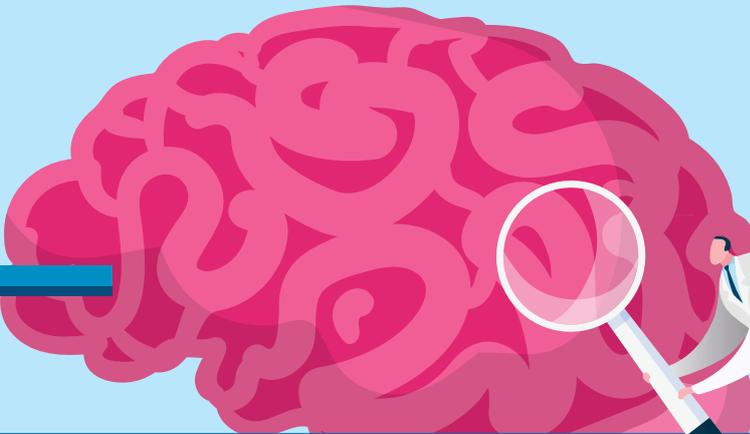


PRATIKSHA TRUST INITIATIVE ON

Brain, Computation, and Data Science

ANNUAL REPORT 2025



भारतीय विज्ञान संस्थान

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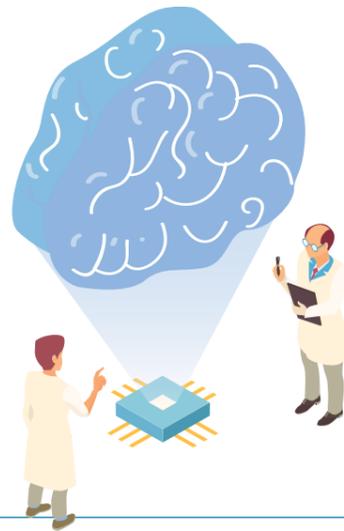
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The IISc Team

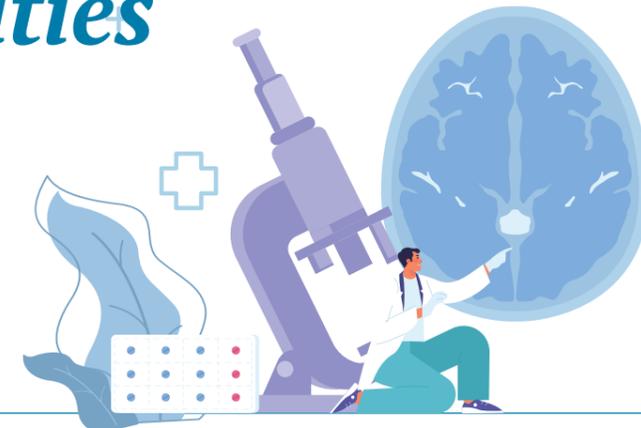
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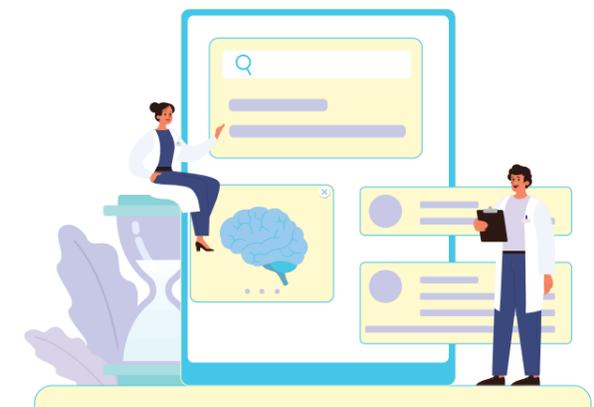
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Overview



The Brain, Computation, and Data Science Initiative is the brainchild of Shri Kris Gopalakrishnan and Smt Sudha Gopalakrishnan, Founders of the Pratiksha Trust, Bengaluru. The Trust has been extending very generous support to the Indian Institute of Science (IISc) in promoting research in brain science, data science, computing architectures and algorithms inspired by the brain. The mission of this Initiative is to foster intense research collaboration leading to capacity building, ecosystem creation, and high-impact research outcomes in brain, computation, and data science in IISc and India.

The participating departments and centres of IISc include Computational and Data Sciences, Computer Science and Automation, Electrical Communication Engineering, Electrical Engineering, Electronic Systems Engineering, Mathematics, Molecular Biophysics, and Neuroscience. The research areas pursued encompass artificial intelligence, brain-inspired algorithms, computational neuroscience, data science, image analysis, machine learning, neural signal processing, neuromorphic computing and engineering, vision and visualisation.

In June 2015, the Pratiksha Trust set up three Distinguished Chair Professorships at IISc. The purpose of these Chair Professorships is to

bring frontline researchers in the areas of data science, computational neuroscience, machine learning, and neuromorphic computing to the Institute to help strengthen the research and international collaboration in these important emerging areas.

During 2016–2021, the activities of this Initiative were shaped and anchored by the following members of the Scientific Advisory Committee: Professors P S Sastry (Convener), Rishikesh Narayan (Co-Convenor), Shalabh Bhatnagar, K V S Hari, Aditya Murthy, M Narasimha Murty, and Rajesh Sundaresan. In July 2021, the Committee was reshaped to include the following members: Professors Prasanta Kumar Ghosh (Convener),

Sridharan Devarajan (Co-Convener), Ambedkar Dukkipati, K V S Hari, Ramesh Hariharan, Supratim Ray, and Yogesh Simmhan. Our grateful thanks for their precious time and efforts.

Between 2021 and 2024, there was a change in the Committee members, to include Professors Rajesh Sundaresan (Chair), Prasanta Kumar Ghosh (Convener), Sridharan Devarajan (Co-Convener), Supratim Ray, and Vijay Chandru.

This booklet provides a bird's eye view of the activities undertaken as a part of this Initiative in IISc during 2025.

Rajesh Sundaresan

*Dean-in-charge of the programme,
Pratiksha Trust Initiative at IISc*



Overview



Govindan Rangarajan

*Director,
Indian Institute of Science,
Bengaluru*



We are immensely grateful to Shri Kris Gopalakrishnan and Smt Sudha Gopalakrishnan for choosing the Indian Institute of Science for these generously endowed Chair Professorships. These Chairs intend to invigorate and accelerate extremely important emerging interdisciplinary research areas. I am sure the Chair Professors will add a new dimension to research collaboration between IISc researchers and star contributors to these areas anywhere in the world.



Kris Gopalakrishnan

*Founder, Pratiksha Trust,
Bengaluru*



We hope the launching of these Distinguished Chair positions will help push the frontiers in brain-inspired research. It would be excellent if the collaborations lead to highly creative new computing architectures and algorithms inspired by the functioning of the brain.

Sudha Gopalakrishnan

*Founder, Pratiksha Trust,
Bengaluru*



IISc Team

Scientific Advisory Committee

Rajesh Sundaresan, EECS (Chair)	Prasanta Kumar Ghosh, EE (Convener)	Sridharan Devarajan, CNS (Co-Convener)
Vijay Chandru, ARTPARK (Member)	Supratim Ray, CNS (Member)	

Faculty Team (Brain, Computation, and Data Science Group)

Aditya Murthy, CNS	Arnab Barik, CNS	D Ambedkar, CSA	Prathosh A P, ECE	Sashikumaar Ganesan, CDS	Srikanth Padmala, CNS	Y Narahari, CSA
Aditya Sadhanala, CeNSE	Ashesh Dhawale, CNS	Danish Pruthi, CDS	Partha Talukdar, CDS	Shalabh Bhatnagar, CSA	Sriram Ganapathy, EE	Yogesh Simmhan, CDS
Akshay Singh, Physics	Balaji Jayaprakash, CNS	Debayan Das, ESE	Phaneendra Yalavarthy, CDS	Shayan G Srinivasa, ESE	Sumantra Sarkar, Physics	and all other interested faculty members
Anand Louis, CSA	Banibrata Mukhopadhyay, Physics	Deepak Kumaran Nair, CNS	Prasanta Kumar Ghosh, EE	Shirish Shevade, CSA	Sundeeep P Chepuri, ECE	
Anand Srivastava, MBU	Chandra Murthy, ECE	Deepak Subramani, CDS	R Venkatesh Babu, CDS	Shishir N Y Kolathaya, CPS	Supratim Ray, CNS	
Animesh Kuley, Physics	Chandra Sekhar Seelamantula, EE	Giriraj Sahu, MBU	Rajesh Sundaresan, ECE	Siddharth Barman, CSA	T V Prabhakar, ESE	
Anirban Chakraborty, CDS	Chetan Singh Thakur, ESE	Hardik Pandya, ESE	Rajiv Soundararajan, ECE	Siddhartha Gadgil, Mathematics	Utsav Banerjee, ESE	
Arindam Ghosh, CeNSE	Chirag Jain, CDS	K V S Hari, ECE	Rishikesh Narayanan, MBU	Soma Biswas, EE	Vijay Natarajan, CSA	
Arjun Jain, CDS	Chiranjib Bhattacharyya, CSA	P S Sastry, EE	S P Arun, CNS	Sreetosh Goswami, CeNSE	Vini Gautam, CeNSE	
Arkaprava Basu, CSA		Pavan Nukala, CeNSE	Santanu Mahapatra, ESE	Sridharan Devarajan, CNS	Vaanathi Sundaresan, CDS	

Chair Professors

Pratiksha Trust Distinguished Chair



Rajesh P N Rao

CJ and Elizabeth Hwang Professor, Paul G Allen School of Computer Science and Engineering and Department of Electrical and Computer Engineering, University of Washington (UW), Seattle

Co-Director, Center for Neurotechnology (CNT)

Adjunct Professor, Bioengineering Department

Faculty member, Neuroscience Graduate Program at UW

EDUCATION

- BS - Angelo State University - 1992
- MS - University of Rochester - 1994
- PhD - University of Rochester - 1998

EXPERTISE

- Computational neuroscience
- Brain-computer interfacing
- Artificial intelligence

AWARDS AND DISTINCTION

- Guggenheim Fellowship
- Fulbright Scholar Award
- NSF CAREER Award
- ONR Young Investigator Award
- Sloan Faculty Fellowship
- David and Lucile Packard Fellowship

EDUCATION

- BSc - Brown University - 1986
- MS - Massachusetts Institute of Technology - 1988
- PhD - Massachusetts Institute of Technology - 1994

EXPERTISE

- Characterisation of neural circuits
- Cognitive neuroscience
- Computational neuroscience
- Executive control and memory
- Non-invasive brain monitoring
- Spatial cognition and attention

AWARDS AND DISTINCTION

- Fellow, American Institute for Medical and Biological Engineering
- Fellow, Acoustical Society of America
- Member, Telluride Auditory Attention Team
- Treasurer and Member, Council of the Association for Research in Otolaryngology
- Biennial Mentorship Award, Acoustical Society of America
- Bernice Grafstein Award for Outstanding Accomplishments in Mentoring
- Acoustical Society of America Silver Medal

Shri K Vaidyanathan Distinguished Chair



Barbara Shinn-Cunningham

Glen de Vries Dean, Mellon College of Science and Professor, Biomedical Engineering, Carnegie Mellon University, Pennsylvania

Chair Professors

Smt Sudha Murty Distinguished Chair



Maneesh Sahani

Professor,
University College,
London

Director,
Gatsby Computational
Neuroscience Unit,
University College,
London

EDUCATION

BS - California Institute of Technology - 1993
PhD - California Institute of Technology - 1999

EXPERTISE

- Theoretical neuroscience
- Machine learning
- Computational and neural systems

AWARDS AND DISTINCTION

- General Chair, Computational and Systems Neuroscience Conference (COSYNE)
- Programme Chair, COSYNE
- Member, Board of Directors, Computational Neuroscience Organization
- Member, Society for Neuroscience
- Member, Association for Research in Otolaryngology
- Member, Institute of Electrical and Electronics Engineers (IEEE)

Chairs at the Indian Institute of Technology Madras

Prof H N Mahabala Chair

Partha P Mitra
Professor,
Cold Spring Harbor Laboratory



Dr N R Narayana Murthy Chair

Mriganka Sur
Professor,
Massachusetts Institute of Technology



Prof Muthukrishnan Chair

Anand Raghunathan
Professor,
Purdue University



Moonshot Project

BRAIN CO-PROCESSORS

The project derives its name from a 2019 paper on “neural co-processors” by Rajesh Rao, Chong Jia and Elizabeth Yun Hwang Endowed Professor, and Co-director, Center for Neurotechnology at the University of Washington, and Pratiksha Trust Distinguished Chair Professor, Indian Institute of Science. The project commenced in October 2022, following a special call for proposals by the BCD Scientific Advisory Committee.

A novel approach distinguishes the Brain Co-Processors Moonshot Project. As a key element, the principal investigators (PIs) of the project have decided to focus on cognitive rehabilitation of stroke patients as the target

medical application for the co-processor. The rationale is that stroke patients are a good model for exploring rehabilitation across multiple sub-themes that were initially envisaged (decoding vision, decoding attention, decoding decisions, decoding actions, and low-power decoding in real-time).

The Moonshot Project seeks to develop a new class of implantable and non-invasive brain co-processors that draw in equal parts from fundamental neuroscience, novel hardware development, and cutting-edge AI. This project brings together interdisciplinary expertise from cognitive neuroscience, electrical engineering, neuromorphic devices, systems biology, and

bioelectronics. By working across domains and scales – from cellular activity to behaviour – the project aims to build co-processors that not only restore lost functions but also expand our understanding of how the brain solves complex problems. The actualisation of the project vision entails collaboration between basic science researchers and clinicians (neurologists and neurosurgeons) from different institutes and hospitals across the country. For instance, IISc researchers will work with clinicians to study normal brain activity in epilepsy patients when they are not having seizure episodes. Each team will tackle one facet of the project with immediately realisable goals.

PHASE I

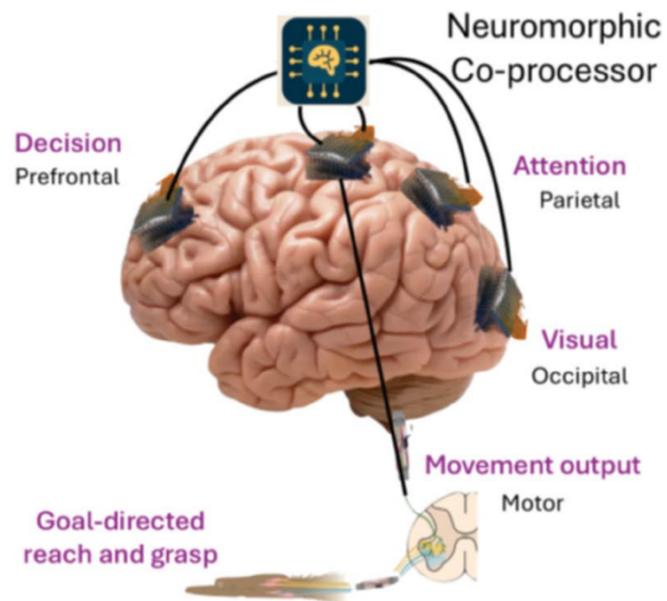
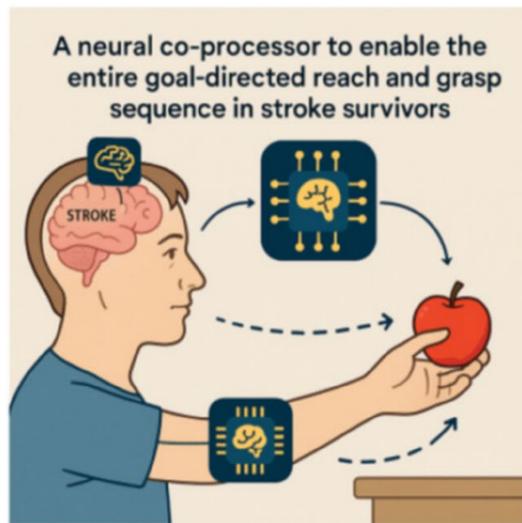
Technology Development and Non-Invasive Co-Processor (Years 1–5)

Objective: Develop and validate a non-invasive neural co-processor to decode user intent and provide sensorimotor feedback for restoring goal-directed reaching in stroke survivors with residual neural connectivity.

System Development: Design a low-latency EEG-based neurofeedback platform integrated with real-time multimodal feedback (visual, tactile, auditory) and non-invasive brain stimulation (tDCS/tACS).

A moonshot project on brain co-processors has been initiated by the Brain, Computation, and Data Science group under the aegis of the Pratiksha Trust BCD Initiative at IISc. The aim of this project is to develop invasive (implantable) or non-invasive brain co-processors to enhance or restore brain functions such as memory, attention, vision, and motor skills. Such co-processors involve decoding activity from neural recordings, processing it with an AI (artificial intelligence) algorithm implemented in software or hardware, and re-encoding signals back into the brain, either directly with neural stimulation/neurofeedback or by actuating external devices, such as prosthetic arms. The figure on the next page shows a simplified view of a co-processor and its use case of a motoric brain-computer interface.

Moonshot Project



Data and AI Integration: Conduct large-scale data collection using non-invasive EEG and invasive sEEG, and train AI models to decode multi-modal intention signals across populations.

Validation and Prototyping: Design and test indigenous implantable electrodes in animal models and, by Year 5, achieve a fully integrated non-invasive prototype evaluated through human-in-the-loop and feasibility studies in stroke patients, using behavioural, kinematic, and neurophysiological metrics.

PHASE II Embedded Co-Processor for Restorative Intervention (Years 6–10)

Objective: Develop and clinically validate a minimally invasive, embedded brain co-processor to restore sensorimotor coordination and goal-directed reaching in individuals with chronic deficits following MCA stroke.

Progressive Clinical Evaluation: Conduct staged testing of electrodes, followed by controlled human studies using limited implants and systematic integration of indigenous electrode systems.

Longitudinal Validation: Perform long-term recovery and outcome assessments to evaluate sustained functional improvement and co-adaptive rehabilitation effects.

Translation and Ethics: Focus on scale-up, regulatory readiness, and clinical

adoption, while ensuring continuous stakeholder input and strict compliance with ethical standards, informed consent, data privacy, and ICMR, CDSCO, and NIH guidelines.

There are six Phase I sub-projects with a focus on technology development and developing a non-invasive co-processor

1. Cognitive mapping of the human brain with intracranial EEG

Key objectives: Human cognitive mapping with intracranial recordings: Data will be analysed with state-of-the-art AI algorithms to understand how cognitive processes like attention, memory, and decision-making shape these networks. Design a novel battery of tasks that can be used for restoration of goal-directed reaching abilities in MCA stroke patients.

Stimulation to understand the causal role of brain regions in cognition.

Create a first-of-its-kind India-centric stereo-EEG recordings and stimulation database of human intracranial EEG recordings, including sEEG and ECoG, along with video recordings and

related anonymised patient information from clinical centres.

Pilot goal: Localise epileptic foci and arrest seizure propagation. Develop a real-time tool for recording sEEG data with deep learning models to identify specific patterns that index the focus or “origin” of EEG seizures. Study the use of focal electrical stimulation to specific electrodes to arrest the ongoing seizure.

Principal Investigators: Sridharan Devarajan (IISc), SP Arun (IISc), Aditya Murthy (IISc), Arjun Ramakrishnan (IITK), and clinician collaborators (Amrita Hospital, MS Ramaiah Hospital, Sree Chitra Tirunal Hospital, Deenanath Mangeshkar Hospital).

2. Validation of stimulation and recording co-processor technologies in the non-human primate

Key objectives: Compare the performance of invasive versus non-invasive decoders/stimulators.

Analyse various stimulation paradigms that affect neural circuitry. Find the optimal stimulation paradigm for improving functional connectivity.

Principal Investigators: Supratim Ray (IISc), SP Arun (IISc), and Chandra Murthy (IISc)

Moonshot Project

3.

Development of indigenous deep brain recording and stimulation electrodes for cognitive rehabilitation

Key objectives:

Design, develop, and validate indigenous deep brain recording and stimulation electrodes (MER and sEEG). Build state-of-the-art, cost-effective microelectrode systems tailored for the Indian clinical landscape.

Establish and validate behavioural assays and neural decoding algorithms for cognitive rehabilitation in nonhuman primates. Leverage an ecologically valid behavioural paradigm (dynamic foraging) to characterise cognitive deficits and recovery in models of brain dysfunction.

Principal Investigators:

Arjun Ramakrishnan (IITK), Kaustubh Deshpande (Eywa Neuro), and clinician collaborators (Jaslok Hospital, DM Hospital)

4.

Indigenous implantable technologies for brain signal acquisition and stimulation

Key objectives:

Develop a multi-contact miniaturised intracortical depth electrode. In vivo testing of the intracortical depth electrode in a rodent model and translation towards human trials.

Design and develop a micro-pillar-based multi-contact cortical array implant. Electrical, mechanical, and material characterisation of the cortical implant. Design and development of the electronic acquisition and stimulation interfaces and peripherals for the cortical implant.

Principal Investigators:

Hardik Pandya (IISc), and Dr. Shabari Girishan (MS Ramaiah Hospital)

5.

High-Precision molecular neuromorphic accelerator for real-time neuro-feedback and signal conditioning

Key objectives:

Design and implement a high-precision analog computation platform using molecular memristor crossbars.

Demonstrate the utility of this platform in AI/ML operations such as deep learning, predictive analytics, and signal denoising.

Fabricate a compact, high-precision System-on-Chip integrating the neuromorphic crossbars for deployment in cognitive neurofeedback platforms.

Validate the system through advanced signal processing techniques and neural network applications.

Principal Investigators:

Sreetosh Goswami (IISc), and Navakanta Bhat (IISc)

6.

Neuromorphic AI co-processor for cognitive rehabilitation

Key objectives:

Develop a non-invasive approach for training cognitive functions like attention and working memory using real-time neurofeedback.

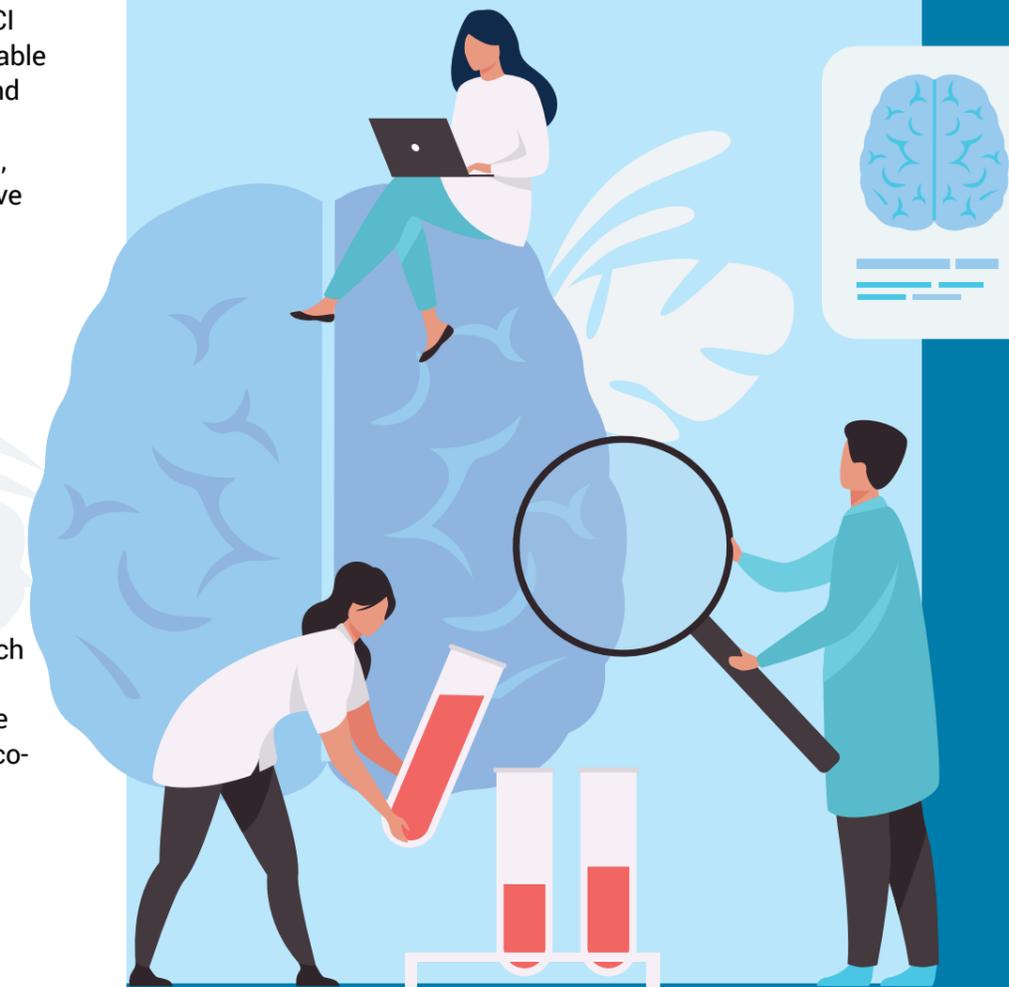
Implement a Commercial Off-The-Shelf (COTS) hardware-based BCI system with indigenous IPs capable of real-time signal processing and ML-based decoding on acquired EEG, ECoG, intracranial EEG, etc., for both invasive and non-invasive cognitive neurorehabilitation.

Design and fabricate a real-time neuromorphic AI co-processor as a System-on-Chip (SoC) for accessible invasive and non-invasive cognitive rehabilitation leveraging the inherent sparsity of neural signals.

Design a modular chiplet ecosystem with multiple neuromorphic front-end dies, each capable of streaming 256 neural recording channels and interface seamlessly with a dedicated AI co-processor.

Principal Investigators:

Chetan Singh Thakur (IISc), and Sridharan Devarajan (IISc)



Moonshot Project: Team

TEAM 1

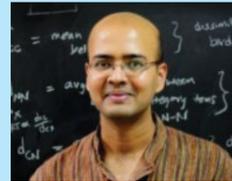
Cognitive mapping of the human brain with intracranial EEG



Sridharan Devarajan (PI)



Arjun Ramakrishnan



S P Arun



Aditya Murthy

TEAM 2

Validation of stimulation and recording co-processor technologies in the non-human primate



Supratim Ray (PI)



S P Arun



Chandra Murthy

TEAM 3

Development of indigenous deep brain recording and stimulation electrodes for cognitive rehabilitation



Arjun Ramakrishnan (PI)



Kaustubh Deshpande

TEAM 4

Indigenous implantable technologies for brain signal acquisition and stimulation



Hardik J Pandya (PI)



Shabari Girishan

TEAM 5

High-Precision molecular neuromorphic accelerator for real-time neuro-feedback and signal conditioning



Sreetosh Goswami (PI)



Navakanta Bhat

TEAM 6

Neuromorphic AI co-processor for cognitive rehabilitation



Chetan Singh Thakur (PI)



Sridharan Devarajan

Young Investigators

The Pratiksha Trust Young

Investigator (YI) awards have been instituted to recognise and reward the accomplishments of young faculty members or prospective faculty members. The Pratiksha endowment now supports up to five YI awards at any time.

The awardees receive, for two years, a top-up salary of Rs 25,000 per month and a research grant of Rs 3 lakhs per year. Recognition as a Young Investigator will be based on academic achievement at the highest national and international level.

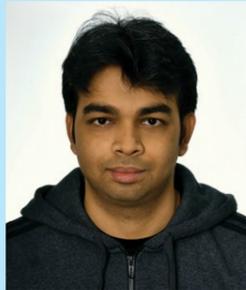


- Sriram Ganapathy**
Department of Electrical Engineering (2017-19)
- Prasanta Kumar Ghosh**
Department of Electrical Engineering (2017-19)
- Sridharan Devarajan**
Centre for Neuroscience (2017-19)
- Chetan Singh Thakur**
Department of Electronic Systems Engineering (2017-19)
- Siddharth Barman**
Department of Computer Science and Automation (2018-20)
- Anirban Chakraborty**
Department of Computational and Data Sciences (2018-20)
- Anand Louis**
Department of Computer Science and Automation (2019-21)
- Sundeep Prabhakar Chopuri**
Department of Electrical Communication Engineering (2019-21)
- Arkaprava Basu**
Department of Computer Science and Automation (2020-22)
- Chirag Jain**
Department of Computational and Data Sciences (2020-22)
- Aditya Sadhanala**
Centre for Nano Science and Engineering (2020-22)
- Arindam Khan**
Department of Computer Science and Automation (2021-23)
- Shishir Kolathaya**
Robert Bosch Centre for Cyber-Physical Systems and Department of Computer Science and Automation (2021-23)
- Sreetosh Goswami**
Centre for Nano Science and Engineering (2021-23)
- Utsav Banerjee**
Department of Electronic Systems Engineering (2022-24)
- Gugan Thoppe**
Department of Computer Science and Automation (2022-24)
- Danish Pruthi**
Department of Computational and Data Sciences (2023-25)
- Debayan Das**
Department of Electronic Systems Engineering (2023-25)
- Vaanathi Sundaresan**
Department of Computational and Data Sciences (2023-25)
- Vini Gautam**
Centre for Nano Science and Engineering (2023-25)
- Shubhada Agrawal**
Department of Electrical Communication Engineering
- Anant Raj**
Department of Computer Science and Automation

Young Investigators



Web link



Anant Raj

Starting Oct. 2024, I am an Assistant Professor in the Department of Computer Science and Automation (CSA) at Indian Institute of Science (IISc). I lead the Theoretical Foundations of ML and Optimization Lab (TFMLO Lab) at Indian Institute of Science (IISc).

Previously, I was a Marie-Curie Fellow, jointly hosted by Prof. Francis Bach at SIERRA Project Team (Inria) and Prof. Maxim Raginsky at Coordinated Science Laboratory (CSL), UIUC till Sept. 2024. Before that, I completed my PhD in Machine Learning at the Max-Planck Institute for Intelligent Systems in the Empirical Inference Department under the supervision of Prof. Bernhard Schölkopf. I received my B.Tech-M.Tech dual degree in Electrical Engineering from IIT Kanpur where my research was advised by Prof. Rajesh M Hegde, Prof. Vinay Namboodiri, Prof. Amitabha Mukerjee and Prof. Tinne Tuytelaars (External Master's Thesis Advisor).

My research interest is in understanding problems in general machine learning theory and applications. More specifically, I am interested in optimization theory, kernel methods and theoretical foundation of machine learning. I have also a vivid interest in understanding resource efficient learning such as active learning, coresets and distributed inference. On the application side, I am interested in application of machine learning methods in the healthcare domain.

Research

My recent research advances the theoretical foundations of learning, optimization, and generative systems in regimes where classical assumptions break down, and spans four distinct and independent research threads. The first thread develops a sharp learning-theoretic and information-theoretic characterization of CVaR-based learning under heavy-tailed and contaminated data, establishing minimax-optimal generalization and excess-risk rates, uniform Bahadur–Kiefer expansions that account for endogenous quantiles, and fundamental impossibility results for decision robustness in tail-scarce regimes. A second, separate line of work studies optimization dynamics, where I show that gradient descent and stochastic gradient descent can achieve

exponential convergence for separable logistic regression using simple increasing step-size schedules, demonstrating that acceleration does not require instability or edge-of-stability behavior and yielding anytime guarantees for both deterministic and stochastic methods.

A third research thread introduces a general framework for mean-field optimization and sampling beyond log-Sobolev inequalities, providing finite-time convergence guarantees and stationary propagation-of-chaos bounds under Poincaré and weak-Poincaré assumptions, thereby extending Wasserstein-based optimization and sampling theory to weakly confined, heavy-tailed, and multimodal distributions. The fourth thread addresses

trustworthy generative AI, where I analyze the statistical limits of AI watermark detection under human edits, showing that semantic-preserving transformations impose intrinsic information-theoretic constraints on detectability and lead to sharp robustness–detectability trade-offs for practical watermarking schemes. Collectively, these works illustrate a broad research agenda that combines optimization theory, statistical learning, mean-field analysis, and information theory to understand the fundamental capabilities and limitations of modern machine learning systems.

Young Investigators



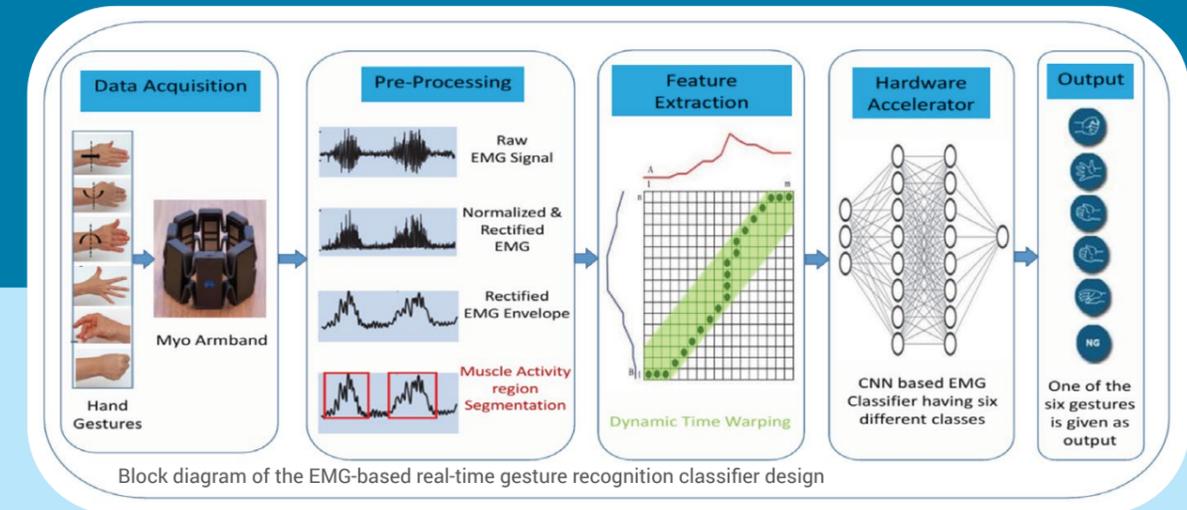
Debayan Das

Debayan Das is an Assistant Professor with the Department of Electronic Systems Engineering (DESE) at the Indian Institute of Science (IISc), Bangalore. He received his PhD and MS in Electrical and Computer Engineering from Purdue University, USA, in 2021 and his Bachelor of Electronics and Telecommunication Engineering degree from Jadavpur University, India, in 2015. He worked as a Security Researcher at Intel, USA, during 2021-22 and as a Research Scientist in the Intel Labs, USA, during 2022-23. Before his Ph.D., he worked as an Analog Design Engineer at a startup based in India. His research interests include mixed-signal IC design, biomedical circuits, and hardware security.

Dr. Das was awarded the Pratiksha Young Investigator by IISc in 2023-24. He received the IEEE HOST Best Student Paper Award in 2017 and 2019, IEEE CICC Best Student Paper Award in 2021, the Third Best Poster Award in IEEE HOST 2018, and the 2nd Best Demo Award in HOST 2020. In 2019, one of his papers was recognized as a Top Pick in Hardware and Embedded Security. He was recognized as the winner (third place) of the ACM ICCAD 2020 Student Research Competition (SRC). During his Ph.D., he was awarded the ECE Fellowship during 2016–2018, the Bilslund Dissertation Fellowship in 2020–2021, the SSCS Pre-doctoral Achievement Award in 2021, and the Outstanding Graduate Student Research Award by the College of Engineering, Purdue University, in 2021 for his outstanding overall achievements. He has authored/co-authored more than 65 peer-reviewed conferences and journals, including 2 book chapters and 3 US patents. He is currently serving as a Guest Editor for the IEEE Solid-State Circuit Letters (SSCL) and a Program Chair for the IEEE International Conference on Intelligent Computing and Systems at the Edge (ICEdge). He has been a technical program committee (TPC) member, track chair, and primary reviewer for multiple reputed journals and conferences, including JSSC, CICC, TCAS-I, TVLSI, TCAD, ISLPED, Design & Test, TODAES, JETCAS, TBME, IEEE Access, IoTJ, DAC, GLSVLSI, IMS, VLSI Design.

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2. Harshit Saurabh, et al. "SNOW-SCA: ML-Assisted Side-Channel Attack on SNOW-V." 2024 IEEE International Symposium on Hardware Oriented Security and Trust (HOST). IEEE, 2024.
3. Rahul Balout et al., "Machine Learning Power Side-Channel Attack on SNOW-V", IEEE VLSI Design 2026.
4. Samarth S T, Harshit Saurabh, and Debayan Das. "TYLOR: TDC-based Low-Overhead Synthesizable Power SCA Countermeasure on FPGAs." IEEE Design & Test, 2024.
5. Raghvendra Singh et al., "From the Two-Capacitor Paradox to Electromagnetic Side-Channel Mitigation in Digital Circuits", IEEE MAPCON 2025.



Block diagram of the EMG-based real-time gesture recognition classifier design



Web link

Research

In the second year of the funding, we worked on the development of mixed-signal circuits for hardware security and biomedical applications. On hardware security, we focused on the side-channel analysis (SCA) of 5G mobile communication security protocols like SNOW-V and the development of SCA countermeasures for FPGAs. In biomedical research, we are currently working on a wearable ultrasound transceiver design and EMG-based real-time gesture recognition.

We have published 3 peer-reviewed research papers in the first year of this project. In our HOST 2024 paper [1, 2], we performed a power side-channel analysis (SCA) on a 5G encryption algorithm SNOW-V and demonstrated successful key recovery from a 32-bit ARM microcontroller. This work utilized a combination of statistical correlational power analysis (CPA) along with linear discriminant analysis (LDA) to perform a machine-learning (ML) assisted SCA attack. In [3], we demonstrated the efficacy of machine-learning-based side-

channel attack on SNOW-V revealing that linear discriminant analysis (LDA) alone is sufficient to reveal the entire key of the stream cipher with a single encryption.

In the IEEE Design & Test paper [4], we proposed a fully synthesizable low-overhead circuit-level countermeasure against power SCA attack on an FPGA. This work utilized a time-to-digital converter (TDC) to instantaneously sense the voltage fluctuations due to the crypto core operations. The TDC output is then fed to a digital FSM, which turns ON or OFF the required number of ring oscillator (RO) slices acting as a bleeder circuit to compensate for the crypto current, making the overall supply current almost constant.

In our recent article published in IEEE MAPCON 2025 [5], we demonstrated how adiabatic charging can help mitigate non-invasive electromagnetic side-channel attacks on encryption devices.

In biomedical research, we are currently developing an ASIC to

perform real-time energy-efficient gesture recognition using EMG signals. Such a wearable can help with hands-free mobile phone control and various AR/VR applications (Fig.1).

Some of my technical contributions over the last year include: (1) Served as a Guest Editor for the IEEE Solid-State Circuit Letters (SSCL). (2) Served as the Program Chair and founding member for the IEEE International Conference on Intelligent Computing and Systems at the Edge (ICEdge) 2025. (3) Delivered an invited talk on 'Security in VLSI: Addressing the growing importance of hardware security and strategies for protecting against emerging threats such as side-channel attacks and hardware Trojans' at the IEEE CAS Industry Forum held in PES College of Engineering, Bangalore, June 2025. (4) Delivered an invited talk on 'Traversing through the Hardware Security Landscape: Secure Compute and Communication' at the SPARC workshop on 'Spintronics and Hardware Security' organized by IIT Roorkee in March 2025.

Young Investigators



Web link



Shubhada Agrawal

Shubhada Agrawal is an Assistant Professor in the Department of Electrical Communication Engineering (ECE) at IISc, Bangalore. She was a postdoctoral researcher at Georgia Tech. and Carnegie Mellon University. She obtained a PhD from the Tata Institute of Fundamental Research, Mumbai, and her undergraduate degree from IIT Delhi. She received the INSPIRE Faculty Fellowship (2025), the Sarojini Damodaran Foundation Fellowship (2022), and the Google PhD Fellowship in Machine Learning (2021). She has been recognised as a Rising Star at the TCS-for-all Workshop, STOC (2023), and a US Junior Oberwolfach Fellow (2024). Her research interests lie broadly in applied probability and sequential decision-making under uncertainty.



Reference:
<https://arxiv.org/pdf/2512.12325>

Research

Understanding how learning algorithms perform over time is a central question in statistics and machine learning. A particularly strong notion of performance is a path-wise guarantee to one that holds along individual data sequences, rather than only on average or in expectation. In our recent work, we establish such guarantees for a classical yet powerful construction: Robbins' mixture. We show that the mixture method using Robbins' prior achieves an iterated logarithmic regret rate, $O(\ln \ln T)$, along every data path within a natural

"Ville event." Remarkably, this guarantee holds even when the data are unbounded, provided they satisfy a sub-Gaussian condition. Under standard stochastic models, the Ville event occurs with high probability, meaning that our deterministic guarantee translates into strong stochastic bounds.

This result bridges two traditionally distinct perspectives: martingale-based sequential inference, which provides time-uniform concentration guarantees under stochastic assumptions, and adversarial

online learning, where regret bounds are inherently path-wise but typically require bounded data. By showing that a classical sub-Gaussian mixture strategy achieves low eventual regret even on unbounded sequences, our work connects these frameworks and extends law-of-the-iterated-logarithm (LIL)-type behavior to a significantly broader setting. Beyond its conceptual implications, this provides a new theoretical foundation for designing robust, time-uniform sequential inference procedures with sharp, deterministic guarantees.

Young Investigators



Vaanathi Sundaresan

Dr. Vaanathi Sundaresan is an Assistant Professor at the Department of Computational and Data Sciences (CDS), Indian Institute of Science (IISc), Bangalore. She is also the convenor of Biomedical image Analysis (BioMedIA) laboratory at CDS, IISc. Prior to this appointment, she was working as a postdoctoral research fellow at Athinoula A. Martinos Centre, Department of Radiology, Harvard Medical School and Massachusetts General Hospital. She received her doctorate degree at Oxford Centre for Function MRI of Brain (FMRIB), Wellcome Centre for Integrative Neuroimaging (WIN), University of Oxford. Later, she continued her research at WIN as a Postdoctoral researcher, where she is currently affiliated as an Honorary Research Fellow. She has around 10 years of experience in open source tool development for medical imaging applications.

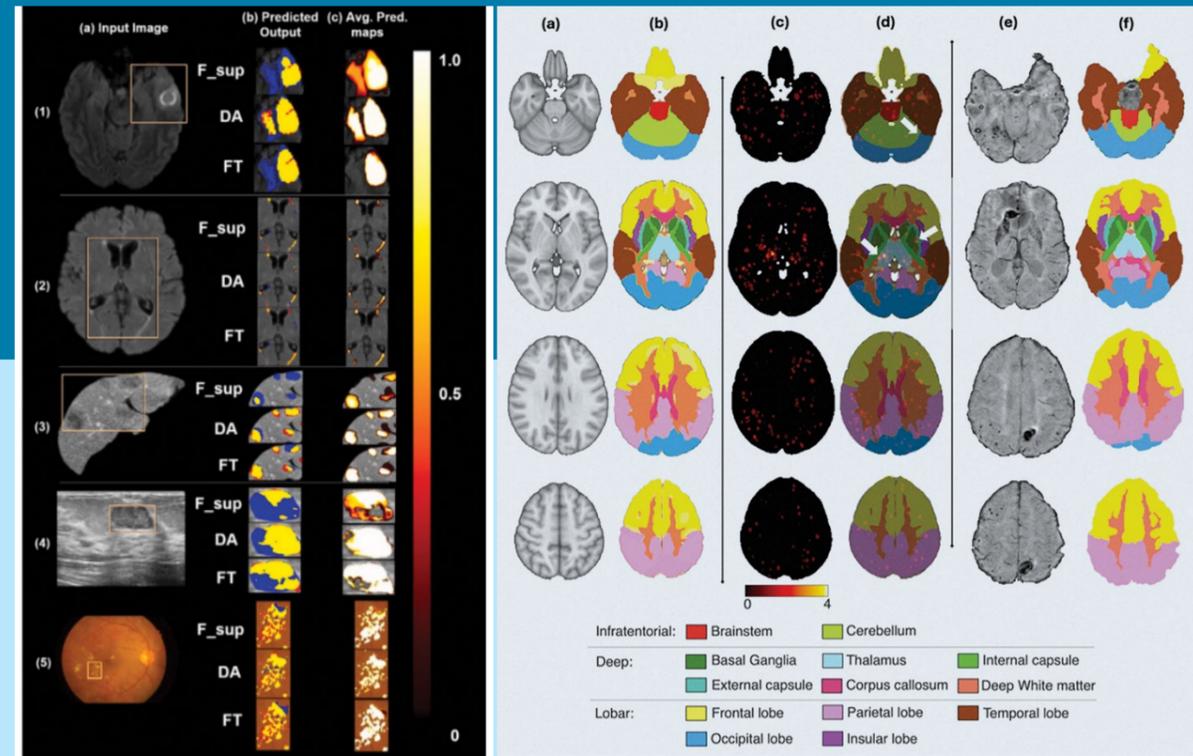
References:

Publications / Journals:

1. Automated detection of lacunes in brain MR images using SAM with robust prompts using self-distillation and anatomy-informed priors. P Deepika, G Shanker, R Narayanan, V Sundaresan. *Computers in Biology and Medicine* (2025), 196, 110806 (impact factor: 6.3)
2. Label-efficient sequential model-based weakly supervised intracranial hemorrhage segmentation in low-data non-contrast CT imaging. SH Ramananda, V Sundaresan *Medical Physics* (2025) 52 (4), 2123-2144 (Impact factor: 3.2)
3. MedLesSynth-LD: Lesion synthesis using physics-based noise models for robust lesion segmentation in low-data medical imaging regimes. R Narayanan, V Sundaresan *Pattern recognition letters* (2025) 188, 155-163 (Impact factor: 3.3)
4. Self-supervised segmentation and characterization of fiber bundles in anatomic tracing data. V Sundaresan, JF Lehman, C Maffei, SN Haber, A Yendiki. *Imaging Neuroscience* (2025) 3, imag_a_00514
5. Automated characterisation of cerebral microbleeds using their size and spatial distribution on brain MRI. V Sundaresan, G Zamboni, RA Dineen, DP Auer, SN Sotiropoulos et al. *European radiology experimental* (2025) 9 (1), 5 (Impact factor: 3.6, Editor's highlight for best clinical research)
6. Automated grading of diabetic retinopathy and Radiomics analysis on ultra-wide optical coherence tomography angiography scans. VN Soren, HS Prajwal, V Sundaresan. *Image and Vision Computing* (2024) 151, 105292. (Impact factor: 4.2)
7. Automated detection of cerebral microbleeds on MR images using knowledge distillation framework. V Sundaresan, C Arthofer, G Zamboni, AG Murchison, RA Dineen, et al. *Frontiers in Neuroinformatics* (2023) 17, 1204186 (Impact factor: 2.5)

Conferences:

1. Inter-class Separability Loss for Weakly Supervised Mutually Exclusive Multiclass Segmentation of Brain Tumor Lesions. V Dhamale, V Sundaresan *International Conference on Medical Image Computing and Computer-Assisted Intervention (MICCAI) 2025*, 247 – 257 (acceptance rate: 25%, spotlight presentation and travel grant)



Web link

Research

Anomaly segmentation for neurodegenerative biomarkers on multiple modalities with lesion simulation using physics-informed noise models, within randomly generated shape priors and contrast variables in low data regimes.

Precise biomarker extraction for diabetic retinopathy (DR) on UW-OCTA using three stages: (i) quality assessment, (ii) segmentation of vascular biomarkers such as intraretinal microvascular abnormalities, non-perfusion areas and neovascularisation, and (iii) grading of DR into no-DR, non-proliferative and proliferative DR.

Weakly supervised intra-cerebral haemorrhage (ICH) segmentation on NCCT images from image-level labels of presence or absence of ICH using class activation maps from the classification model.

Detection of lacunas for neurodegeneration on brain MR

images using foundation models using Adaptive Thresholding using anatomical priors and study their effect on clinical and demographic factors for neurodegeneration and vascular cognitive impairment to facilitate in precision medicine.

Extraction of clinical information for microbleeds (one of the early signs of neurological diseases of vascular origin) in terms of their spatial distribution as per Microbleeds Anatomical Rating Scale (MARS) and size of microbleeds in different regions of the brain.

Lesion characteristics, especially size-adaptive, pruning of models in federated learning framework for efficient lesion segmentation in heterogeneous datasets with different lesion sizes.

Obtaining accurate saliency maps for weakly supervised segmentation of multi-label lesions, where colocalization is a main challenge using novel

inter- and intra-class separability components of loss functions.

Efficient detection of out-of-distribution samples from medical imaging datasets using confidence scores, while aiming for accurate in-distribution classification, thus aiming for an accurate open-set recognition method.

Tracking the progression of stroke lesions to identify the post-intervention penumbra region and diffusion MR images from pre-intervention non-infract regions on contrast CT images using diffusion models in unsupervised manner. Simulated lesions will be used for supplementing the training data for infarct detection.

Exploring explainability in domain adaptation applications including federated learning for various model architectures and identifying salient domain invariant features for anomaly detection.

Young Investigators



Vini Gautam

Vini Gautam is Assistant Professor at the Centre for Nano Science and Engineering (CeNSE), Indian Institute of Science, Bangalore, India, where she leads the NeuroElectronics Lab. Her interdisciplinary research work focuses on neural interfaces, bionic vision, and biomaterials, pioneering advanced technologies for neural tissue engineering applications.

Reference:
Manuscripts are currently under preparation.



Web link

Research

Modulating in vitro neuronal networks using flexible micropillar scaffolds: Our work showcases the fabrication of flexible PDMS (poly-dimethylsiloxane) micropillars as scaffolds for neural tissue engineering. PDMS micropillars were fabricated by replica molding from a silicon stamp with varying diameter (W) and gap (G) of $2\mu\text{m}$, $3\mu\text{m}$, $4\mu\text{m}$, $5\mu\text{m}$ and $10\mu\text{m}$. The micropillars are isotropically arranged as vertical arrays over 0.25 mm^2 ($500\mu\text{m} \times 500\mu\text{m}$) on the PDMS substrate. Primary hippocampal neurons from

post-natal rat pups were plated on the scaffolds and the neuronal growth characteristics on the scaffolds were analyzed using light and electron microscopy at DIV 7. Results show that the average neurite length per neuron was the highest on the PDMS micropillar scaffolds compared to the control (flat) substrates. The neurites were found to grow at 0° and 90° on pillars with $G=2\mu\text{m}$ ($G2$) and $G=3\mu\text{m}$ ($G3$) features, irrespective of the W dimensions. With increasing G ; e.g. $G = 4\mu\text{m}$ ($G4$) or $G=5\mu\text{m}$ ($G5$), the neurites also

exhibited growth at angles of 45° . At $G=10\mu\text{m}$ ($G10$), the extent of alignment was gradually reduced to become completely random. Further, when the interpillar distances were minimum ($G2$), the neurites were thinner, and the thickness increased with increasing interpillar gap. The size of the cell nucleus was also observed to be larger on scaffolds with nano topography compared to the flat controls. Our studies give an insight into how the effect of topography can be used to modulate functional neuronal networks in vitro.

PhD Programme

Interdisciplinary PhD programme in Brain, Computation, and Data Science



CONVENER
Prasanta K Ghosh



DCC CHAIR
Supratim Ray

The

interactions among the faculty members involved in the Brain, Computation, and Data Science group led to the proposal for an interdisciplinary PhD programme in Brain, Computation, and Data Science to give a thrust to research in this important area. This interdisciplinary PhD programme is aimed at promoting research at the intersection of neuroscience and artificial intelligence, by providing wholesome training that spans both fields and blurs their distinctions. Its focus is on computational approaches to understanding brain function and their synergistic interactions with artificial intelligence paradigms.

This unique programme commenced its operations from the academic year 2020–21. Students with MSc or equivalent degree in any branch of Sciences or BE/ BTech or equivalent degree in any discipline or 4-year Bachelor of Science degree

(and who have qualified in national eligibility tests as needed) are eligible to apply to this programme. The students are interviewed to assess both their background as well as aptitude for interdisciplinary research. Each selected student will be working with two advisers belonging to two different departments, reflecting the inter-disciplinary flavour of the programme.

Areas of Research

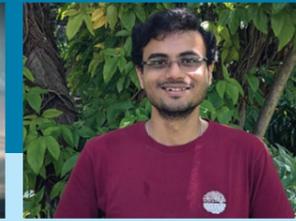
- » Brain-inspired artificial intelligence
- » Machine learning
- » Signal processing
- » Theoretical and computational neuroscience
- » Cellular, systems and cognitive neuroscience
- » Sensory systems: vision, speech
- » High-level cognitive processes: learning, attention, decision making
- » Brain-machine interfaces
- » Neuromorphic computation, neuromorphic hardware



Anjana S
YEAR 2020–21
AD1 - Rishikesh Narayanan
AD2 - Sachin



Sveekruth Pai
YEAR 2020–21
AD1 - Supratim Ray
AD2 - P N Rangarajan



Mainak Biswas
YEAR 2021–22
AD1 - Sridharan Devarajan
AD2 - D Ambedkar



Satyapreet Singh
YEAR 2022–23
AD1 - Chetan Thakur
AD2 - Chandra Sekhar Seelamantula



Kashmiri M Lande
YEAR 2022–23
AD1 - Giriraj Sahu
AD2 - Deepak K Nair



Priyam Dey
YEAR 2023–24
AD1 - R Venkatesh Babu
AD2 - S P Arun



Aditi Saxena
YEAR 2024–25
AD1 - Sridharan Devarajan
AD2 - D Ambedkar



Priyam Garg
YEAR 2024–25
AD1 - Rishikesh Narayanan
AD2 - Ashesh Dhawale



Saptarshi Maiti
YEAR 2024–25
AD1 - Chetan Thakur
AD2 - Sridharan Devarajan



Aniket Mandal
YEAR 2024–25
AD1 - Chandra Murthy
AD2 - Supratim Ray



Maiolica
YEAR 2024–25
AD1 - Balaji Jayaprakash
AD2 - Rishikesh Narayanan



Chetan P
YEAR 2025–26
AD1 - Chetan Thakur
AD2 - Chandra Sekhar Seelamantula



Devangam Bangaru
YEAR 2025–26
AD1 - Sridharan Devarajan
AD2 - Gugan Thoppe



Mummani Nuthan
YEAR 2025–26
AD1 - Balaji Jayaprakash
AD2 - Rishikesh Narayan



Harikrishna Metta
YEAR 2025–26
AD1 - Venkatesh Babu
AD2 - Sriram Ganapathy

Activities 2025

Workshop on Brain Co-Processor Moonshot Project

December 18, 2025

The workshop brought together IISc leadership, Pratiksha Trust Chair Professors, advisors, collaborators, and national and international researchers to deliberate on the proposed Brain Co-Processor Moonshot Project, a long-term, multidisciplinary initiative aimed at transforming cognitive rehabilitation.

The project vision centers on developing a “brain co-processor” that goes beyond conventional motor decoding to engage distributed brain networks underlying cognition (attention, vision, decision-making). A defining philosophy is to induce adaptive neural plasticity—helping the brain heal and reconfigure itself—rather than merely bypass damaged circuits. The roadmap follows a phased approach, beginning with non-invasive technologies, functional

mapping, and animal validation, and progressing to implantable devices, neuromorphic hardware, and human testing.

Mr. Kris Gopalakrishnan strongly endorsed the initiative as a true “Moonshot,” emphasizing India’s responsibility and capability to participate in global grand challenges. He highlighted the need for rigorous long-term project management, standardization, early industry engagement, and modularity to enable spin-offs and translational impact even before the project’s completion.

The Pratiksha Trust Chair Professors reinforced the project’s strategic and scientific depth. Prof. Rajesh Rao positioned it within India’s tradition of building affordable, scalable neuro-technologies, stressing its unique focus on holistic

cognitive rehabilitation and recommending parallel execution and early public data release. Prof. Maneesh Sahani emphasized extracting fundamental principles of brain function, advocating the use of foundation-model-like data strategies to leverage large datasets. Prof. Barbara Shinn-Cunningham described the effort as ambitious yet grounded, underscoring success as the ability to absorb uncertainty and learn from failures, while advancing closed-loop brain-technology systems.

The Advisors and Deans echoed the importance of keeping the grand vision central, building open shared infrastructure, enforcing data and protocol standardization, maintaining a strong operating rhythm, and treating data as a public good. They stressed governance, extensibility to adjacent clinical conditions, and early engagement with

regulators and industry. The Institute leadership expressed strong institutional support.

The PIs detailed their complementary sub-projects which include: creating India’s largest standardized human invasive brain database (sEEG); developing indigenous, low-cost electrodes; advancing vision decoders and cross-area stimulation paradigms; engineering neuromorphic, low-power hardware; leveraging clinical workflows for data acquisition; and ensuring regulatory and commercialization pathways.

Collectively, the engineering philosophy focuses on shifting from “stimulating to evoke a response” to “stimulating to modify and heal neural networks.”

Key next steps identified include:

1. Accelerating and annually releasing the human brain database as a public resource.
2. Scaling indigenous electrode manufacturing to reduce costs and improve access.
3. Running parallel primate and human validation studies.
4. Developing naturalistic, closed-loop tasks for cognitive rehabilitation.
5. Prototyping neuromorphic hardware, progressing toward integrated multi-channel AI-enabled chips.

Overall, the workshop aligned stakeholders to a bold, coordinated vision to position India at the forefront of next-generation cognitive neurotechnology through open science, parallel execution, and translational focus.

Activities 2025

Key insights from Mr. Kris Gopalakrishnan

Kris Gopalakrishnan offered strategic guidance and strong support for the initiative, positioning it as a necessary "Moonshot" that India is capable and well-prepared to drive. He stressed that India must actively participate in global scientific challenges rather than remain an observer, especially given its talent pool and its responsibility as a nation representing nearly 20% of the world's population. Acknowledging the long 10-year timeline, he emphasized the importance of strong project management and mechanisms to ensure continuity, noting that people and roles may change over time. He highlighted the need to follow or develop global standards to enable interoperability and ensure the project's relevance internationally. While science should remain the immediate priority, he advised early engagement with industry partners to enable future commercialization, regulatory readiness and feedback for medical device development. He further encouraged treating software, AI models, and hardware components as modular systems, allowing each to evolve independently and generate spin-offs and translational applications even before the Moonshot reaches completion.

Prof. Rajesh Rao (U. Wash.), Pratiksha Chair Professor at IISc, contextualized the project within a historical framework of Indian innovation, recalling conversations with President Abdul Kalam in 2002 regarding the need for indigenous, affordable neurotechnologies (like cochlear implants) that can be deployed across large populations. He identified the project's focus on holistic "cognitive rehabilitation" – rather than just motor recovery – as a unique differentiator that sets it apart from other global efforts. Strategically, Rao advised the team to introduce parallelism to shrink the proposed ten-year cycle time and strongly recommended releasing data incrementally as a "public good" to benefit the community, rather than waiting for the project's conclusion.

Prof. Maneesh Sahani (UCL), Smt. Sudha Murty Chair Professor at IISc, emphasized the need to move beyond merely documenting the brain's "tripled" complexity (noting the massive expansion of neuroscience textbooks since 1981) to discovering the few fundamental principles from which these complex functions follow. He highlighted the critical "loop" wherein better scientific understanding enables better technology, which in turn provides the human brain unprecedented access required to advance science further. Looking toward data strategy, Sahani suggested adopting "foundation models" – similar to those used in large language modelling – where massive datasets are used to learn structural importance, allowing researchers to later tailor the model to specific tasks using smaller amounts of data.

Prof. Barbara Shinn-Cunningham (CMU), Sri K. Vaidyanathan Chair Professor at IISc, validated the initiative as a genuine "Moonshot" because it is "bold without being naive" and "ambitious without

being reckless". She praised the project's philosophical shift from simple signal decoding to viewing the brain as a distributed system and developing a "coprocessor" to engage with it, noting that this aligns perfectly with CMU's own work on closed loop systems and their complementary "brain and body function" initiative. She concluded by redefining success for such a large venture, arguing that a true moonshot succeeds because its vision is strong enough to "absorb uncertainty and failures," which ultimately teach researchers more than their successes. She emphasized fundamental understanding of neural mechanisms and the associated brain technologies required to realize an effort of this nature in stroke rehabilitation ultimately. Success for a project of this scale should be defined by its ability to absorb uncertainty and learn from failures, not solely by linear milestone completion.

Input from advisors and Deans highlighted the need for open shared infrastructure, standardised data collection, regulatory preparedness, and maintaining cognitive rehabilitation as a unique differentiator. PIs presented their sub-projects, which include building India's largest human sEEG database, developing indigenous polymer-based electrodes, conducting parallel monkey-human decoding studies, designing naturalistic cognitive rehabilitation tasks, and prototyping neuromorphic chips. The meeting concluded with alignment on five key next steps: periodic public release of invasive brain datasets, multi-pillar electrode development and scaling, parallel primate-human experiments, development of closed-loop cognitive task frameworks, and neuromorphic prototype design – marking a major step toward realising a transformative Indian Moonshot in brain – technology and rehabilitation research.

The Pratiksha Trust Chairs further strengthened the strategic direction through key insights

Activities 2025

5th Brain, Computation, and Learning (BCL) Workshop



The fifth edition of the workshop on Brain, Computation, and Learning (BCL5) was held at the Indian Institute of Science (IISc), Bangalore from June 30 – July 4, 2025. The primary aim of this biennial workshop is to promote interdisciplinary research in the broad area of neuroscience and artificial intelligence in India and to promote synergistic interactions among neurobiologists and engineers. The workshop seeks to enable young researchers to understand the diverse themes of research and appreciate the close relationships between these apparently distinct themes. The overarching theme of this year's workshop

is "Brain Co-Processors". This is part of a bigger "Moonshot" project, details of which can be found here: <https://brain-computation.iisc.ac.in/moonshot-project/>.

There were five 1-day modules, namely Vision (June 30), Motor and Cognition (July 1), Clinical (July 2), NeuroEngineering (July 3) and a new feature this year, NeuroTech (July 4), where startups and companies showcased their products in this space.

This workshop is funded by a generous endowment from the Pratiksha Trust, which has been significantly promoting fundamental and translational neuroscience research within the country through the establishment of research centres and Chair Professorships at the Indian Institute of Science (Bengaluru) and Indian Institute of Technology Madras (Chennai).

Each module of the workshop lasted 1 day, during which there were 5 lecture sessions, with plenty of interspersed breaks to give time for discussions. In the final session, there was a panel discussion between all

the speakers of the module and the students about the outstanding questions in the field. In addition, there were 3 lab visit sessions during the evenings on (1) Human Functional Neuroimaging (MRI), (2) EEG (3) Nano fab lab where the students got a first-hand look at the cutting-edge research techniques and experiments. The workshop was attended by 82 participants from institutes from all over India, in addition to the student population at the Centre for Neuroscience and the IISc student community in general. Participants for the workshop were undergraduate, Master's, PhD students as well as postdocs, clinicians and faculty, from colleges across India.

A survey conducted at the end of the workshop revealed that participants had extremely positive reviews of the workshop. Informal feedback from the workshop speakers was also outstanding, with many speakers saying they were pleasantly surprised at how enthusiastic and interactive the students were during the formal lecture discussion sessions and also during the informal discussions during

tea and lunch breaks. Thus, the workshop successfully achieved its primary goal of promoting interdisciplinary research in the broad area of neuroscience and artificial intelligence in India and promoting synergistic interactions among neurobiologists and engineers. Secondly, some scientific interactions between the Indian speakers, and between Indian and foreign speakers (including the Pratiksha Chair Professors) have the potential to become longer-term national and international collaborations. Finally, we believe that the active participation of students from various disciplines and their interactions with Indian speakers in BCL5 would eventually increase student enrollment in cognitive and computational neuroscience-related programs in IISc and across the country.

Workshop applications, schedule, maps, etc. were all made available on a website at the address given below: <https://bcl.iisc.ac.in/bcl5/>

Selection Procedure and Participants

To publicize the workshop, a workshop poster was e-mailed to over 300 colleges all over

India. We received more than 200 applications from colleges across India, and participants were selected based on their merit, statement of purpose, and geographic uniformity. Preference was given to students who are in their final year of Bachelor's or Master's education, as there is a greater chance of such students applying for PhD programs in the area of cognitive science in the subsequent academic year. More importantly, we took affirmative action to select students from different reserved categories. By doing so, we identified some good prospective PhD students, especially from reserved categories. All selected students were Indian nationals and half of them were females.

Logistics

Prof. Supratim Ray oversaw the overall logistics of the workshop. The organizing committee comprised Dr. Simimol (Programme Manager, BCD), Ms. Vinitha (Secretarial Assistant), and five PhD student volunteers who managed specific aspects such as speaker hospitality, social events, and other logistical arrangements and administrative logistics, including travel reimbursements.

Activities 2025

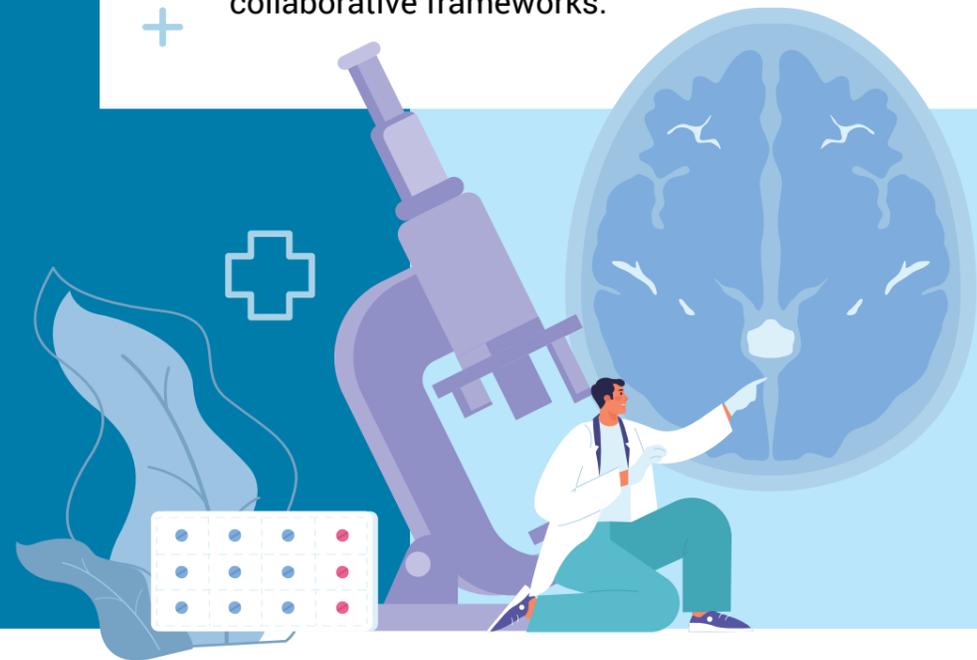
List of BCL5 Speakers

S. NO.	TITLE	NAME	AFFILIATION
1	Prof	Rajesh P. N. Rao	University of Washington
2	Prof	Maneesh Sahani	University College London
3	Prof	Amol Yadav	UNC School of Medicine
4	Prof	Ben Grannan	UW Medicine
5	Prof	Carlos Ponce	Harvard Medical School
6	Prof	Jeffrey Herron	UW Medicine
7	Prof	Nishant Sinha	University of Pennsylvania
8	Prof	Abhilasha Joshi	NCBS
9	Prof	Akash Kulgod	Dagnosis
10	Prof	Amey Desai	Lifespark Technologies
11	Prof	Arjun Ramakrishnan	IIT Kanpur
12	Prof	Biswarup Mukherjee	IIT Delhi
13	Prof	George Vilanilam	SCTIMST
14	Prof	Gokul NA	CynLr

S. NO.	TITLE	NAME	AFFILIATION
15	Prof	Hardik Pandya	IISc
16	Prof	Hunny Bhagchandani	TorchIt
17	Prof	Jayavardhana Gubbi	TCS
18	Prof	Kaustubh Deshpande	Eywa Neuro
19	Prof	Koel Das	IISER Kolkata
20	Prof	Nikunj Bhagat	IIT Kanpur
21	Prof	Nilesh Kurwale	DM Hospital
22	Prof	Shabari Girishan K V	Ramaiah Medical College Hospital
23	Prof	Siby Gopinath	Amrita Hospital
24	Prof	SP Arun	IISc
25	Prof	Sridharan Devarajan	IISc
26	Prof	Supratim Ray	IISc
27	Prof	Vaidy Narayanan	Charukesi
28	Prof	Veeky Baths	BITS Pilani

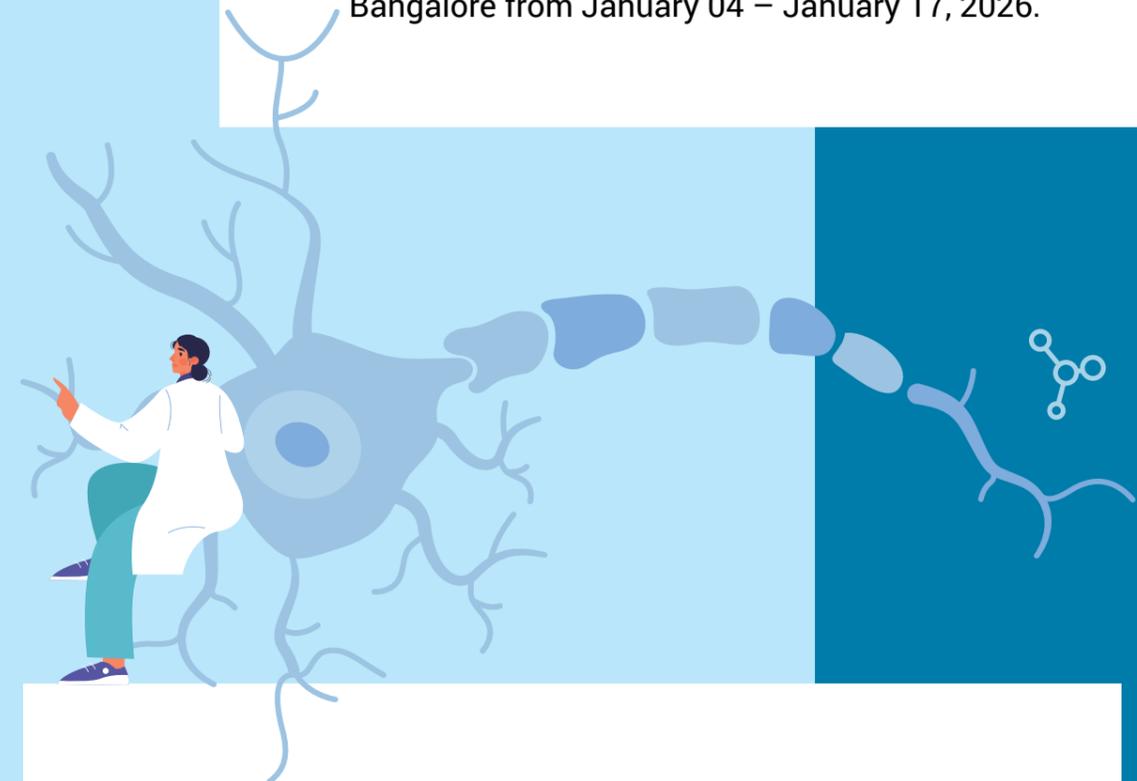
Planned Activities 2026

Submission of the revised Moonshot project proposal, incorporating updated objectives, methodologies, and collaborative frameworks.



Two Ph.D. students from BCD faculty labs at IISc to spend 3 months at UCL, working under the mentorship of, and establishing collaborations with faculty at the Gatsby Computational Neuroscience Unit and the Sainsbury Wellcome Centre.

Bangalore Neuromorphic Engineering Workshop (BNEW 2026) will be held at the Indian Institute of Science (IISc), Bangalore from January 04 – January 17, 2026.



Visits of the three Chair professors – Prof. Rao, Prof. Sahani and Prof. Shinn-Cunningham - to IISc to speak at the BNEW 2026 in January, and to engage in interactions with faculty and students in December.

Research Publications

2025

P Deepika, G Shanker, R Narayanan, V Sundaresan. *Computers in Biology and Medicine* (2025), 196, 110806. Automated detection of lacunes in brain MR images using SAM with robust prompts using self-distillation and anatomy-informed priors. (impact factor: 6.3)

SH Ramananda, V Sundaresan *Medical Physics* (2025). Label-efficient sequential model-based weakly supervised intracranial hemorrhage segmentation in low-data non-contrast CT imaging. 52 (4), 2123-2144 (Impact factor: 3.2)

R Narayanan, V Sundaresan *Pattern recognition letters* (2025). MedLesSynth-LD: Lesion synthesis using physics-based noise models for robust lesion segmentation in low-data medical imaging regimes. 188, 155-163 (Impact factor: 3.3)

V Sundaresan, JF Lehman, C Maffei, SN Haber, A Yendiki. *Imaging Neuroscience* (2025). Self-supervised segmentation and

characterization of fiber bundles in anatomic tracing data. 3, *imag_a_00514*

V Sundaresan, G Zamboni, RA Dineen, DP Auer, SN Sotiropoulos et al. *European radiology experimental* (2025). Automated characterisation of cerebral microbleeds using their size and spatial distribution on brain MRI. 9 (1), 5 (Impact factor: 3.6, Editor's highlight for best clinical research)

Singh RP, Chatterjee B, Sen S, Das D, (2025) From the Two-Capacitor Paradox to Electromagnetic Side-Channel Mitigation in Digital Circuits, *IEEE MAPCON*.

Balotia D., Balout R., Kundu S., Golder A., Karmakar A., Das D., (2025) Machine Learning Power Side-Channel Attack on SNOW-V, *IEEE VLSID*.

Pramanik S, William V, Raha A, Das D, Mukherjee A, Paluh J L, (2025) TYTAN: Taylor-series based Non-Linear Activation Engine for Deep Learning Accelerators, *Springer International*

Symposium on VLSI Design and Test (VDATE).

Anand A, Murthy CM, and Ray S (2025) Burst Estimation through Atomic Decomposition (BEAD): A Toolbox to find Oscillatory Bursts in Brain Signals. *Imaging Neuroscience*. 3: *IMAG.a.86*

Krishnakumaran R, Pavuluri A, and Ray S (2025) Delayed accumulation of inhibitory input explains gamma frequency variation with changing contrast in an Inhibition Stabilized Network. *Journal of Neuroscience*. 45 (5):e1279242024; <https://doi.org/10.1523/JNEUROSCI.1279-24.2024>

Bhaskara, S., Shabari Girishan, K. V., Murugaiyan, S., Dwivedi, A. A., Krishnakumaran, R., & Pandya, H. J. (2025). An L-shaped flexible neural implant for chronic ECoG signal acquisition in M2 region of control and Parkinsonian rat models. *Scientific Reports*, 15(1), 39461. DOI: <https://doi.org/10.1038/s41598-025-23049-0>

Invention Title: L-shaped Cortical Surface Neural Implant
Inventors: Hardik J. Pandya, Sreenivas Bhaskara, Shabari Girishan K V, Saravanan M, Rathin K. Joshi, and Nitu Bhaskar
Current Status: Granted (Patent No. 570869, Date of Grant: October 18, 2025))

Invention Title: L-shaped Cortical Surface Neural Implant
Inventors: Hardik J. Pandya, Sreenivas Bhaskara, Shabari Girishan K V, and Saravanan M
Current Status: Granted (Indian Design No 412404-004, In class 24-99, Journal No: 19/2025, and Issue Date: 09/05/2025)

Invention Title: L-shaped Cortical Surface Neural Implant
Inventors: Hardik J. Pandya, Sreenivas Bhaskara, Shabari Girishan K V, and Saravanan M
Current Status: Granted (Indian Design No 412404-003, In class 24-99, Journal No: 03/2025, and Issue date: 17/01/2025)

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