Department of Electrical Communication Engineering

Indian Institute of Science, Bangalore

List of Open Positions for Research Admission, August 2023

The following are the open positions with different faculty members of the department. Please note that some of them are open for either PhD or M.Tech (Research) degrees while some others currently have open positions for one of these degrees only. Please click on the faculty name to visit their personal/group web pages.

Communications and Signal Processing	
Faculty Name:	**A Chockalingam**
Degrees	PhD/MTech Res
Brief Description	
Our current research focus is on 1) Robust modulation schemes for high-Doppler channels (e.g., Zak-OTFS modulation using delay-Doppler signal processing) suited for emerging use cases in 6G and beyond 2) Reconfigurable intelligent surfaces (RIS) aided joint beamforming and modulation for 6G 3) Joint wireless communication and radar sensing in autonomous vehicles 4) Deep learning based wireless communication transceivers design	
Faculty Name:	**Sudhan Majhi**
Degrees	PhD/MTech Res.
Brief Description	
Study of full-duplex (FD) communication under the doubly selective fading channel for reflecting intelligent surface (RIS) assisted system, where orthogonal time frequency space (OTFS), orthogonal frequency division multiplexing (OFDM) and massive multiple-input multiple-output (MIMO) will be utilised to enhance the system performance and data rate. Further, the active RIS will be adopted to enhance link distance and beamforming, this work will be carried forward for non-terrestrial communication such as satellite communication and UAV communication. Backscatter communication also will be investigated for IoT devices and devices which are in high-mobility environments to reduce latency and increase the energy efficiency of the communication which will be another key technology for green communication where the overall carbon footprint will be reduced. In 6G communication, adaptation and intelligent receiver will be playing a major role to improve the estimation accuracy of synchronization, channel estimation, parameter estimation, modulation classification, and symbol detection, phase estimation of the above system model. Different types of AI/ML will be investigated to improve the estimation/detection accuracy and all the physical layer transceiver blocks can be replaced by AI/ML blocks. Students who are interested in signal processing for communication may opt for these topics. The other research direction could be OTFS-based code division multiple access (CDMA) technologies, index modulation with massive MIMO, and Sparse code multiple access (SCMA) and interference cancellation for RIS-assisted joint radar communication (JRC). Most research work will be implemented and tested over a practical RF testbed. Please visit my research page: https://ece.iisc.ac.in/~sudhan/research.html Please visit my publication page : https://ece.iisc.ac.in/~sudhan/publication.html	
Faculty Name:	**Neelesh B Mehta**
Degrees	PhD/MTech Res
Brief Description	
Engage in research on cutting-edge problems in wireless communications. Focus areas include 5G and beyond wireless communication systems, native AI/ML enabled wireless communications, next generation wireless local area networks (WLANs), and sensor networks.	
Faculty Name:	**Chandra R Murthy**
Degrees	PhD only
Brief Description	
Beyond 5G/6G communications: cell-free massive MIMO systems, new waveforms, intelligent reflecting surface-aided communications. Sparse signal processing for communications and control. .	

Faculty Name:	**Sundeep P Chepuri**
Degrees	PhD/MTech Res
Brief Description	
We are looking for both PhD and M.Tech(Res) students to work in the areas of Signal Processing, Wireless Communications, and Machine Learning. The PhD and M.Tech(Res) projects are in the following topics: (1) Signal Processing and Machine Learning for 6G Communications (example topics include distributed MIMO, joint sensing and communications, reconfigurable intelligent surfaces), (2) Deep Graph Representation Learning (example topics include graph neural networks, graph signal processing), and (3) Optimization for Machine Learning (example topics include federated and decentralised learning). You may email at spchepuri@iisc.ac.in for more information on these topics.	

Faculty Name:	**Navin Kashyap**
Degrees	PhD only
Brief Description	
1) Design and implementation of security protocols within the IEC 62351 standard for security of communications within a smart power grid. For information on the standard, please see https://syc-se.iec.ch/deliveries/cybersecurity-guidelines/security-standards-and-best-practices/iec-62351/ 2) Sampling and data-driven methods for the design of coding schemes for use over channels seen in wireless communications.	

Faculty Name:	**B. Sundar Rajan**
Degrees	PhD/MTech Res
Brief Description	
(1) Low latency MIMO communication for 6G and beyond. (For both PhD and MTech) (2) Cache-Aided Communication and Coded Caching for 6G and beyond (For both PhD and MTech) (3) Private Information Retrieval (PIR) and Private Information Delivery (PID) for 6G and beyond. (For both PhD and MTech)	

Faculty Name:	**P. Vijay Kumar**
Degrees	PhD/MTech Res
Brief Description	
Coding theory and signal design for communication and storage applications, including quantum error correction. Please see my homepage for details on past work: https://ece.iisc.ac.in/p-vijay-kumar/.	

Signal Processing, Machine Learning, Data science; Networks & Control for Communications	
Faculty Name:	**Rajiv Soundararajan**
Degrees	PhD/MTech Res
Brief Description	
1. Blind visual quality assessment by learning with limited labeled data: The goal of this problem is to design blind visual quality assessment algorithms by learning with limited labeled data using semi-supervised/self-supervised learning and vision-language models. 2. Novel view synthesis using NeRFs: Neural radiance fields (NeRFs) require a large number of training images to generate high quality novel views. Our goal is the design methods to train NeRFs effectively when very few input images are available for training. Both the topics are open for both PhD and MTech (Res) students. Please see https://ece.iisc.ac.in/~rajivs/#/publications for an idea on some of the topics we work on.	

Faculty Name:	**Rajesh Sundaresan**
Degrees	PhD/MTech Res
Brief Description	
From data to decisions. The research will involve principled approaches to derive insights from data and use them to arrive at decisions. The PhD student will explore one or more of the following: platform for the creation of gold standard imaging data sets for cancer studies, image analysis for biometric authentication, smart city applications, epidemiological modeling going beyond the recent pandemic.	

Faculty Name:	**Parimal Parag**
Degrees	PhD only
Brief Description	
1. Core scheduling in servers for optimizing energy-delay tradeoff: Energy consumption of data centers is a major concern. Data center networks host diverse applications, some of which are delay sensitive. Current techniques to save power can result in degradation of delay performance for such applications. This project involves developing models and algorithms for core scheduling in modern servers under energy and delay constraints. 2. Performance evaluation of transport protocols for data center networks: This project involves performance modeling and evaluation of the newer transport-layer proposals (HOMA, dcPIM, etc.) for dominant applications in data center networks. The models thus developed can aid in selection and optimization of transport protocols for a given workload profile. 3. Network workload characterization for Machine Learning and AI pipelines: ML/AI model training relies on massive data sets and is computationally intensive. Thus, the data and computations are spread over multiple nodes, and model training workflow involves massive I/O over the network. Characterizing the network traffic will help develop optimized network architecture and protocols. This involves: a. developing efficient instrumentation at various points of interaction within the operating system and the network, and b. Statistical characterization of network workloads and dependency graph generation among the workloads' microservices. 4. Scheduling and placement in Cloud-native architecture: Scheduling and placement of microservices within a cloud impacts the performance and resource utilization due to factors such as data locality, job completion deadlines, and compute/power profile of heterogeneous servers. The project also explores host-side optimization of data path. 5. Distributed trust systems: When there is no single trusted party, distributed nodes have to reach a consensus for the network to accept a transaction. Popular examples of such systems are distributed ledger, cryptocurrencies, etc. We are interested in the modelling, design, and performance analysis of such systems. All the above projects are collaborative with leading industry and research labs. Projects 1, 2,3, and 4 are sponsored by Centre for Networked Intelligence at IISc. This work involves theoretical tools from probability theory, which can be learned by taking courses offered at IISc. We will also develop algorithms and test them in practical scenarios by implementing them on emulated testbeds. The student should be enthusiastic about solving fundamental problems, have a good mathematical foundation, and a keen interest in developing practical tools. Prior experience in the above topics is not a prerequisite. To understand the problems solved by the current research group on these topics, please see the list of recent publications: https://ece.iisc.ac.in/~parimal/pubs/, or email at parimal@iisc.ac.in for more information on these topics.	

Faculty Name:	**Rahul Singh**
Degrees	PhD/MTech Res
Brief Description	
Machine learning, Reinforcement Learning and Networks Theoretical problems from the fields of machine learning, reinforcement learning, time-series models and cyberphysical systems. Goal is to develop algorithms which quickly learn to make optimal decisions by utilizing as few samples as possible. Such algorithms must also be robust in the event of "modeling errors" or "adversarial tampering." Work involves theoretical tools from probability, optimization, statistics, dynamical systems, knowledge of which can be built by taking courses offered at IISc. Work will also involve testing the algorithms on real-world datasets.	

Faculty Name:	**Aditya Gopalan**
Degrees	PhD only
Brief Description	
Our group's focus is on developing learning and optimization algorithms that operate in a sequential fashion (act, observe data, repeat). Such problems are usually categorized under the fields of reinforcement learning, online learning, black-box optimization, multi-armed bandits and statistical decision theory. The approach followed is primarily theoretical (including performance analysis, stochastic modeling and design and analysis of algorithms), but with an added emphasis on prototyping the learning algorithms in code and numerically benchmarking them.	

Faculty Name:	**Vaibhav Katewa (CPS/ECE)**
Degrees	PhD/MTech Res

Brief Description

I am proposing three projects - all of them are open to both PhD and MTech Research students.
1. Safety, Security and Resilience in Cyber-Physical Systems:
This project involves developing techniques to make dynamical CPS safe and secure. We will develop statistical ML-based algorithms to detect the presence and location of malicious attacks, and develop countermeasures against such attacks. Further, we will analyze the resilience of the system against the attacks and develop design algorithms to make such systems inherently more secure.
2. Reinforcement Learning (RL) based Inference and Control:
This project involves applying RL techniques for problems related to decision making, inference and control. It will focus on transfer learning and generalization problems within the context of RL. The goal is to explore if optimal policies computed in one setting/environment can be used to compute the optimal policies in another related setting. We will explore how well this generalization happens and what factors influence this.
3. Vulnerability Analysis of Smart Grids:
This project is sponsored by PowerGrid Corporation of India which manages the transmission grid of India and is setting up a Center of Excellence at IISc. It involves identifying and quantifying various vulnerabilities in smart grids and develop mechanisms to eliminate these weaknesses. We will develop a graphical model of the grid with different devices as nodes and transmission/communication links as edges. We will measure how attacks on a particular node spread in the whole network and how can we stop this spread. It will also involve developing a GUI for visualizing the network and attack spread.
These are interdisciplinary projects that use mathematical tools from linear algebra, probability, optimization, control, signal processing etc. Students will also get an opportunity to do experimental work on drones and ground robots as per their interests.

Faculty Name:	**SP Arun** (CNS/ECE)
Degrees	MTech Res only

Brief Description

Image processing in brains and machines
We recognize objects easily, but this is in fact a very challenging problem. Even the best computers do not match human performance today on the simplest of tasks, such as the distorted letters we see on websites. Object recognition is not easy for the brain either: a series of cortical areas, taking up ~40% of the brain, is dedicated to vision. But we know very little about the code in which the brain represents objects for perception, and about how the brain transforms what we see into what we perceive. How do we crack the code for objects? What are its features and what are its rules?
To investigate these questions, we perform three types of experiments: (1) In experiments using humans, we recruit participants to perform behavioral tasks such as visual search and explore the neural correlates using brain imaging or perturbation studies; (2) In experiments using monkeys, we record from single neurons in brain regions involved in processing visual information while monkeys perform complex cognitive tasks; (3) In experiments using computer vision, we compare state-of-the-art computer vision algorithms with biological vision to understand their flaws and improve their performance.
Typically, PhD students who join our lab are asked to identify a question they are curious about, identify experimental techniques to answer the question, and design many experiments to investigate the topic thoroughly. Students from biology and engineering backgrounds have been extremely successful in this research. The only qualification required is curiosity and interest in the topic!
For more information, visit the Vision Lab IISc at https://sites.google.com/site/visionlabiisc/

NanoElectronics, Optoelectronics, Quantum, Optical/Photonics Technologies,	
Faculty Name:	**Kausik Majumdar**
Degrees	PhD/MTech Res
Brief Description	
The student is expected to work on one or more of the following projects. All these projects will require a combination of both theory and experiment. The candidate should have a strong foundation of basic physics, mathematics, and electronics. During the PhD tenure, the student will be trained in the state-of-the-art experimental facility the lab hosts. The nature of the projects will make the student ready to take up both academic and industrial positions at the end of the PhD. To get a feel about the nature of the work, I strongly encourage the candidate to have a quick look at our research publications here: https://ece.iisc.ac.in/~kausikm/publications.html Research projects: 1. Transistor scaling down to sub-5 nm [Application: electronics, high speed computation] 2. Design and experimental demonstration of single photon emitter [Application area: quantum communication, quantum processing, enhanced imaging, space] 3. Design and experimental demonstration of high efficiency single photon detector at room temperature in visible and infrared region [Application area: quantum communication, quantum processing, sensing, imaging, space, military] 4. Building hardware for high quality random number generation [Application: Hardware security, cryptography] 5. Quantum sensing using nano-diamond [Application: Strategic sector, biomedical] 6. Light-matter interaction in 2D materials and their heterojunction [Application: Exciton physics, exotic phenomena, spectroscopy] 7. Quantum memory	
Faculty Name:	**Varun Raghunathan**
Degrees	PhD only
Brief Description	
[1] Optical metasurfaces for wavefront shaping: to design, fabricate and experimentally demonstrate infrared wavelength based dielectric metasurfaces to realize optical elements for wavefront shaping (such as lenses, polarizer, wave-plates etc.) [2] Resonant Nanophotonic Structures: to design, fabricate and experimentally demonstrate infrared wavelength based dielectric metasurfaces to enable strong field confinement to realize sensors, imagers etc.	
Faculty Name:	**Balaswamy Velpula**
Degrees	PhD/M.Tech. Res.
Brief Description	
Our research focuses on the design and development of fiber based optical sources through numerical and experimental study of optical signal generation and propagation properties in optical fibers. The goal is to use these advanced optical sources to satisfy ever increasing performance demands of Biomedical, Industrial, Quantum and Optical Communication applications. Our current interests are 1. Experimental and numerical analysis of spectral and temporal characteristics of different fiber laser and amplifier architectures. 2. Development of Numerical model and analysis framework to study the propagation characteristics of different laser (optical signal) types in optical fibers in dispersive and nonlinear regimes. 3. Experimental, numerical analysis and design of low intensity noise Continuous wave tuneable fiber lasers. 4. Experimental and numerical analysis of intensity noise properties of supercontinuum generation in step-index optical fibres. We are looking for highly self-motivated students who loves to have fun doing experiments in the lab, play with equations and numerical simulations on daily basis. Prerequisites are basic knowledge in Electromagnetic theory and Photonics.	
Faculty Name:	**T Srinivas**
Degrees	M.Tech. Res. only
Brief Description	
The research involves analysis, design and experimental realization of photonic integrated devices for application to quantum communication and computing. Silicon on insulator (SoI) and Lithium on Insulator (LNoI) are the technology platforms under consideration. This is a part of IISc Quantum Technology Initiative.	

RF/Microwaves, Applied Electromagnetics	
Faculty Name:	**Debdeep Sarkar**
Degrees	PhD only
Brief Description	
Tentative Research Topic: Wireless Power Transfer for Implantable Medical Devices Brief Description: Wireless power transfer (WPT) is a promising technique for transferring power wirelessly to implanted medical devices (IMDs). WPT enables the realization of a compact system that can deliver energy from outside of the human body, which leads to potential elimination of expensive periodical surgeries for battery replacement. Near-field WPT based on magnetic resonance coupling (MRC) has been known as a well-known technique that provides a medium penetration depth of about 10 – 30 mm, with a high system efficiency. However, such MRC-WPT systems work in an MHz range of frequency, implying that the coil-based antennas are relatively large and bulky, leading to inconvenience in practical implementation. Moreover, an MRC-WPT requires a critical alignment of transmit-receive (Tx-Rx) antennas and is usually sensitive to the receiver's (Rx) misalignments. While in a GHz frequency range, the implantable antenna's dimensions become improved, but the tissue losses due to the high values of the relative permittivity and conductivity draw a significant challenge. The PhD research will focus on: (a) design of compact multi-band transmitters/receivers for IMD applications, (b) studies on WPT in real-time using phantoms and skin/tissue mimicking substances, (c) developing cost-effective ways to enhance the received power in IMDs (possible use of matching layers). Also, as a related topic, bio-telemetry related subjects can be explored. The candidate should be familiar with full-wave and circuit simulation tools (CST-MWS and Keysight ADS), along with PCB based fabrication of antennas/circuits, and setting up experiments using VNAs/SDRs/Spectrum analyzers.	
Faculty Name:	**KJ Vinoy**
Degrees	PhD only
Brief Description	
Topic 1 Time/frequency domain computational methods including fast methods for uncertainty analysis Topic 2: High Q-factor RF/Microwave resonators for quantum devices: design, analysis, characterization and their sensing circuits Topic 3: Microwave sensing using components and antennas with multiple resonances; associated circuits Topic 4: Reconfigurable surfaces for sensing, communication, beam steering, or imaging	