglement generation and quantum applications

Quantum optics theory to expand the toolbox for quantum information processing

Dr. Basudev Roy

PhD, IISER Kolkata, India

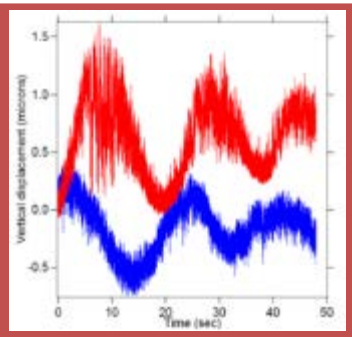
Associate Professor, Physics

044-2257-4843; basudev@iitm.ac.in

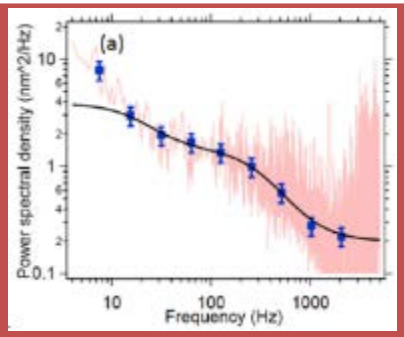
http://basudevroy.wixsite.com/website

- Soft matter using optical tweezers
- Cell biology and biophysics using optical tweezers
- High resolution imaging

OPTICAL TWEEZERS



SOFT MATTER APPLICATIONS



CELLULAR RHEOLOGY

SOFT MATTER AND BIOPHYSICS USING OPTICAL TWEEZERS

Dr. B R K Nanda

PhD, IIT Bombay

Professor, Physics

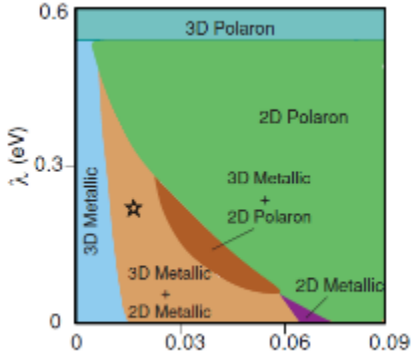
+91-44-2257-4887, nandab@iitm.ac.in

http://www.physics.iitm.ac.in/~nandab/

Condensed Matter Theory & Computational

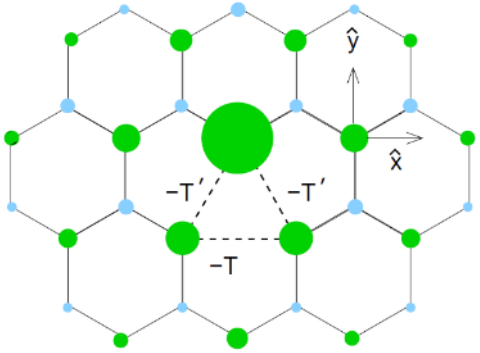
- Nanoscale Electronic and Magnetic Properties:
- Oxide Interfaces/Superlattices
- Graphene

- Energy Research:
- Lithium based Cathode Materials



Phases at the $LaAlO_3/SrTiO_3$ interface as a function of electron-lattice coupling and dielectric constant

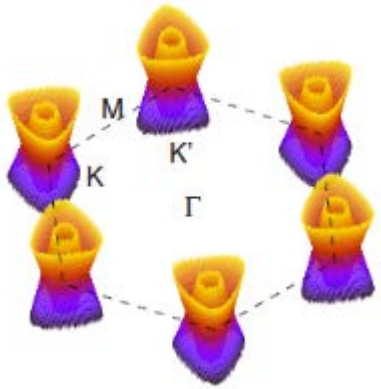
Scope for spintronic applications



Induced Spin density in monolayer graphene with a single vacancy

S = n ↑ - n ↓ (+ve green -ve blue)

Scope for magnetism in graphene



Electric field induced Fermi surface in hexagonal bilayer graphene:

Scope for hole and electron doping

Dr. Chandra Kant Mishra

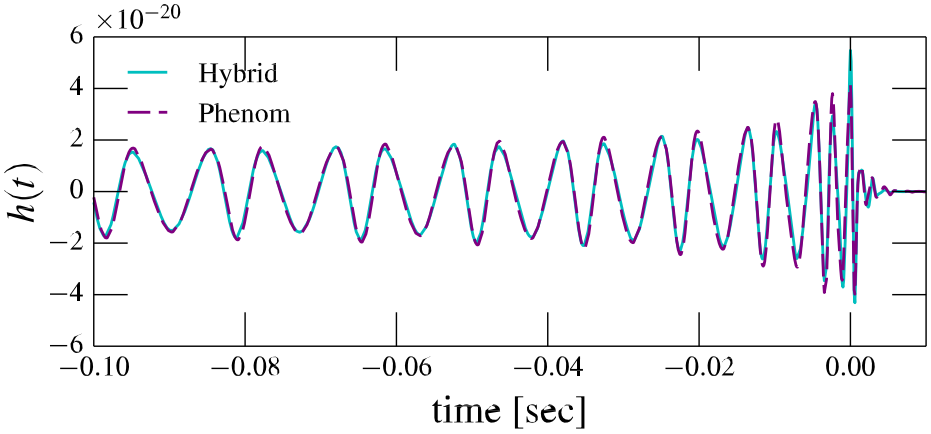
PhD, IISC, India

Associate Professor, Physics

044-2257-4860; ckm@iitm.ac.in

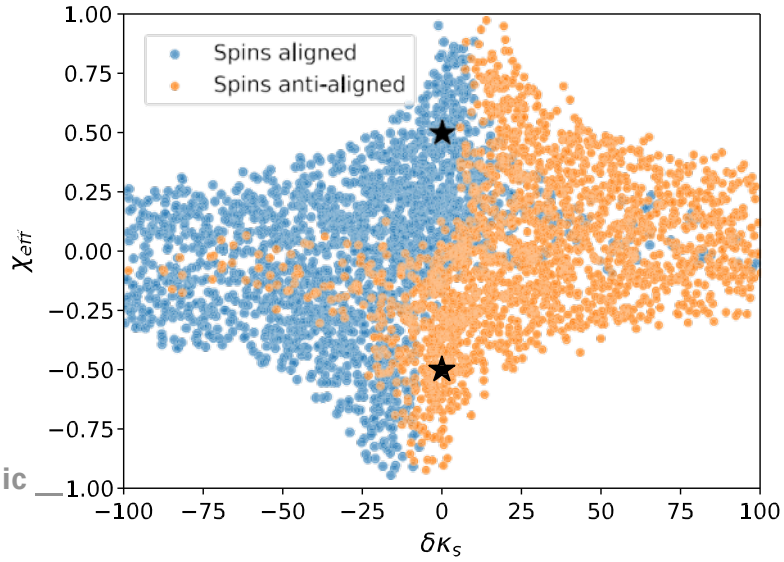
https://physics.iitm.ac.in/ckm

- Gravitational Waves / Waveform modelling
- Gravitational Waves / Signal processing
- Gravitational Waves / Observational tests using dynamical spacetimes



Waveforms constructed using phenomenology that closely mimic true signals and are used for analysis of data collected by gravitational wave detectors.

PHYSICAL REVIEW D 96, 124010 (2017)



Measuring parameters that characterise the true nature of compact object in a binary undergoing merger

PHYSICAL REVIEW D 100, 104019 (2019)

Dr. Dawood Kothawala

PhD, IUCAA, PUNE

Professor, Physics

044-2257-4848; dawood@iitm.ac.in

- Thermodynamically aspects of gravity, Black hole entropy
- Statistical mechanics and thermodynamics in curved space-time
- Implications of a “minimal space-time interval”

Thermodynamically aspects of gravity, Black hole entropy:

- Thermodynamic structure of gravitational field equations
- Hawking radiation and semi-classical aspects of black hole entropy
- Horizon thermodynamics in higher derivative theories

Statistical mechanics and thermodynamics in curved space-time:

- Thermal systems in curved space-times
- Entropy of self-gravitating systems and horizon entropy
- Interplay between quantum and thermal fluctuations

Implications of a “minimal space-time interval”:

- Quantum field propagators in presence of a minimal length
- Minimal length and space-time singularities
- Quantum field theories based on deformed quantization

Dr. Dillip Kumar Satapathy

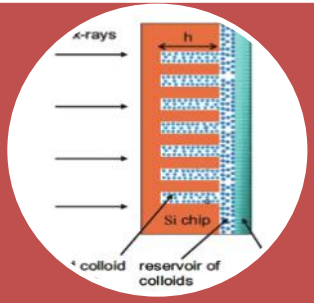
PhD, Humboldt University, Germany

Professor, Physics

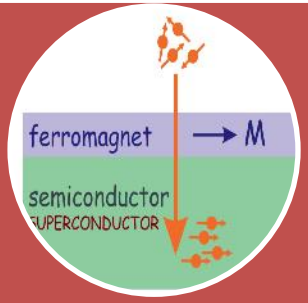
044-2257-4899; dks@iitm.ac.in

https://www.physics.iitm.ac.in/people_files/faculty/dilip.html

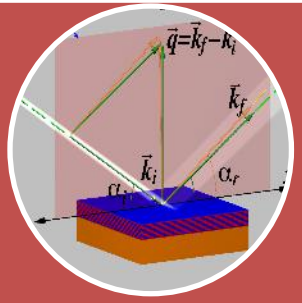
- Soft matter in confinement (confined fluids)
- Physics of complex oxide heterostructures
- Structure and dynamics of materials by X-ray and neutron scattering



Microfluidics
Friction & lubrications
Glass transition in polymer films



Spintronics
Oxide based electronics



Non-destructive characterization of structure-property relations in materials

Condensed matter physics research by using scattering techniques

Dr. A R Ganesan

PhD, IIT Madras, India

Professor, Physics

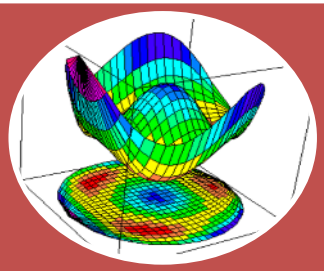
044-2257-4891; arg@iitm.ac.in

https://www.physics.iitm.ac.in/people_files/faculty/ganesan.html

- Applied Optics and Laser Instrumentation
- Holography and Speckle Metrology
- Adaptive Optics and Vision Science

Laser based optical measurement techniques and Fiber optic sensors

Holographic and Laser speckle Interferometry for Engineering Metrology



Adaptive Optics for far field imaging and correction of human ocular aberrations

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

Dr. N Harish Kumar

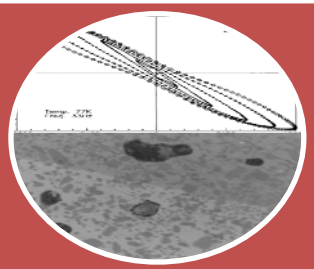
PhD, University of Hyderabad, India

Professor, Physics

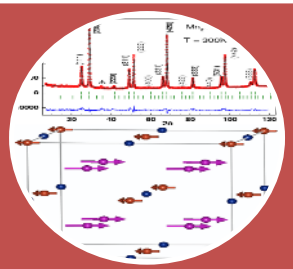
044-2257-4879; nhk@iitm.ac.in

http://www.iitm.ac.in/component/faculty/81/nhk/

- Research Area/Focus 1 Superconductivity
- Research Area/Focus 2 Spintronics
- Research Area/Focus 3 Novel Magnetic Materials

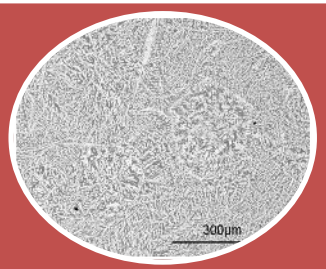


Second generation high T_c superconducting current leads



Half metallic Spin injection electrodes

Dilute magnetic Semiconductors for Magnetooptoelectronics



Novel magnetic sensors and devices

Advanced Magnetic Materials

Dr. Ipsita Saha

PhD, IACS, Kolkata

Assistant Professor, Dept. of Physics

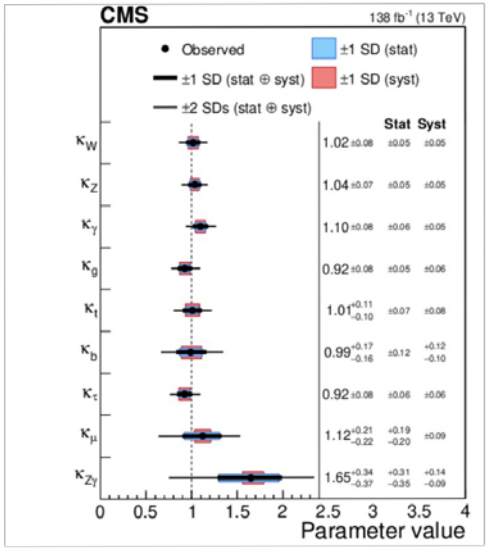
044-2257-4869; ipsita@iitm.ac.in

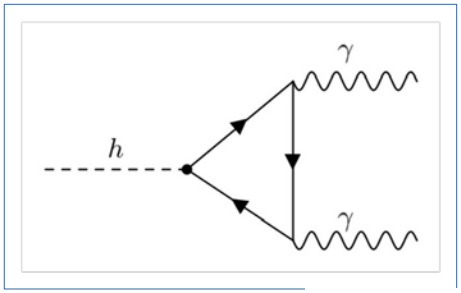
- Beyond the Standard Model Physics.
- Higgs Physics and Electroweak symmetry breaking.
- Collider and particle Dark Matter phenomenology.

SM assumes only one Higgs doublet contributing to the Electroweak symmetry breaking.

$$V_{\rm SM} = \mu^2(\phi^\dagger\phi) + \frac{\lambda}{4}(\phi^\dagger\phi)^2$$

$$SU(2)_L \times U(1)_Y \Rightarrow U(1)_{\rm EM}$$

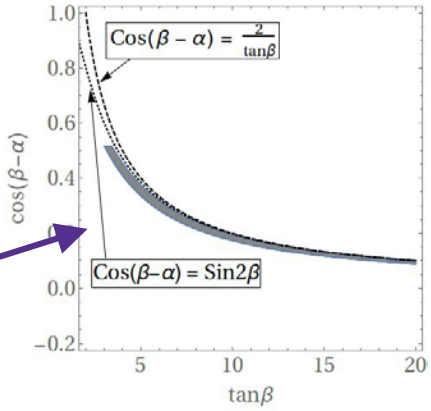


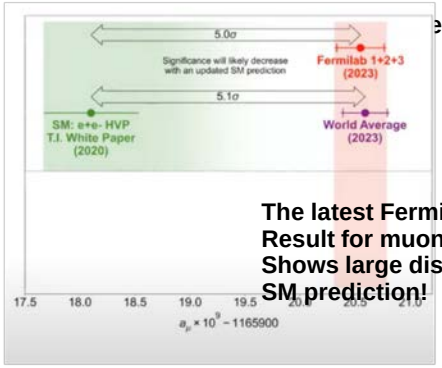


Various obseravtional aspects to look beyond the Standard Model Physics, such as, neutrino oscillation, existence of Dark Matter, anomalous muon(g-2) data etc.

e Bullet Cluster

Loop-induced Higgs decay mode to di-photon channel is an essential probe to detect any nonstandard charged particles.





The latest FermiLAB Result for muon (g-2) Shows large discrepancy with SM prediction!

The current LHC Higgs data shows an inclination towards the SM Higgs prediction. But, a wrong-sign Higgs coupling arrangement is still possible.

Dr. Jim Libby

D. Phil., University of Oxford, UK

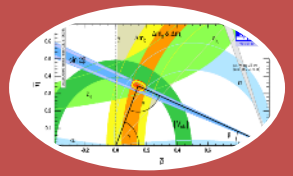
Professor, Physics

044-2257-4885; libby@iitm.ac.in

https://www.physics.iitm.ac.in/people_files/faculty/libby.html

- Experimental particle physics
- CP violation – origin of the matter anti-matter asymmetry in the universe
- Neutrino physics – studies with the India-based Neutrino Observatory (INO)

Particle detector development for INO



Measurements of CP violation using existing data from collider experiments

Belle II

Simulation studies for future high luminosity flavour factories

Instrumentation and data analysis for particle physics

Dr. Jayeeta Bhattacharyya

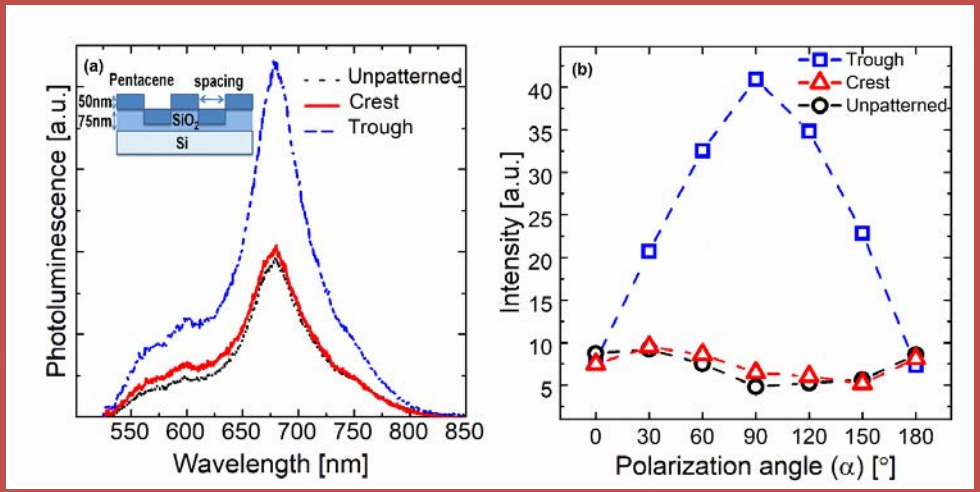
PhD Tata Institute of Fundamental Research

Associate Professor, Physics

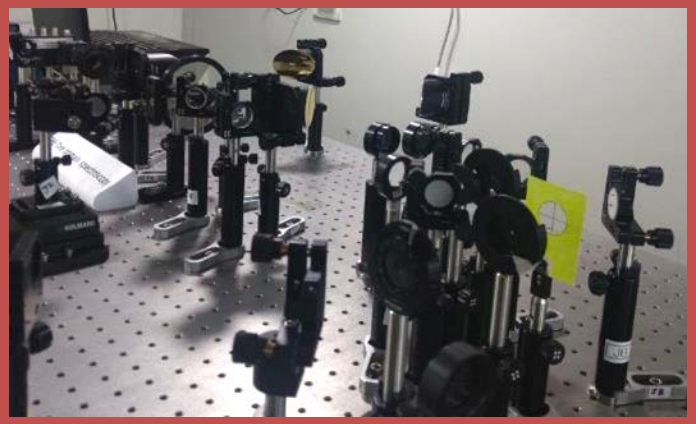
044-2257-4856; jayeeta@iitm.ac.in

Major Areas of Research

- Spectroscopic study of organic semiconductor's
- Time resolved measurements – Ultrafast spectroscopy
- Investigation of carrier dynamics in THz domain



Effect of surface patterning on pentacene thin films



THz time domain spectroscopy set-up

Dr. C V Krishnamurthy

PhD, IIT Madras, India

Professor, Physics

044-2257-4864; cvkm@iitm.ac.in

http://www.iitm.ac.in/

- Acoustic/Elastic Wave Propagation (Simulations / Experiments)
- Electromagnetic Wave Propagation (Simulation / Experiments)
- Thermal physics (Molecular Dynamics based approach / Experiments)
- High resolution capacitance sensing (Computational / Experimental aspects)

Linear and Nonlinear Wave-Matter Interactions for Imaging Applications	Heat absorption and transport in meso- and nano-scales (Fourier / non-Fourier heat conduction in complex media; and thermal imaging)	Dielectric response of materials on meso- and nano-scales

Dr. Mahaveer Kumar Jain

PhD, IIT Delhi, India

Professor, Physics

044-2257-4880; mkjain@iitm.ac.in

https://physics.iitm.ac.in/mkjain

Major Areas of Research

- **Semiconductor**
- **Photovoltaics**
- **Chemical Sensors**

Source: Faculty website

Dr. Manoj Gopalakrishnan

PhD, Institute of Mathematical Sciences, India

Professor, Physics

044-2257-4894; manojgopal@iitm.ac.in

http://www.physics.iitm.ac.in/~manoj

THEORETICAL STUDIES IN BIOPHYSICS AT THE LEVEL OF THE CELL

- Noise and its impact on cellular functions
- Active transport in the cell and its properties

Motor protein motion and active vesicle transport

Microtubule dynamics in Cell division

Chemotaxis of micro-organisms

PHYSICAL MODELING OF PROCESSES IN THE LIVING CELL

Dr. Manu Jaiswal

Graphene & 2D systems Lab

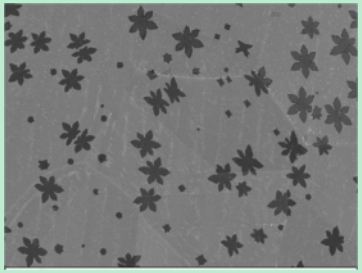
Professor, Physics

044-2257-4893; manu.jaiswal@iitm.ac.in

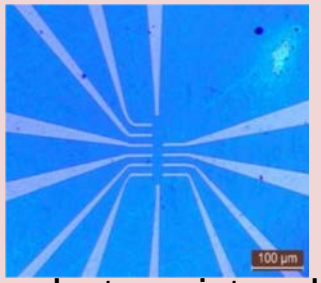
http://www.physics.iitm.ac.in/~manu_jaiswal/

Major Areas of Research

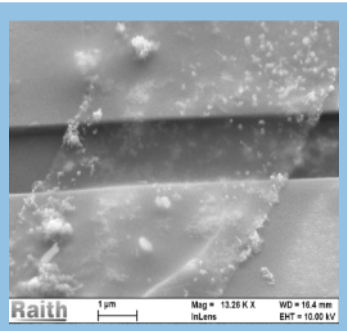
- Basic physics of 2D membranes. Graphene & 2D systems for flexible electronics
- Structure, dynamics of water in confinement. Water purification
- Interfacial phenomena in 2D. Devices and Sensors. Van der Waals heterostructures
- Mesoscopic physics of graphene & 2D systems
- Conducting polymers – soft matter and electrical transport



Growth of Graphene by Chemical Vapor Deposition



Nanoscale transistor device with electron-beam lithography



Investigating Basic Physics and Applications

SYNTHESIS → **FABRICATION** → **CHARACTERIZATION**

Dr. P. Murugavel

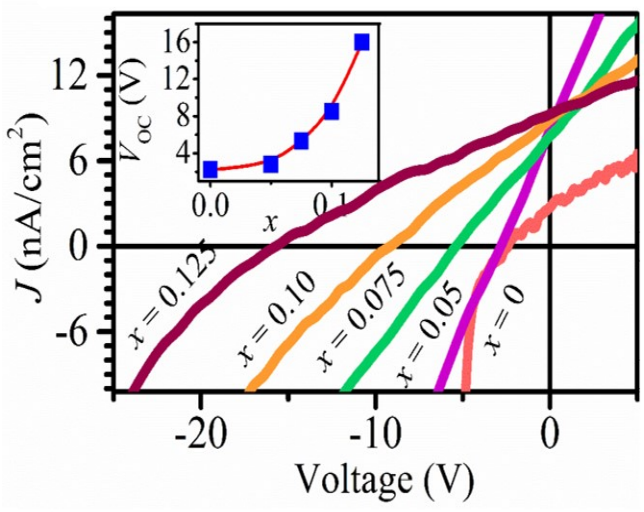
PhD, IISc Bangalore, India

Professor, Physics

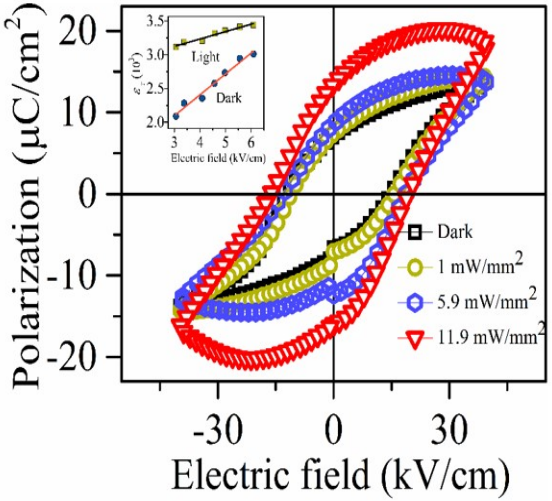
044-2257-4897 muruga@iitm.ac.in

http://www.physics.iitm.ac.in/muruga

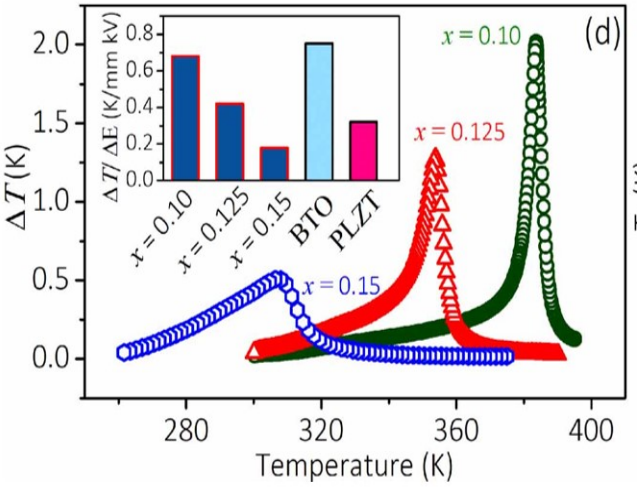
- Ferroelectric Oxides in Energy Applications
- Multiferroic and Magnetoelectric Oxides
- Strongly Correlated Perovskite Oxide heterostructures and their interphase phenomena



Ferroelectric-photovoltaic effect



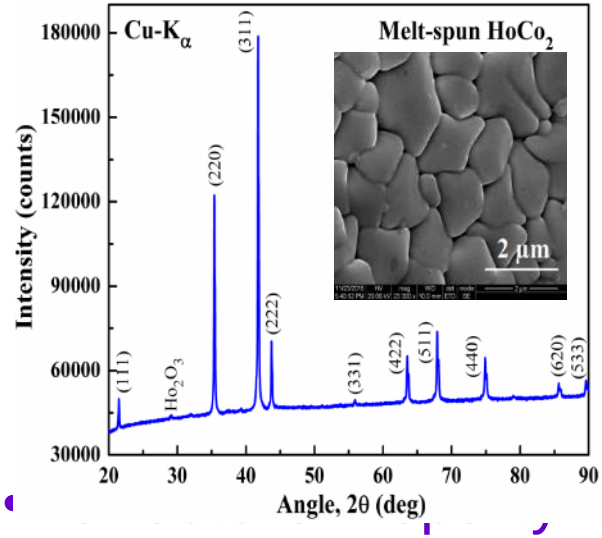
photoferroelectricity

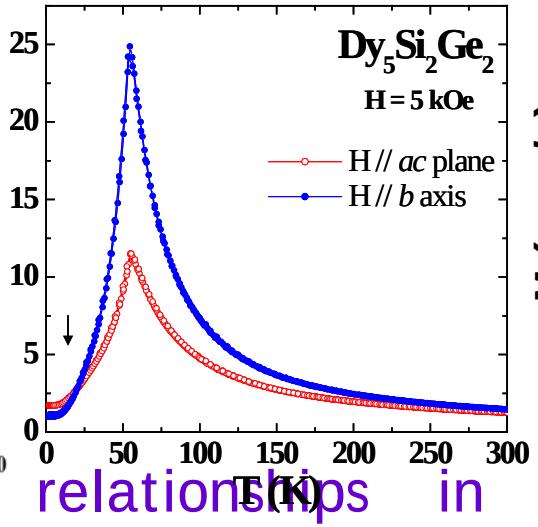


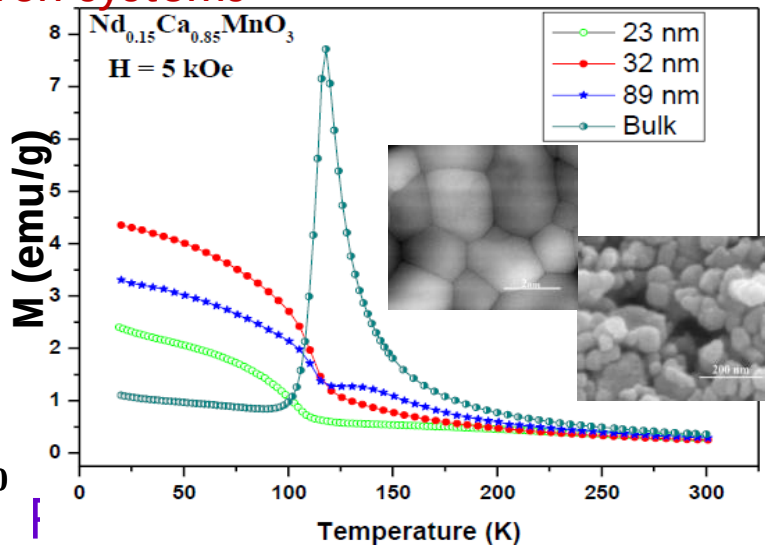
Electrocaloric effect

Dr. R Nirmala
PhD, IIT Madras
Professor, Physics
044 2257-4888; nirmala@iitm.ac.in

Magnetism of Rare earth intermetallics and
Strongly correlated electron systems







- relationships in
  compounds, alloys and oxides
- Magnetic entropy changes near magneto-structural transitions – materials for Magnetic cooling/heating applications
- Microstructure and Particle size dependence of magnetic properties

Dr. Panchanana Khuntia

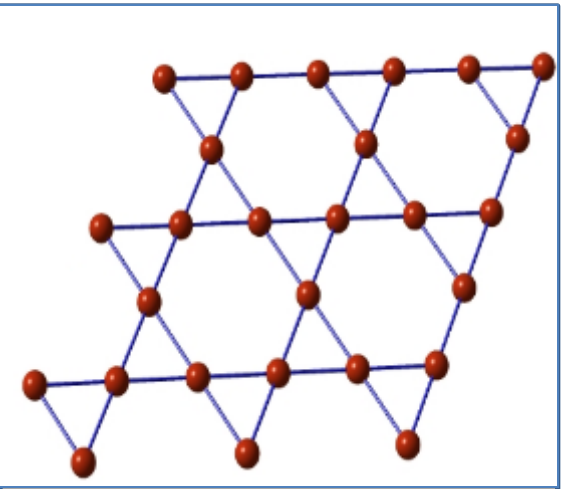
Associate Professor, Physics

044-2257-4847; pkhuntia@iitm.ac.in

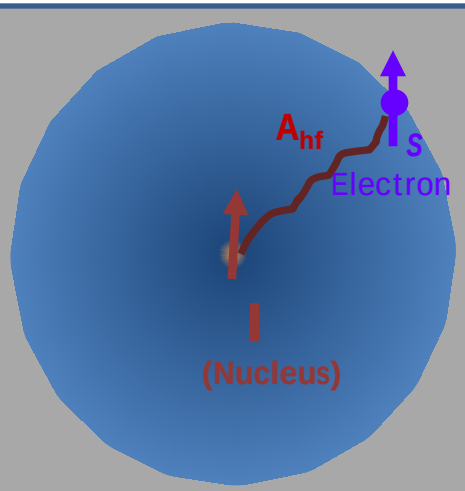
https://physics.iitm.ac.in/pkhuntia

Major Areas of Research

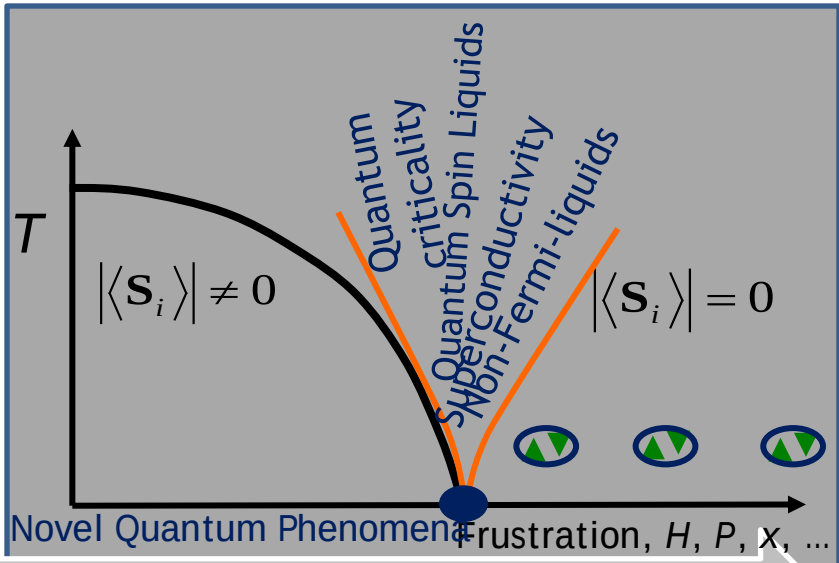
- Design, growth, characterization, and investigation of novel quantum materials
- Exploring dynamic properties of correlated electron systems by NMR, μSR and Neutron Scattering encompassing a wide range of energy scales and sensitive to spin, charge and orbital degrees of freedom
- Microscopic insights into topological order and elementary excitations in quantum materials



Novel Materials



Microscopic Probes



Novel Quantum States in Condensed Matter Physics

Dr. M Pattabiraman

PhD, IIT, Madras, India

Associate Professor, Physics

044-2257-4890; pattu@iitm.ac.in

http://www.iitm.ac.in/component/faculty/81/pattu/

Research Area: Experimental Atomic Physics and Quantum Optics

- We study the coherent interaction of light with atoms in order to control and manipulate their optical properties

Applications:

- Measurement of ultra-low magnetic fields
- Low-noise frequency standards for atomic clocks

Dr. Prabha Mandayam

PhD, California Institute of Technology

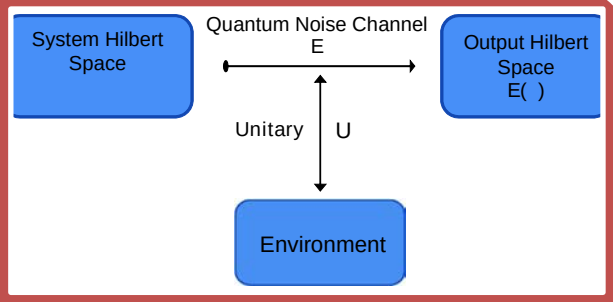
Associate Professor, Physics

044-2257-4853; prabhamd@iitm.ac.in

http://www.physics.iitm.ac.in/~prabhamd

Major Areas of Research

- **Quantum Error Correction** : Modelling decoherence in physical systems and evolving schemes to tackle such decoherence efficiently
- **Quantum Cryptography & Foundations** : Understanding the interplay between complementarity and incompatibility

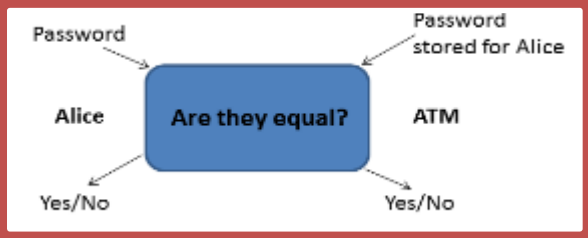


A general framework for **Approximate Quantum Error Correction**

Quantifying **incompatibility**

&

Identifying **measurement bases** which are most incompatible



Two-party protocols in **noisy-storage quantum cryptography**

Quantum Information and Quantum Computing

Dr. Prabhat Ranjan Pujahari

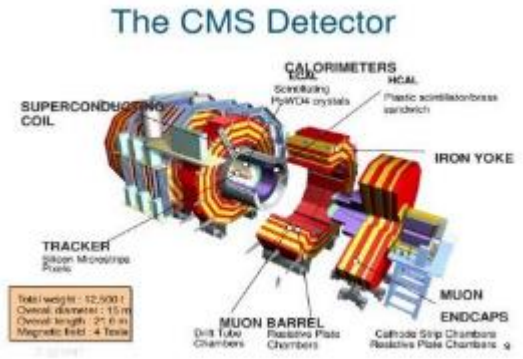
PhD, Indian Institute of Technology Bombay

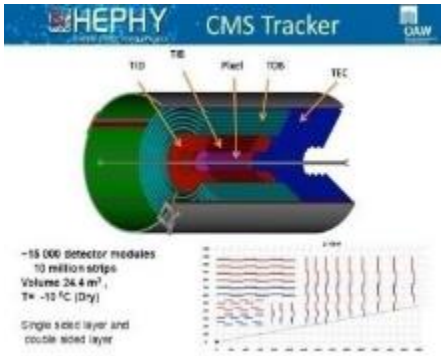
Associate Professor, Physics

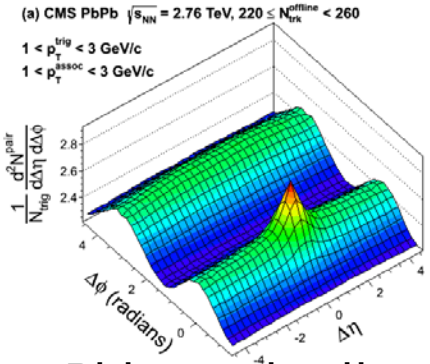
044-2257-4844; p.pujahari@iitm.ac.in

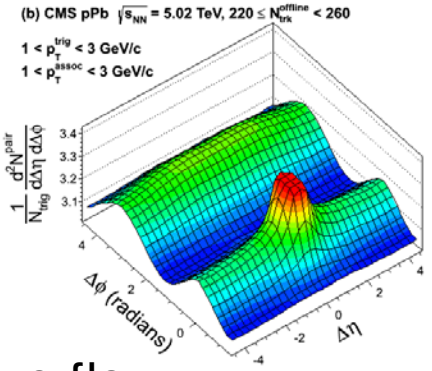
https://physics.iitm.ac.in/p.pujahari

- Experimental High Energy Heavy-Ion Physics in CMS at the Large Hadron Collider, CERN, Geneva
- Study the properties of a new form of matter at extreme conditions of temperature and energy density known as Quark Gluon Plasma (QGP)
- The physics of 'Origin of Mass' and the different phases of the early Universe
- Two-particle correlation, azimuthal anisotropy, charge balance function
- CMS silicon tracker detector up gradation program at LHC









Ridge and collective flow

Dr. Prafulla Kumar Behera

PHD, KEK supported, Japan

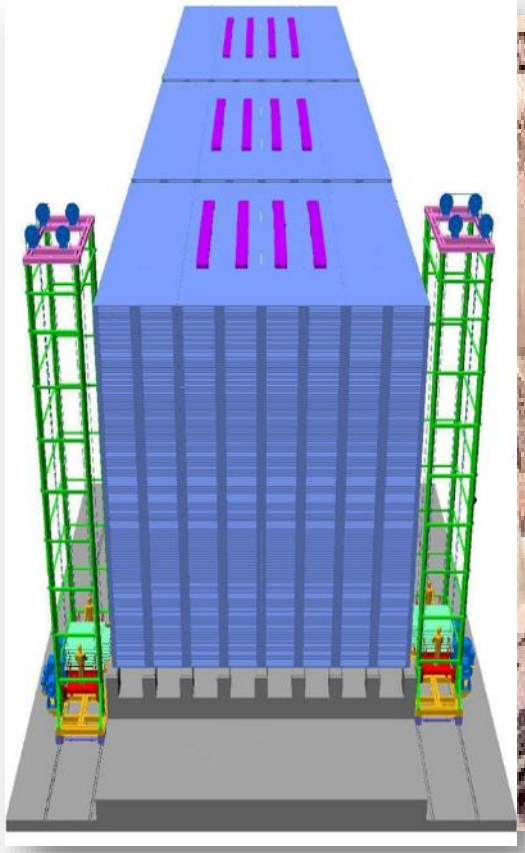
Professor, Physics

044-2257-4898; behera@iitm.ac.in

http://www.physics.iitm.ac.in/~behera

- Focus: Measuring properties of neutrinos using experimental tools. A member of India-based Neitrino Observatroy (INO). Actively involved in ICAL Detector development and detector simulation.
- Understand the matter and antimatter assymetry in the Universe and the origin of mass as part of the BELLE, KEK, Japan and ATLAS experiment, CERN, Switzerland.

Proposed ICAL Detector, India



BELLE Detector, Japan

Experimental High Energy Physics: Atmospheric Neutrino, e^+e^- and pp collider physics.

Dr. Prahallad Padhan

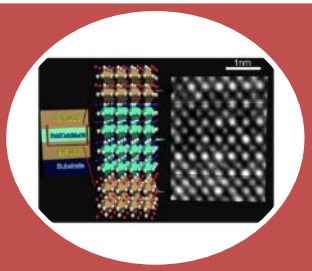
PhD, IIT Madras, India

Professor, Physics

044-2257-4884; padhan@iitm.ac.in

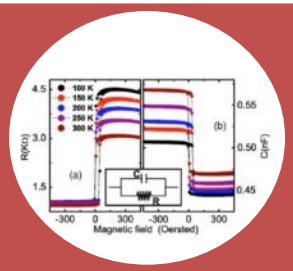
https://www.physics.iitm.ac.in/people_files/faculty/padhan.html

- Research Area/Focus 1 : Transition metal oxide Multilayers/Superlattices
- Research Area/Focus 2 : Thin film devices
- Research Area/Focus 3 : Transition metal oxide nanostructures



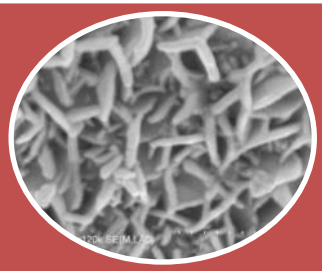
APPLICATION 1 :

Magnetic sensing and storage technology



APPLICATION 2 :

Magnetic random access memory



APPLICATION 3 :

Anode of lithium-ion battery

Dr. Prasanta Kumar Tripathy

PhD, Utkal University, India

Professor, Physics

044-2257-4889; prasanta@iitm.ac.in

http://www.physics.iitm.ac.in/~prasanta

- Calabi-Yau Compactification
- Black Holes, Super gravity
- Attractor Mechanism

Moduli Stabilization String Theory, Flux Compactifications

Calabi-Yau compactifications

Macroscopic Black Hole Entropy

And Attractor Mechanism for Stringy Black Holes

Non-Supersymmetric Attractors and Their Stability

Bianchi Attractors in Gauged Supergravity theory

String Theory and Supergravity, Quantum Field Theory, High Energy Physics

Dr. Prasanta Muduli

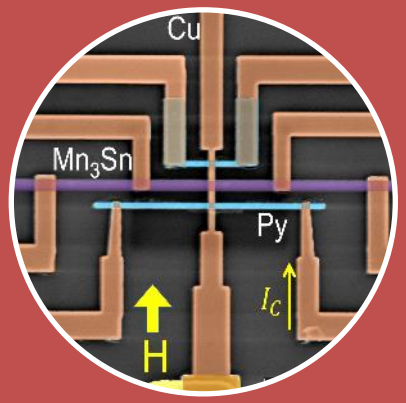
PHD, IIT Kanpur, India

Assistant Professor, Physics

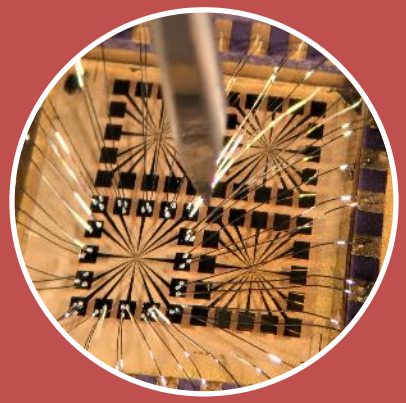
044 – 2257-4837; muduli@iitm.ac.in

https://sites.google.com/view/muduli-lab

- Quantum Device
- Quantum Material
- Superconducting Device



Spintronics



Quantum Computing

Energy Harvesting

Dr. Prem B Bisht

PhD, Kumaun University, India

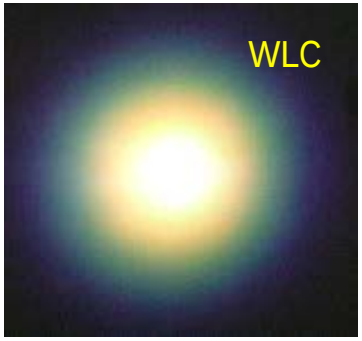
Professor, Physics

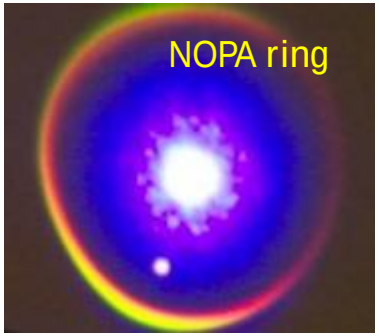
044-2257-4866; bisht@iitm.ac.in

https://www.physics.iitm.ac.in/~prem/

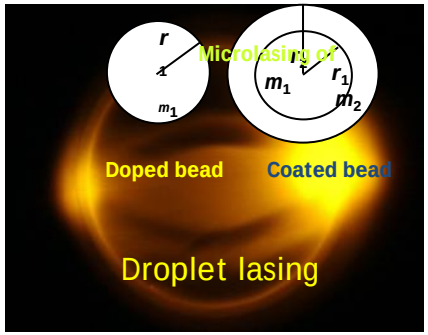
- Optical parametric amplifiers for : fabrication & characterization
- Whispering gallery modes of single microcavity; fluorescence microscopy
- Materials probed with ultrafast laser pulses for photonic applications

I. White light continuum and Optical parametric amplification: Ultrafast lasers

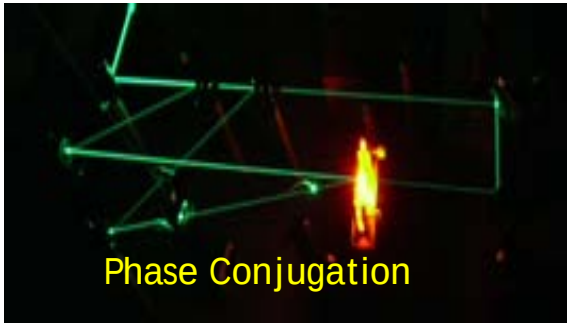




II. Whispering Gallery Modes (WGM) of a micro-cavity: Sensing applications



III. Laser Induced transient gratings: Nonlinear optics and photonic applications of nanomaterials



Ultrafast Lasers and Optical Amplifiers Lab

Dr. Raghuveer Garani

Ph.D., University of Bonn, Germany

Assistant Professor, Physics

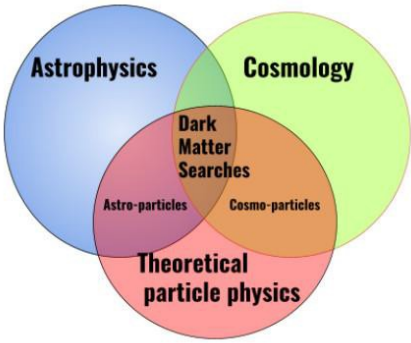
044-2257-439; garani@iitm.ac.in

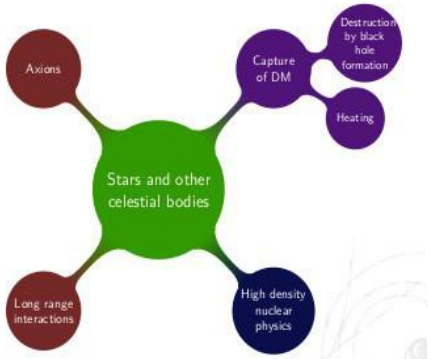
Theoretical astroparticle physics with focus of discovering particle nature of dark matter and their production in the early Universe. Inherently interdisciplinary. Specific lines of inquiry:

I. What are the particle properties of dark matter? How can we measure or constrain them?

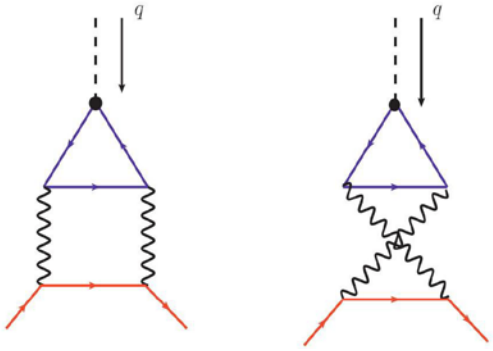
II. Celestial bodies such as the Sun and neutron stars can be used to detect dark matter through non-gravitational interactions, with terrestrial and space based cosmic ray detectors.

III. Gravitationally interacting dark matter can be tested only with cosmological observations.

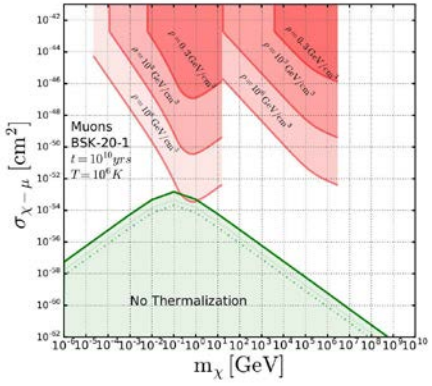




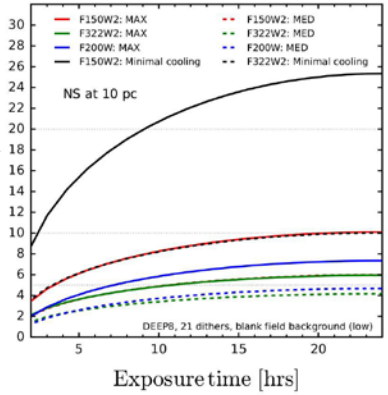
Multiple ways of how celestial bodies to serve as detectors of new particles. From my plenary talk at European Astronomical Society meeting 2022



Diagrammatic representation of quantum corrections in dark matter models, Garani et. al. JHEP 12 (2021) 212



First constraints on dark matter–muon scattering cross section from old neutron stars, Garani et al. JCAP 05 (2019) 035



Simulated exposure time required to find cold neutron star close to the Sun with James Webb Space Telescope, Garani et al. Phys.Rev.D 108 (2023) 2, 2

Dr. Rahul Sawant

PhD, Raman Research Institute, India

Assistant Professor, Physics

044 2257 4850; rahul.sawant@iitm.ac.in

Broadly my research falls under the subject of **Atomic, Molecular, and Optical (AMO) Physics**. I am focused on the systems that enable the creation of **laser-cold atoms and molecules**. Such systems have been instrumental in advancing **Quantum Science and Technology**. Within the domain of Quantum Technology I am interested in the building of systems for **Quantum Information Processing, Quantum Repeaters, Optical Atomic Clocks, and Quantum Inertial Sensors.** I am also interested in the development of laser technologies that are used in the above mentioned systems.

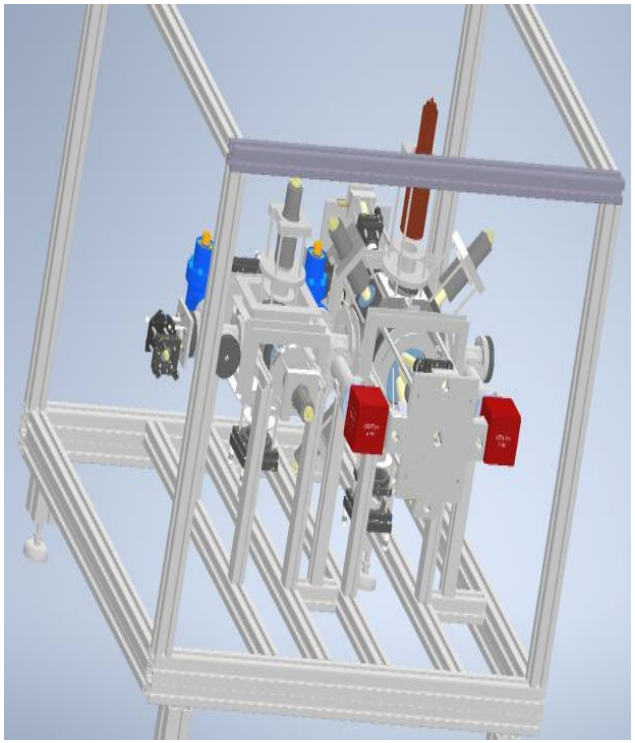


Fig: Quantum Gravimeter Design

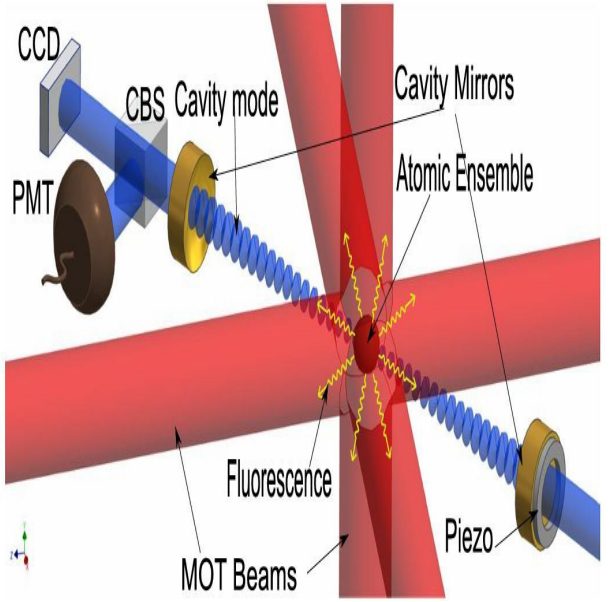


Fig: Study of Interactions of cold atoms with cavity photons.

Dr. Rajesh Narayanan

PhD, University of Oregon, USA

Professor, Physics

044-2257-4858; rnarayanan@iitm.ac.in

https://physics.iitm.ac.in/rnarayanan

Major Areas of Research

- **Condensed Matter Theory: Quantum Field Theories applied to condensed matter systems**
- **Quantum Phase Transitions**
- **Strong disorder physics.**

Source: Faculty website

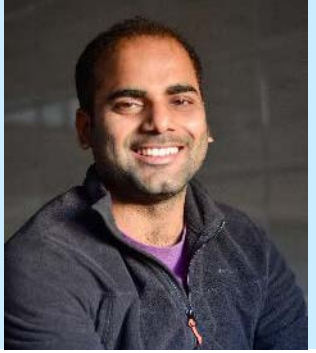
Dr. Rajesh Singh

PhD, IMSc, Chennai, India

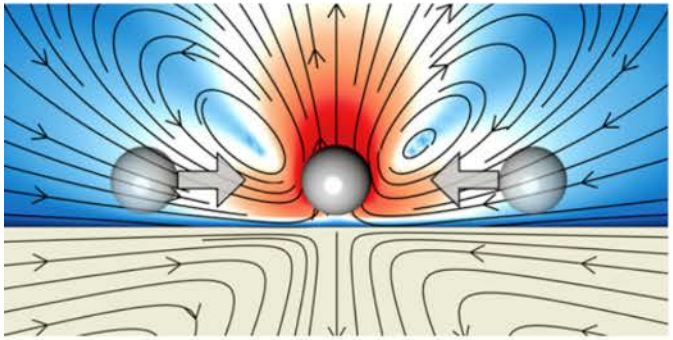
Assistant Professor, Physics

044-2257-4838; rsingh@iitm.ac.in

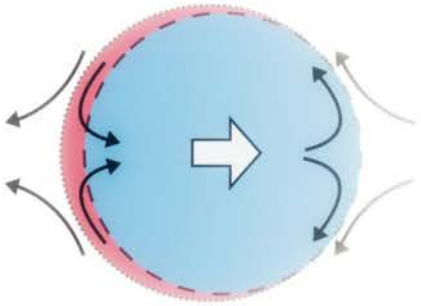
https://physics.iitm.ac.in/rsingh



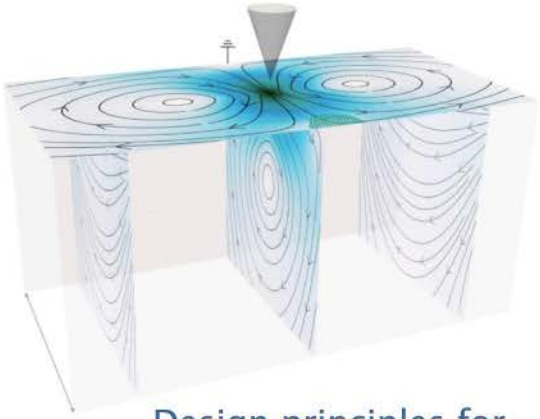
- Soft matter physics
- Fluid mechanics
- Biophysics



Phoresis and Stokesian hydrodynamics of active and driven particles



Statistical field theory of active matter systems



Design principles for novel soft materials

Physics of soft, active, and living materials

Dr. M S Ramachandra Rao

Professor, Physics

Nano Functional Materials Technology Centre and MSRC

044-22574872; msrrao@iitm.ac.in

http://www.physics.iitm.ac.in/~msrrao

Research Theme: "Oxide electronics, Thin Film Nanostructures and Energy Harvesting"

Research Areas: **P**hysics and applications of oxide electronics; **Z**nO nanostructures for light emission; **P**hysics of doping in ZnO; **P**hysics of diffusion in oxide nanoparticles; **M**agnetic nanoparticles; **S**pintronics and Tunnel junctions; **N**anocrystalline diamond for mechanical applications; **C**IGS/CZTS nano-ink for photovoltaic applications; **T**opological insulators; **P**hysics of strongly correlated systems; **Q**uantum effects in nanosystems; **M**aterials for energy harvesting.

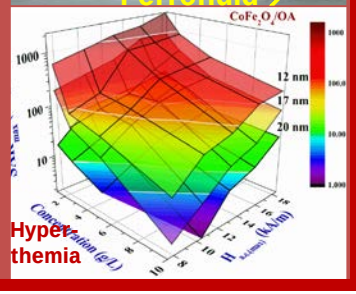
Physics and Applications of Nanostructured Thin Films and Nanomaterials

← Coated WC tools for improved mechanical applications.

Nanocrystalline diamond (NCD) coatings are known for their tribological characteristics (μ < 0.1) and wear resistance. They are potential coatings for mechanical and space applications.

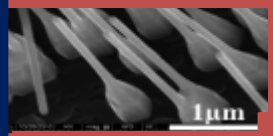
Magnetic Nano-particles

Ferrofluid→

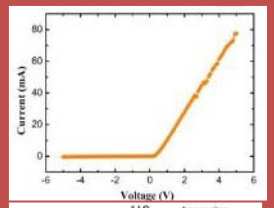


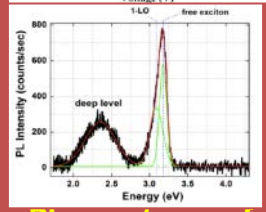
p-ZnO/n-Si Heterojunction diode

1D ZnO nanorods and thin films can be used in UV/blue LEDs and as UV detectors.



ZnO nanorods





PL spectrum of nanorods

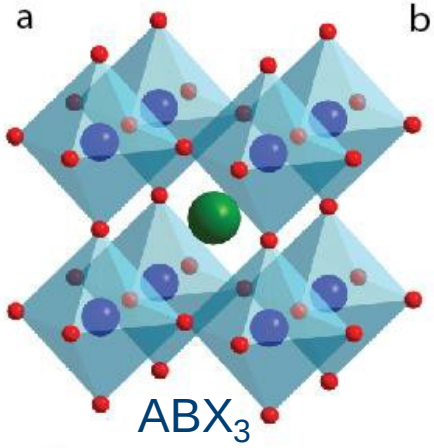
Dr. Ravichandran Shivanna

PhD, JNCASR, Bangalore

Assistant Professor, Physics

044-2257-4834; ravics@iitm.ac.in

Soft semiconductor Halide Perovskites

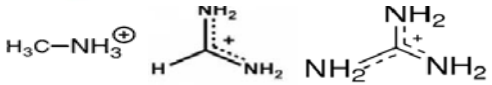


ABX_3

A = MA^+, FA^+ or Cs^+

B = Pb^{2+} or Sn^{2+}

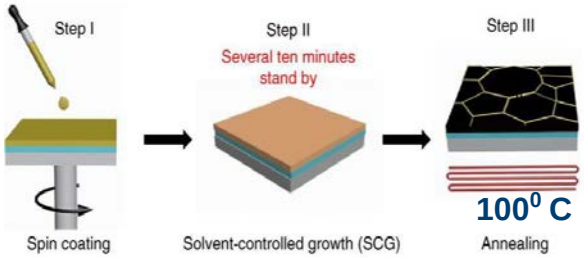
X = Cl^-, Br^- or I^-



MA FA GA

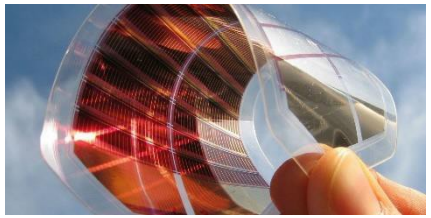
- **Abs Coeff. > 10^4 cm^{-1}**
- **Carrier lifetime > *1* µs**
- ***e* and *h* diffusion length > 1 µm**

Easy Fabrication Solution Processable

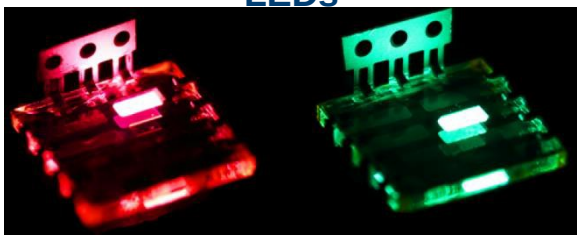


Flexible devices

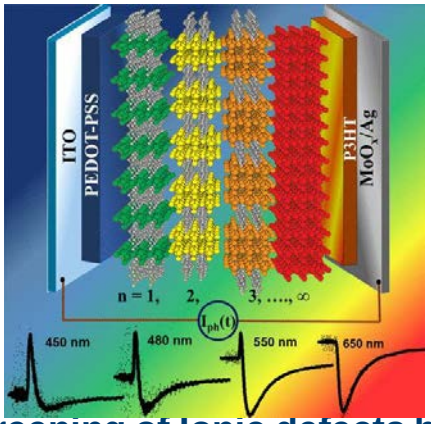
Solar cells



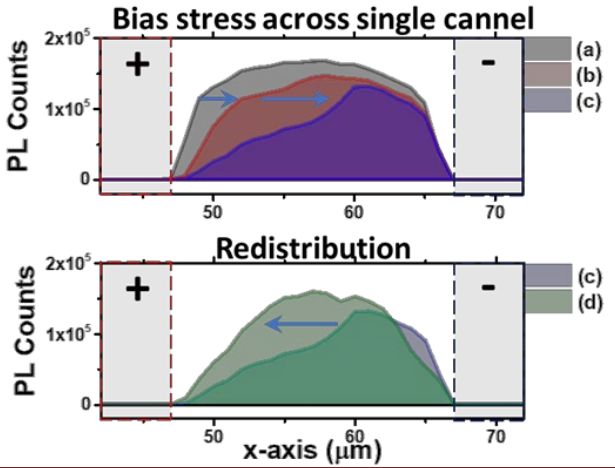
LEDs



Single Pixel Color sensor



Screening of Ionic defects by PL mapping



D Luo,.., Ravichandran S, et al, **Science, 2018**, 360, 6396, 1442-1446

Y Hassan,.., Ravichandran S, et al, **Nature, 2021**, 591, 7848, 72-77

B Zhao, Ravichandran S, et al, **Nature Photonics, 2018**, 12, 12, 783-789

SP Senanayak,.., Ravichandran S, et al, **Nature Materials, 2023**, 22,216-224,

SA Bourelle,.., Ravichandran S, et al, **Nature Communicatio 2022**, 13,1,3320

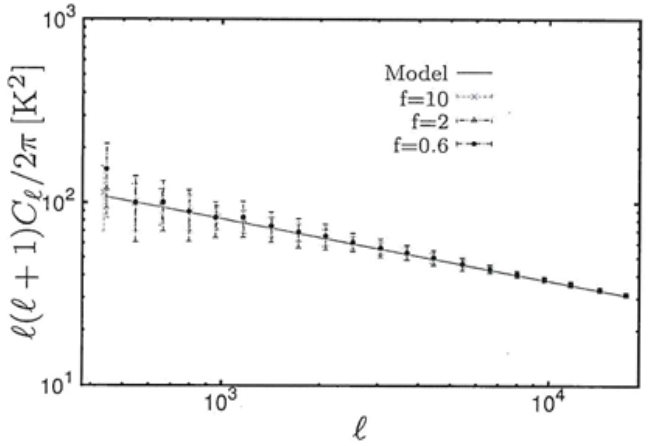
Dr. Samir Choudhuri

PhD, IIT Kharagpur

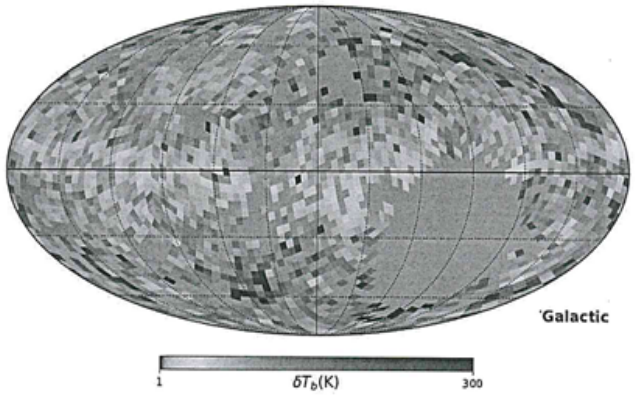
Assistant Professor, Physics

044-2257-4850; samir@iitm.ac.in

- Measuring cosmological 21-cm signal from Cosmic Dawn and Epoch of Reionization
- Develop Simulation pipeline and Statistical estimator for radio interferometric observations
- Study of the diffuse Galactic Synchrotron Emission using radio observations



Validation of the Tapered Gridded Estimator (TGE)



Measurement of the Galactic synchrotron emission using TIFR GMRT Sky Survey (TGSS)

Dr. Santhosh P N

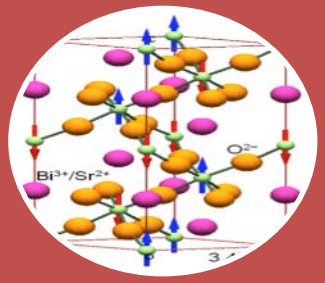
PhD, University of Pune , India

Professor, Physics

044-2257- 4882

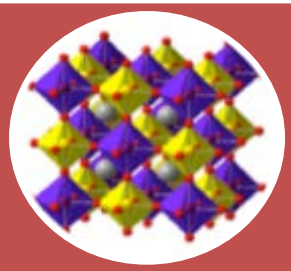
http://www.iitm.ac.in//people_files/faculty/santosh.html

- Experimental Condensed Matter Physics:/Multiferroics
- Structure-property correlations, DFT calculations of Advanced Oxide Materials
- Magnetic and semiconducting nano particles



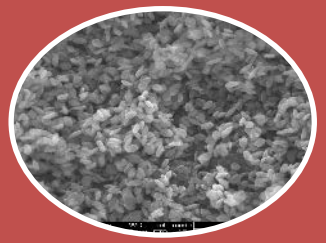
$Bi_{0.5}Sr_{0.5}FeO_3$ multiferroic

Double perovskite multiferroics



Order-disorder in perovskites

New double layered brownmillerites



Ni/NiO core-shell structure

CuO, $FeSe_2$,Fe_3Se_4 nano particles

Gold nano particles for bio applications

Experimental Condensed Matter Physics/ Multifunctional materials

Dr. K Sethupathi

PhD, Moscow State University, Russia

Professor, Physics

044-2257-4875; ksethu@iitm.ac.in

http://www.iitm.ac.in/

- Magnetism and Transport properties of Colossal Magnetoresistance Oxides at low temperatures
- Novel materials in the bulk, thin film and nanocrystalline forms
- High Temperature Superconductors and
- Cryogenic Insulation

Novel materials that exhibit large magnetoresistance for magneto resistive sensors and spintronic device applications

Magnetic refrigeration materials for cooling applications

New materials for electronic cooling

Dr. Shantanu Mukherjee

PhD, University of Wisconsin-Milwaukee, USA

Associate Professor, Physics

044-2257-4845; shantanu@iitm.ac.in

https://physics.iitm.ac.in/shantanu

Major Areas of Research

- **Condensed Matter Theory**

Source: Faculty website

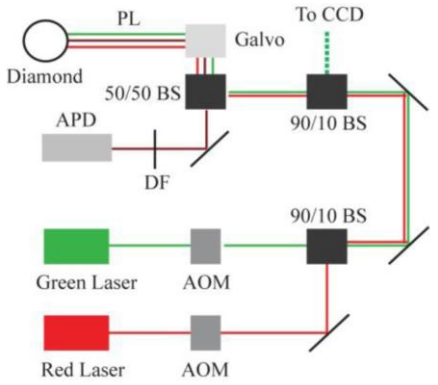
Dr. Siddharth Dhomkar

PhD, City University of New York, USA

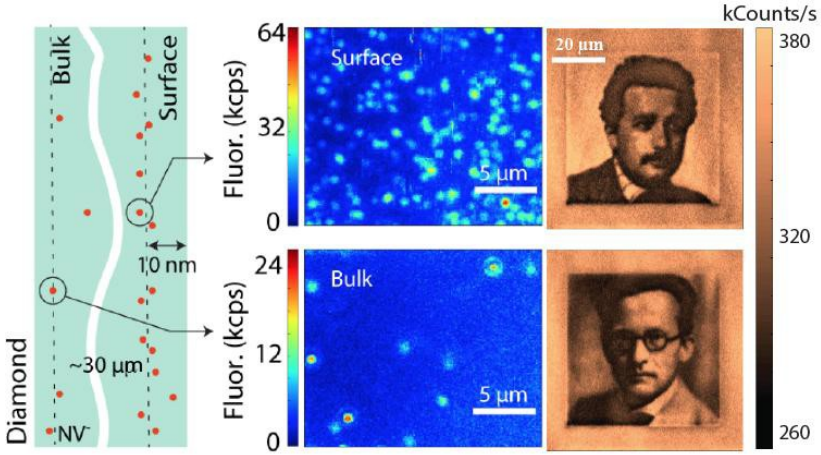
Assistant Professor (Grade I), Physics

044-2257-4835; sdhomkar@iitm.ac.in

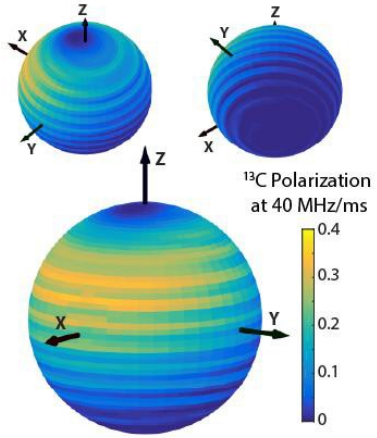
- Optically active spins for quantum sensing and quantum information processing
- Scanning confocal fluorescence microscopy for single spin imaging and control
- Improved electron-nuclear gates for improving readout fidelities



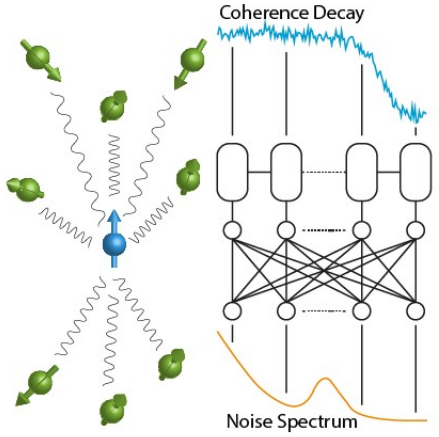
Proposed optical setup



Control of individual defect centers



Magnetic resonance for qubit control



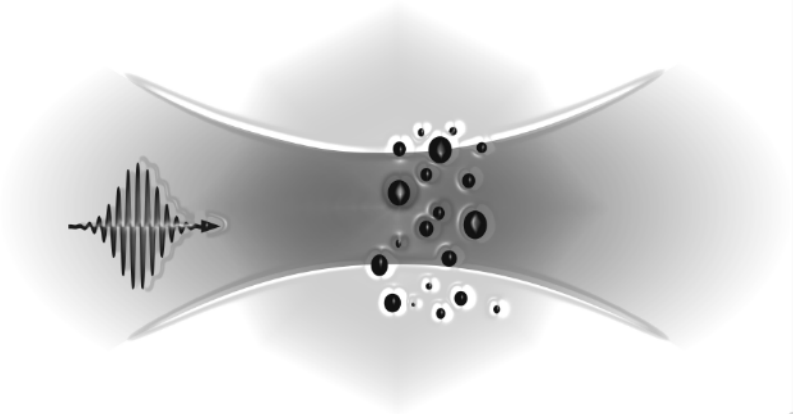
Machine learning for decoherence mitigation

Dr. Sivarama Krishnan

PhD, Max Planck Institute

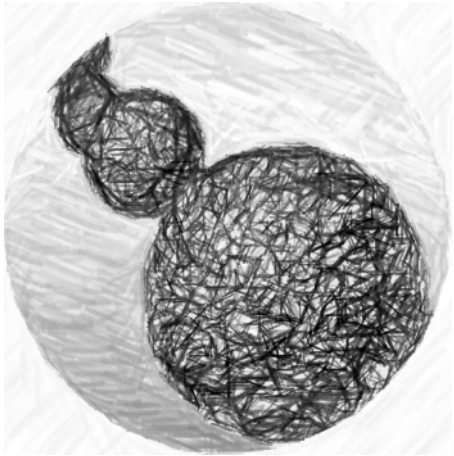
Professor, Physics

044-2257-4857; srkrishnan@iitm.ac.in

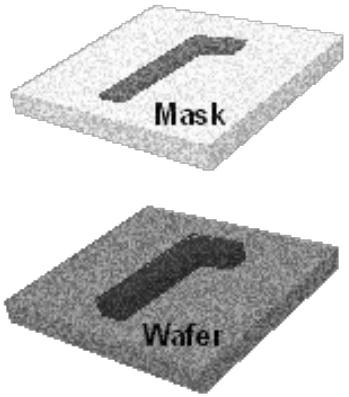


Femto- and atto-second physics
of nanoscale atomic & molecular systems

Synchrotron physics
of nanoscale systems



Dynamics in
Nanoscale superfluids



Nanolithography
next generation technologies

Dr. Somnath Chanda Roy

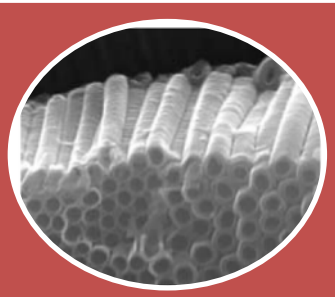
PhD, IIT Delhi, India

Professor, Physics

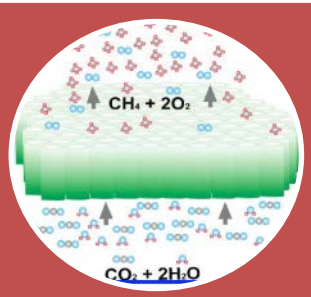
044-2257-4886; somnath@iitm.ac.in

http://www.physics.iitm.ac.in/~somnath

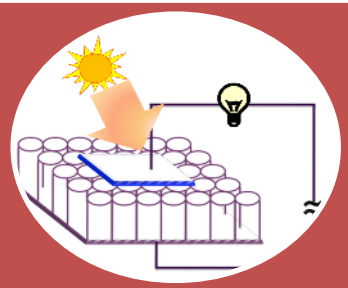
- Synthesis and characterization of metal-oxide nanostructures and thin films
- Study of Electronic conduction and Photo-catalytic properties
- Use of nano-materials for clean Energy and Environment



Metal oxide Nanotubes Sensors for Green-house Gases



Generation of Hydrogen/Hydrocarbons from water/CO_2 using solar energy



Solid state, Hybrid Solar Cells based on nanomaterials

The Environmental Nanotechnology Lab : Novel Nanostructures for (i) Detection of pollutants (ii) Recycling of CO_2 through Photo-catalysis (iii) High efficiency Solar cells

Dr. L Sriramkumar

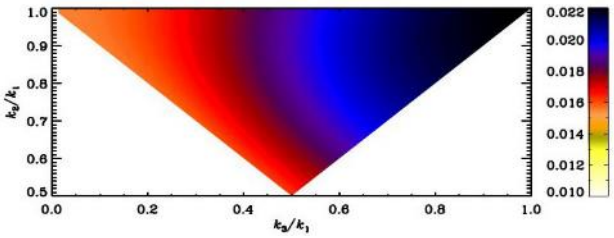
PhD, IUCAA, Pune

Professor, Physics

044-2257-4854; sriram@iitm.ac.in

http://www.physics.iitm.ac.in/~sriram/

- **Origin of perturbations during inflation**
- **Signatures on the Cosmic Microwave Background (CMB)**
- **Semi-classical gravity and the physics of black holes**



Origin of perturbations during inflation

- Deviations from slow roll and features in the primordial power spectrum
- Generation of primordial non-Gaussianities
- Evolution of power and bispectra post inflation

Signatures on the CMB

- Comparison of inflationary models with the recent WMAP and Planck data
- Efficient numerical computation of inflationary bispectra (figure above)
- Imprints of primordial bispectra on the CMB

Semi-classical gravity and the physics of black holes

- Issues related to the origin of Hawking radiation and black hole entropy
- Possible quantum gravitational corrections
- Phenomenological models of quantum gravity

Dr. V Subramanian

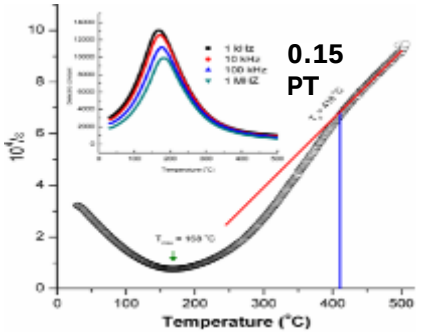
PhD, IIT Madras, India

Professor, Microwave Laboratory, Physics

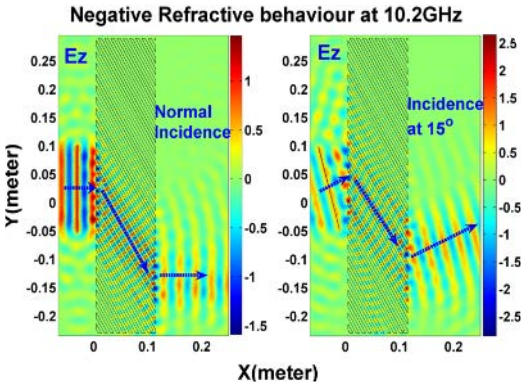
044-2257-4883; manianvs@iitm.ac.in

http://www.physics.iitm.ac.in/~manianvs/index.html

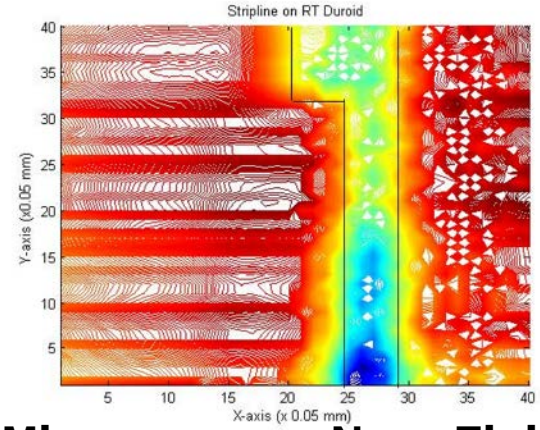
- **Dielectrics, Relaxors and Multiferroics**
- **Photonic Crystals and Metamaterials**
- **Non-Destructive Evaluation at Microwave Frequencies**
- **Microwave Imaging**
- **Magneto-impedance studies at microwave frequencies**



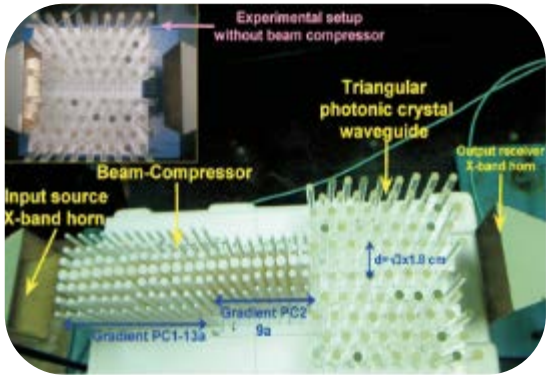
0.15 PT – 0.85 PIN Relaxor



Negative Refraction - Slabs Oriented at 60°



Microwave Near-Field Imaging of a Stripline on RT Duroid Substrate



Spatial Beam Compressor - Based on Photonic Crystal

Dr. Sudakar Chandran

PhD, IISc Bangalore, India

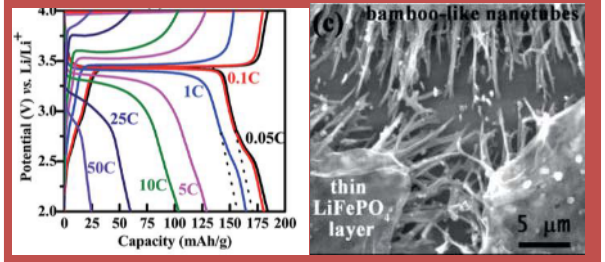
Professor, Physics

044-2257-4895; csudakar@iitm.ac.in

https://home.iitm.ac.in/csudakar/

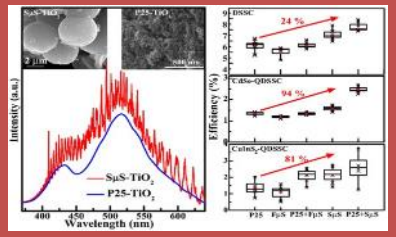
- Materials for energy generation (solar cells) and storage (Li-ion batteries) applications
- High power density cathode and anode materials for quick charge Li-ion batteries
- Novel multifunctional materials with interesting properties for advanced applications
- Defect structure property correlations on composition/microstructure tailored materials
- Nanomaterials for solar cell and LED applications

High-rate capability materials for Li-ion Battery applications



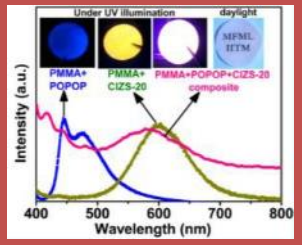
Nanostructured metal oxides for Li ion battery cathode and anode materials; controlling the crystal defect structures and the microstructure to tune the specific capacity and the power density

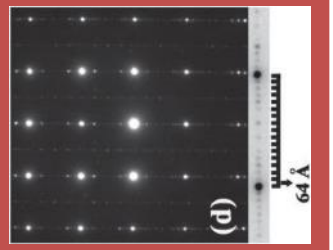
High performance photoanodes and sensitizers for solar cell applications



Functional materials for DSSC, QDSSC, Perovskite solar cell applications, bandgap engineer- ing in sensitizers, fabricating high performance photoanodes for enhancing efficiency

Multifunctional materials and Defect-structure property correlations





Role of oxygen/nitrogen defects and surface/interface effects on the physical properties of semiconducting oxides and nitrides and multiferroics; electrical, optical and magnetic properties studies

MULTIFUNCTIONAL MATERIALS LABORATORY (MFML)

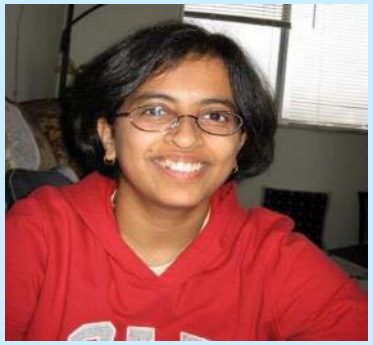
Dr. Sunethra Ramanan

PhD, The Ohio State University, USA

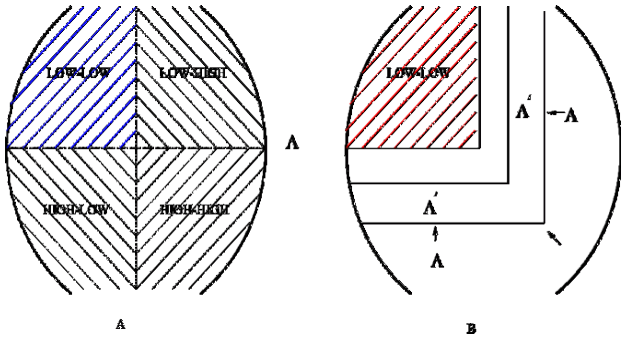
Associate Professor, Physics

044-2257-4871; suna@iitm.ac.in; suna@physics.iitm.ac.in

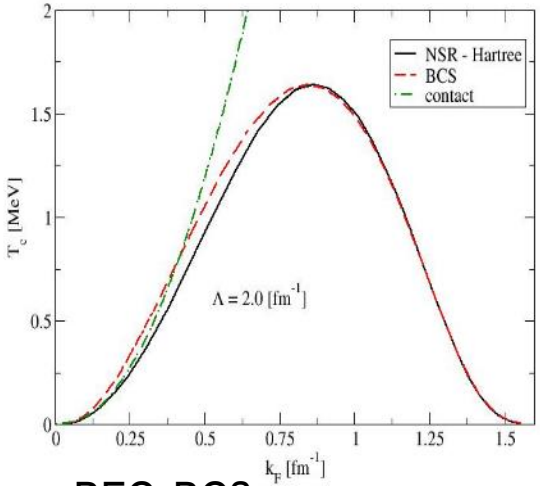
http://www.physics.iitm.ac.in/~suna



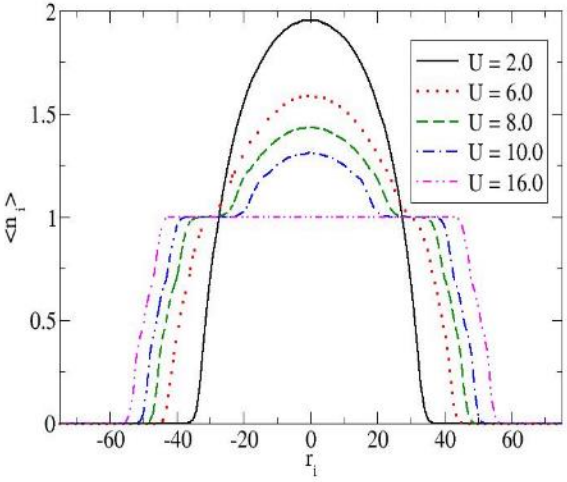
- Effective Field theories and Renormalization Groups
- Nuclear Structure
- Cold Atomic Systems



RG approach to Effective Nucleon-nucleon interactions



BEC-BCS crossover in neutron stars



Cold bosons in optical Lattices

Dr. P B Sunil Kumar

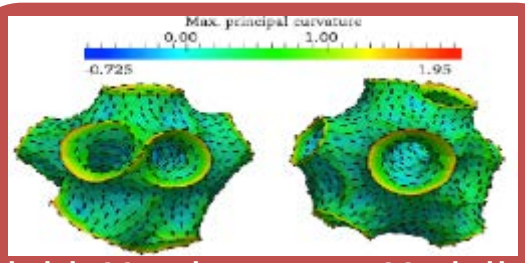
PhD,1995 Raman Research Institute, India

Professor, Physics

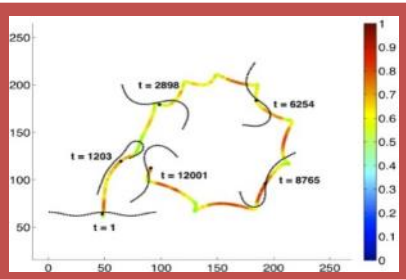
044-2257-4876; sunil@iitm.ac.in

http://www.physics.iitm.ac.in/~sunil

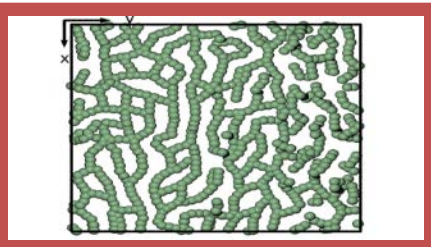
- Soft Condensed Matter Physics
- Biological Physics
- Computational Physics



Lipid Membranes: Modeling equilibrium and dynamical properties of lipid membranes and membrane-protein complexes. Response of membranes to external forces.



Active soft matter: Dynamics of molecular assemblies, that convert chemical energy to mechanical work internally.



Dynamics of polymers.: Rheology and shear induced transitions in polyelectrolytes and living polymer suspensions. Developing coarse grained models for polymers.

Dr. Suresh Govindarajan

PhD, University of Pennsylvania, USA

Professor, Physics

044-2257-4867; suresh@iitm.ac.in

http://www.physics.iitm.ac.in/~suresh

- String Theory and Conformal Field Theory
- Black Holes and Counting of BPS states
- Mathematical Physics (Partitions, Mathieu Moonshine, Modular Forms)

Counting of BPS states in string theory	Moonshine for the Mathieu Groups	Higher Dimensionl Partitions p3(72)=3464274974065172792

THEORETICAL HIGH ENERGY PHYSICS & MATHEMATICAL PHYSICS

Dr. Titas Chanda

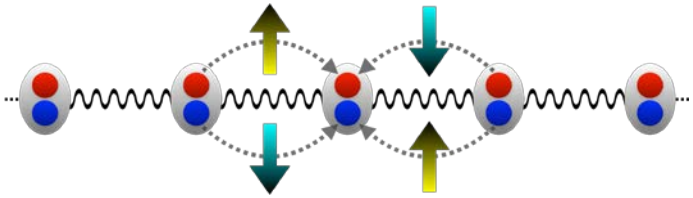
PhD, Harish-Chandra Research Institute, India
Assistant Professor, Physics
044-2257-4833; titas.chanda@iitm.ac.in
https://sites.google.com/view/titaschanda

Condensed Matter Theory / Quantum Many-Body Physics

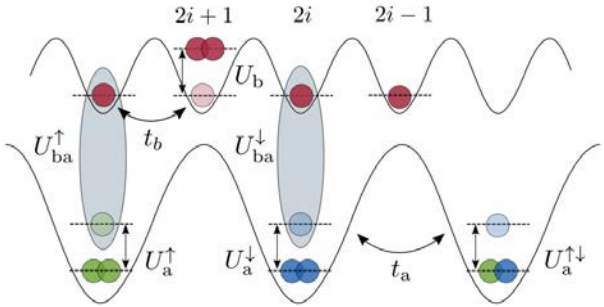
- Quantum simulations with ultra-cold atoms
- Tensor network algorithms
- Lattice gauge theories
- Critical phenomena and conformal field theory
- Topological systems and quantum spin liquids
- Cavity QED many-body systems
- Out-of-equilibrium dynamics

Quantum Information Science

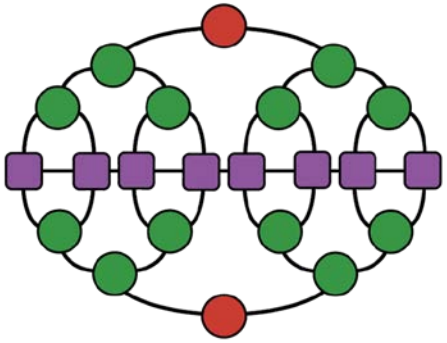
- Entanglement in and out of equilibrium
- Microscopic thermal machines
- Decoherence and open-quantum systems
- Resource theory of quantum magic
- Quantum-inspired algorithms



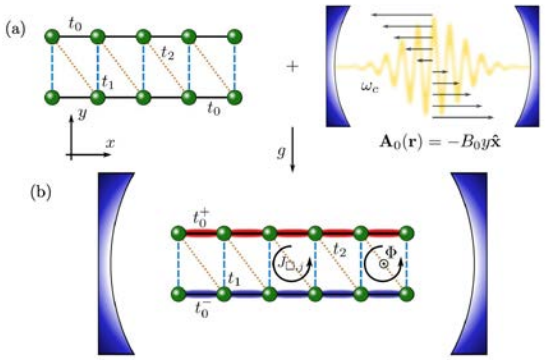
Quantum simulators for high-energy physics



Cold-atom quantum simulators for synthetic quantum systems



Tensor Network algorithms for many-body physics and quantum algorithms
https://titaschanda.github.io/TenNetLib.jl



Light-matter interaction at ultra-strong coupling

A general purpose library for quantum computing, quantum algorithms, and quantum information science
https://titaschanda.github.io/QIClib/

Dr. Vaibhav Madhok

PhD, University of New Mexico

Associate Professor, Physics

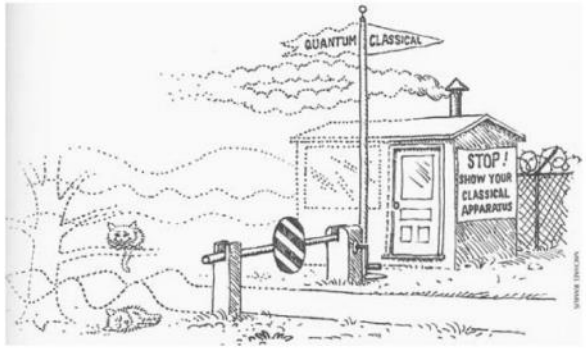
044-2257-4846; madhok@iitm.ac.in

Major Areas of Research

- Physics of Information, Quantum Information Theory
- Chaos: Quantum and Classical Chaos
- Mathematical Biology and Complex Systems

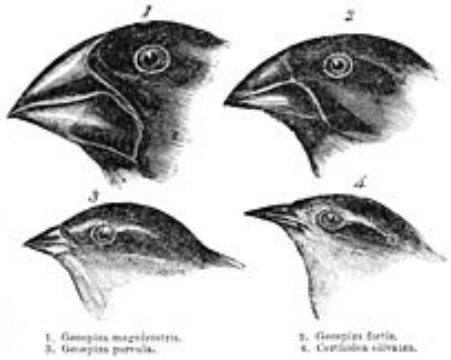
Quantum Computation

Quantum-Classical Transition



Drawing by Michael Ramus, 1991.
© American Institute of Physics

How do species arise?



Dr. Vidya Praveen Bhallamudi

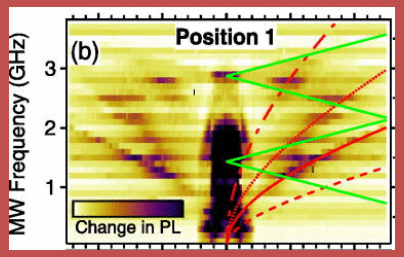
PhD, Ohio State University, USA

Associate Professor, Physics

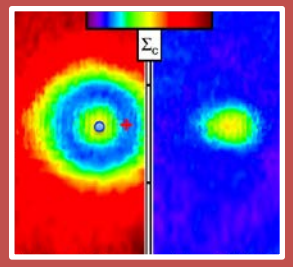
044-2257-4948; Praveen.bhallamudi@iitm.ac.in

https://physics.iitm.ac.in/praveen.bhallamudi

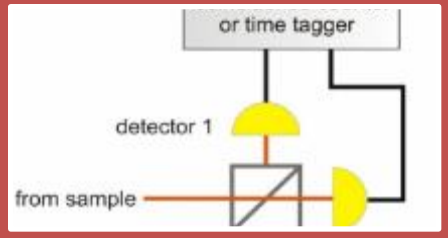
- Condensed Matter experimental
- Microscopy: Fluorescence and Scanned probe microscopy
- Magnetism and Magnetic Resonance



Nanoscale Magnetic spectroscopy



Magnetic imaging



Quantum photon sources

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

Dr. Yasir Iqbal

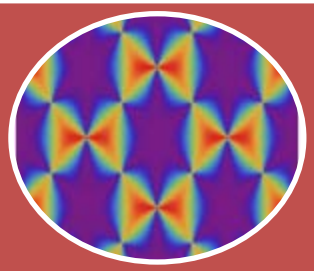
PhD, University of Toulouse, France

Associate Professor, Physics

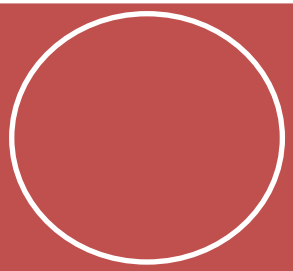
044-2257-4841; yiqbal@iitm.ac.in

https://physics.iitm.ac.in/yiqbal

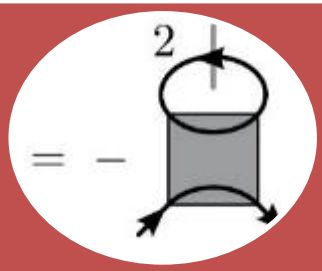
- Frustrated Magnets
- Quantum Spin Liquids
- Numerical Quantum Many-Body Techniques



Novel States of Quantum Matter



3D Quantum Spin Liquids



Functional RG

Search for exotic states of matter and developing their theoretical understanding

Visiting Professors
&
Professors of Practice

Dr. T. Jayachandran

PHD, IIT Kanpur, India

Professor, Dept. of Aerospace Engineering

044-2257-4035; t_jayachandran@iitm.ac.in

Numerical Simulation of Flow Field in Rocket Propulsion Systems

- Incompressible flows
- Compressible flows
- Transition and Turbulent flows
- Reacting flows
- Multiphase flows
- Magnetohydrodynamics
- Rotating flow simulation
- Compressible multifluid formulation

Numerical Methods

- Central and upwind schemes: JST, AUSM, SLAU, HLLC, etc.
- Entropy damped artificial compressibility methods
- VOF and conservative phase field methods
- Regularisation and interface sharpening in multiphase flow
- Rotating coordinate systems
- Moving mesh and rotating co-ordinate systems

Applications

- Granular combustion
- Solid propellant casting; multiphase simulation
- Ignition transients in solid motors
- Fluid-thermo-structural analysis
- Annular linear induction pump
- Dusty flow simulation
- Underwater explosion simulation
- Underwater propulsion

Shri. Karthick Athmanathan

BTech, Mechanical Engg., IITM

Professor of Practice, Dept. of Engineering Design

karthicka@iitm.ac.in

https://www.linkedin.com/in/karthick-athmanathan-b5a958a/

- Zero Emission Heavy Vehicles
- eMobility
- Business, Program and Engineering Management.

CoEZET

Centre of Excellence for Zero Emission Trucking

Policy, Technology, Skilling, Safety

Industry-facing Academic work

eMobility, Power Trains, Energy Management, Target Setting.

e-drive

eMobility

Labs, Programs, Curriculum, Industry Network, Funding, ANRF, PSA Office, RoadMap

Maj Gen Rajiv Narayanan, AVSM, VSM (Retd)

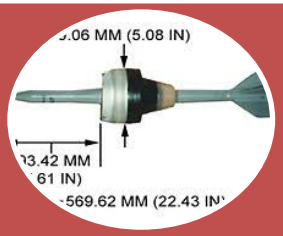
Professor of Practise, Dept. of Aerospace Engineering Department

8130462229; klrajiv.n@gmail.com

- Research Area/Focus 1 – Ramjet Artillery Munition and Rockets.
- Research Area/Focus 2 – AI based Persistent Multi-Domain Awareness for Armed Forces
- Research Area/Focus 3 – Ramjet Kinetic Munition for Main Battle Tanks

Focus 1 _ Increased range, improved accuracy

Focus 2 – Effective utilisation in Command Information and Decision Support System



Focus 3 – Improved range and penetration

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH

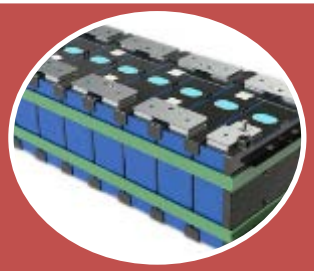
Shri. S A Sundaresan

B. Tech., IIT Madras, MS, Stanford University, USA

Professor of Practice, Dept. of Engineering Design

sundaresan.sa@iitm.ac.in

- Model Based Systems Engineering / Embedded Systems
- Electric Heavy Vehicles, Batteries and Motors
- New Product Development – Processes and Paradigms
- Enabling Industry-Academia Collaboration



Batteries – Life, Sustainability and Manufacturing

Electric Vehicles – Performance and Reliability

AI in Design

Innovate Mobility

Dr. Ramakrishna Srinivasan

PHD, Duke University, US

Professor of Practice, Dept. of Data Science & AI

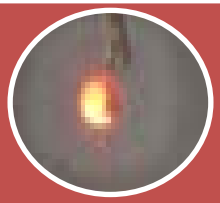
+1 (248) 823-1977; ramakrishna.s@dsai.iitm.ac.in

http://www.iitm.ac.in/….

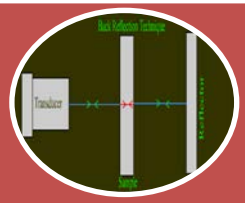
- Mobility Digital Twins
- Use of Telecommunication data for Modeling
- Digital Methods in System Engineering

I work on digital methods for addressing mobility challenges. My current focus is on developing the digital public infrastructure ecosystem in India through the MInT Collaborative, housed within the School of Data Science and AI at IIT Madras. At MInT, we bring together industry, academia, and government to model, understand, and co-create sustainable solutions to complex mobility problems.

Digital Twins Mobility Systems



Digital Public Infrastructure for Mobility



Data Science Techniques for Systems Engineering

Dr. Pawan Labhasetwar

PhD, RTM University, Nagpur, India

Professor of Practice, Dept. of Civil Engineering

044-22574324; pawan@iitm.ac.in

https://civil.iitm.ac.in//vfaculty.php?id=108&s=164

- Water safety
- Waste management
- Environmental impact assessment

Water safety

Water quality monitoring and surveillance

Water treatment

Water safety plan and Risk assessment

Health-based targets

Water resources management

Greywater and wastewater treatment

Waste Management

Municipal solid waste management

Hazardous waste management

Anaerobic digestion and compressed biogas generation

Construction and demolition waste management

Environmental impact assessment

Environmental impact assessment for developmental sectors

Strategic Environmental Assessment (SEA)

Environmental audit

Carrying capacity-based developmental planning

BROAD DESCRIPTION OF THE BANDWIDTH/AREA OF RESEARCH