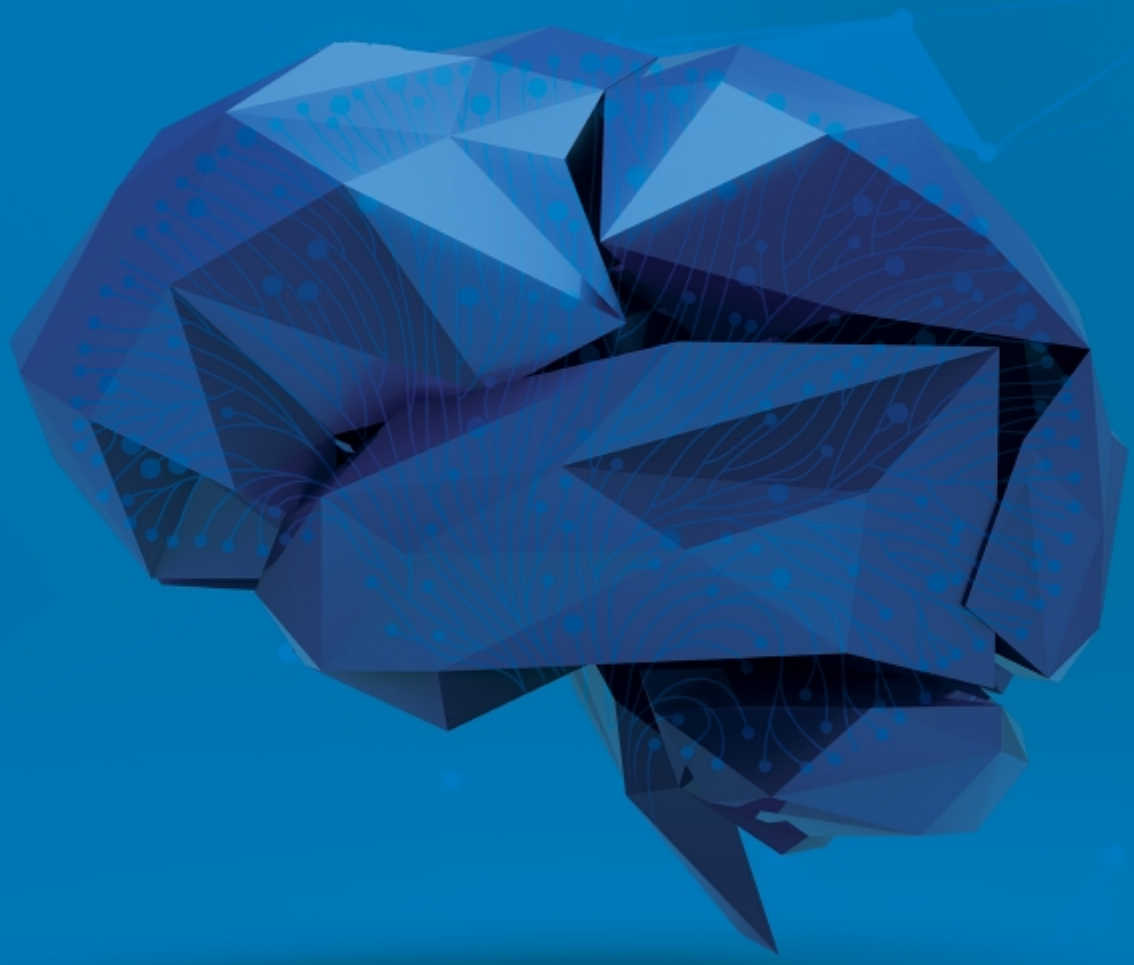
PRATIKSHA TRUST INITIATIVE ON

BRAIN, COMPUTATION, AND DATA SCIENCE



INDIAN INSTITUTE OF SCIENCE
भारतीय विज्ञान संस्थान

ANNUAL REPORT 2024

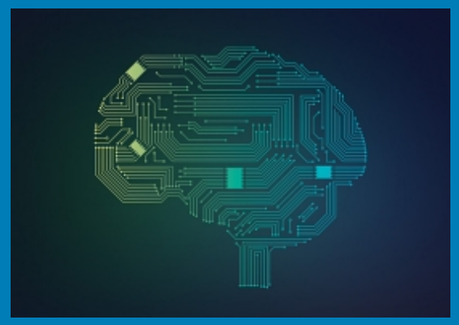
PRATIKSHA TRUST INITIATIVE ON

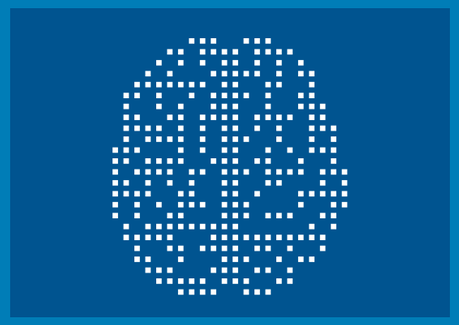
BRAIN, COMPUTATION, AND DATA SCIENCE

ANNUAL REPORT 2024

INDIAN INSTITUTE OF SCIENCE
भारतीय विज्ञान संस्थान

Content





Overview

Overview

Rajesh Sundaresan

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

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 2021and 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 2024.

FROM THE
Director, IISc

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."

FROM THE
Pratiksha Trust Founders

Kris Gopalakrishnan

Founder,
Pratiksha Trust,
Bengaluru

Sudha 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."

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

Aditya Sadhanala, CeNSE

Akshay Singh, Physics

Anand Louis, CSA

Anand Srivastava, MBU

Animesh Kuley, Physics

Anirban Chakraborty, CDS

Arindam Ghosh, CeNSE

Arjun Jain, CDS

Arkaprava Basu, CSA

Arnab Barik, CNS

Ashesh Dhawale, CNS

Balaji Jayaprakash, CNS

Banibrata Mukhopadhyay, Physics

Chandra Murthy, ECE

Chandra Sekhar Seelamantula, EE

Chetan Singh Thakur, ESE

Chirag Jain, CDS

Chiranjib Bhattacharyya, CSA

D Ambedkar, CSA

Deepak Subramani, CDS

Deepak Kumaran Nair, CNS

Giriraj Sahu, MBU

Hardik Pandya, ESE

K V S Hari, ECE

P S Sastry, EE

Pavan Nukala, CeNSE

Prathosh A P, ECE

Partha Talukdar, CDS

Phaneendra Yalavarthy, CDS

Prasanta Kumar Ghosh, EE

R Venkatesh Babu, CDS

Rajesh Sundaresan, ECE

Rajiv Soundararajan, ECE

Rishikesh Narayanan, MBU

S P Arun, CNS

Santanu Mahapatra, ESE

Sashikumaar Ganesan, CDS

Shalabh Bhatnagar, CSA

Shayan G Srinivasa, ESE

Shirish Shevade, CSA

Shishir Nadubettu Yadukumar Kolathaya, CPS

Siddharth Barman, CSA

Siddhartha Gadgil, Mathematics

Soma Biswas, EE

Sreetosh Goswami, CeNSE

Sridharan Devarajan, CNS

Srikanth Padmala, CNS

Sriram Ganapathy, EE

Sumantra Sarkar, Physics

Sundeep Prabhakar Chepuri, ECE

Supratim Ray, CNS

T V Prabhakar, ESE

Vijay Natarajan, CSA

Vini Gautam, CeNSE

Danish Pruthi, CDS

Debayan Das, ESE

Utsav Banerjee, ESE

Vaanathi Sundaresan, CDS

Y Narahari, CSA

Yogesh Simmhan, CDS

and all other interested faculty members

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

Shri K Vaidyanathan Distinguished Chair

Barbara Shinn-Cunningham

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

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

PRATIKSHA TRUST INITIATIVE
ON BRAIN, COMPUTATION,
AND DATA SCIENCE

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)

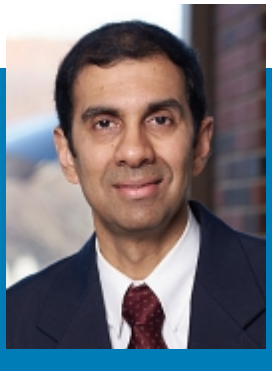
Chairs at the Indian Institute of Technology Madras

Prof H N Mahabala Chair

Partha P Mitra
Professor,
Cold Spring Harbor Laboratory

Dr N R Narayana Murthy Chair

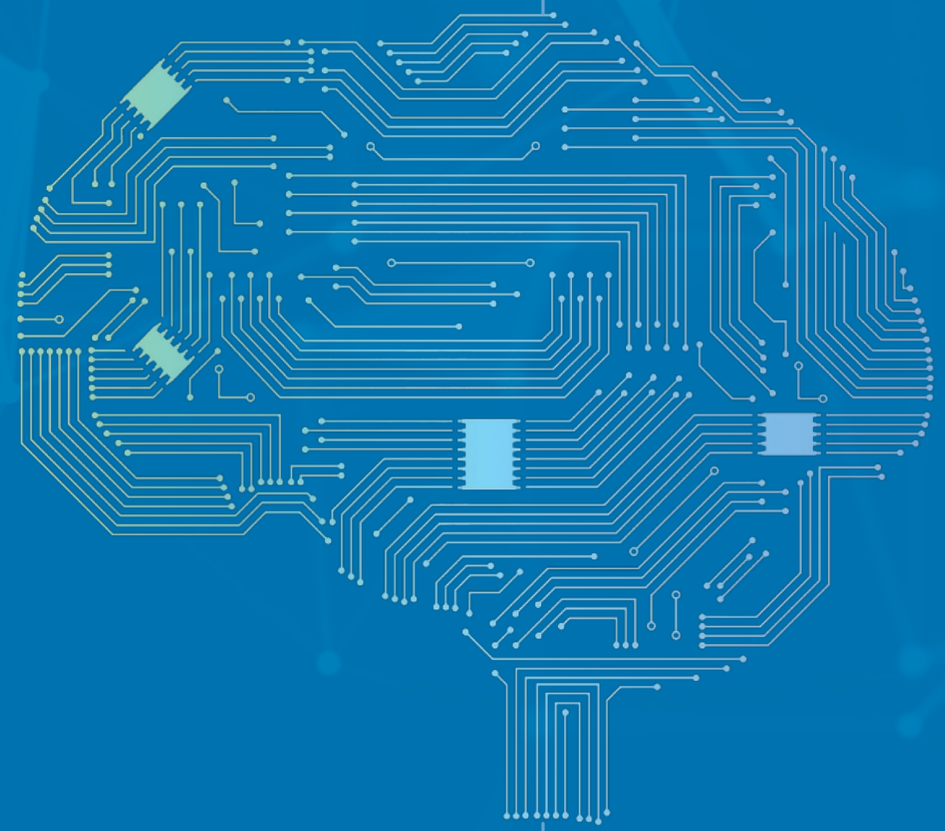
Mriganka Sur
Professor,
Massachusetts Institute of Technology



Prof Muthukrishnan Chair

Anand Raghunathan
Professor,
Purdue University

Moonshot Project



Brain Co-Processors - A Moonshot Project in India

"The moonshot project brings together talents in many different areas to share a common vision – there's AI, device development, electrode development, the animal aspects, neuroscience and the human clinical aspect. And in India, we have the resources, both on the engineering and the sciences side."

Rajesh Rao

Pratiksha Trust Distinguished
Chair Professor, IISc

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 project derives its name from a 2019 paper on 'neural co-processors' by Rajesh Rao, Cherng 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.

As a key element of novelty, the principal investigators (PIs) of the project have decided 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 mutliple sub-themes that were initially envisaged (decoding vision, decoding attention, decoding decisions, decoding actions, and low-power decoding in real-time).

Most neural prostheses involve decoding motor intent through recordings in the motor areas alone. However, several key functions are impaired in patients with MCA (middle cerebral artery) stroke. We will seek to recover and rehabilitate these functions by addressing each of these deficits with a holistic approach of two phases.

PHASE I
Groundwork and non-invasive co-processor (years 1-5)

- Goal 1: Non-invasive co-processor to restore goal-directed orienting and reaching

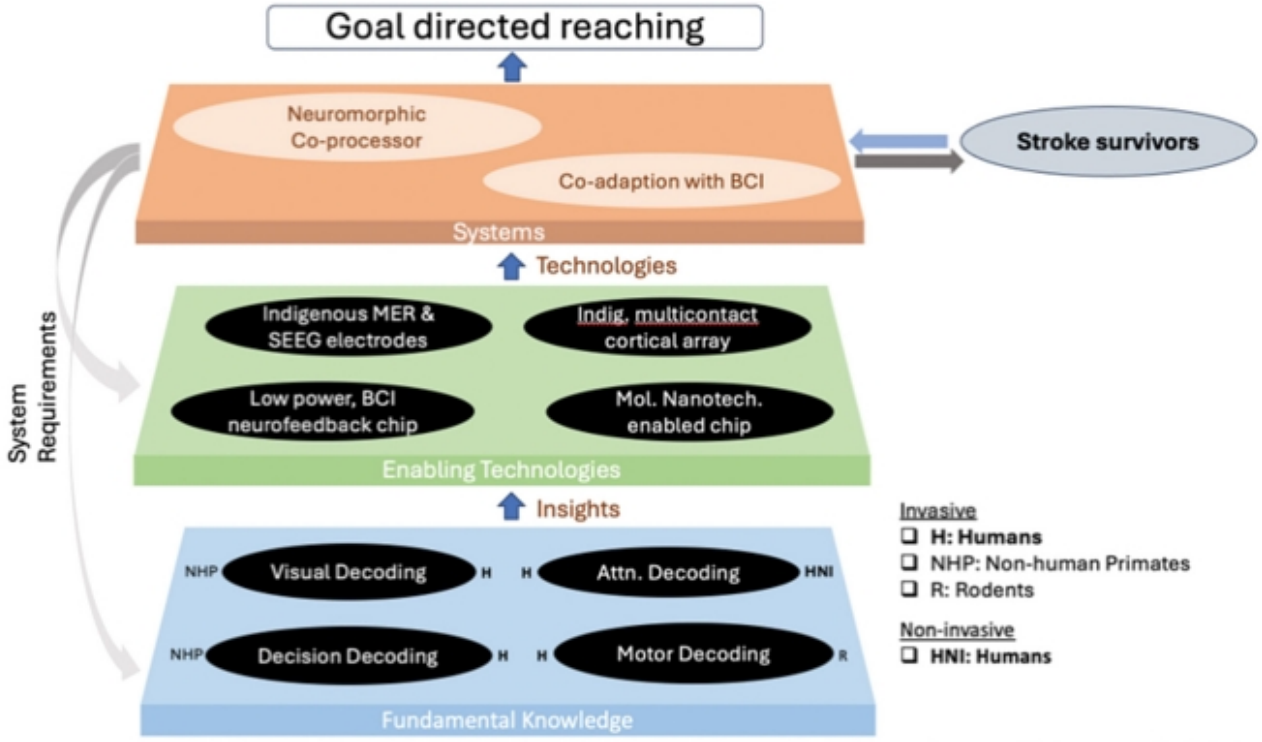
- Goal 2: Invasive decoding and encoding approaches in humans and animal models on components of goal directed reaching

- Goal 3: Build a cohort of stroke survivors who have residual upper limb function ~2 years post-stroke

PHASE II
Invasive co-processor to restore goal-directed reaching (years 6-10+)

Considering the current state-of-the-art and open possibilities, six teams have been created, each focussing on a different aspect:

1. Cognitive mapping with invasive recordings in the human brain
2. Real-time neuromorphic co-processor for stroke rehabilitation



3. Cognitive and sensory mapping of the non-human primate brain
4. Development of indigenous deep brain recording and stimulation electrodes
5. Indigenous implantable technologies for brain signal acquisition and stimulation
6. Molecular nanotechnology enabled platforms

Each team will tackle one facet of the project with immediately realisable goals.

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, to study normal brain activity in epilepsy patients when they are not having seizure episodes, IISc researchers work with clinicians.

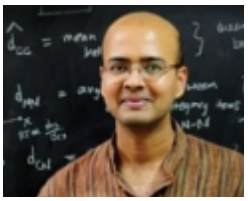
Broadly, the project is envisioned to be carried out in two stages. The first phase (years 1–5) – 'MindReader' – will focus on developing technologies for recording neural activity at high densities from different brain regions and decoding mental states (perceptual, cognitive, and motor) by developing customised AI algorithms in software and hardware. The second phase (years 6–10+) – 'MindHacker' – will focus on developing technologies for re-encoding signals back into the brain using a combination of recording and neurostimulation technologies.

Reference:

1. Report on Brain Co-processors by Krishnan Narayanan, Itihaasa Research and Digital https://itihaasa.com/public/pdf/LandscapeofBrainResearch.pdf

TEAM 1
Cognitive Mapping with Invasive Recordings in the Human Brain

Sridharan Devarajan (PI)



S P Arun

Arjun Ramakrishnan

Aditya Murthy

GOAL 1
Cognitive mapping with human intracranial stereo-EEG/ECoG recordings from epilepsy patients

GOAL 2
Brain stimulation to map the 'causal' role of different brain regions in cognitive functions

GOAL 3
Building a database of stereo-EEG, ECoG and video-EEG and behavioural recordings

TEAM 2
Real-time Neuromorphic Co-Processor for Stroke Rehabilitation

Chetan Singh Thakur (PI)

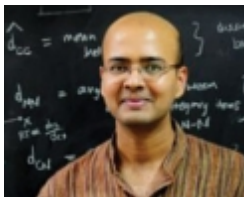
Sridharan Devarajan

GOAL 1
Developing a sparsity-driven, high density, scalable, low power BCI platform for end-to-end closed-loop feedback with low, intelligent hardware–software co-design and sparse signal processing

GOAL 2
Addressing portability, latency, power consumption, and data-throughput challenges to deliver a truly portable, high-performance BCI system

TEAM 3
Cognitive and Sensory Mapping of the Non-human Primate Brain

Supratim Ray (PI)



S P Arun

Chandra Murthy

GOAL 1
Decoding of brain signals can be done using non-invasive (EEG) as well as invasive (micro-electrode arrays) approaches. How much advantage do invasive technologies offer over non-invasive approaches?

GOAL 2
Brain stimulation techniques (sensory, non-invasive, invasive) and parameters (frequency, duration, amplitude) vary considerably. How do different stimulation paradigms affect neural activity and functional connectivity?

TEAM 4
Development of Indigenous Deep Brain Recording and Stimulation Electrodes

Arjun Ramakrishnan (PI)

Kaustubh Deshpande

GOAL 1
Developing and testing indigenous deep brain recording and stimulation electrodes (MER and sEEGs) rigorously safety-tested and optimised for human clinical trials

GOAL 2
Developing and validating decoding algorithms based on neural population recordings to identify optimal stimulation strategies that promote behavioural adaptation in dynamic environments

TEAM 5 Indigenous Implantable Technologies for Brain Signal Acquisition and Stimulation

Hardik J Pandya (PI)

Shabari Girishan

GOAL 1
Developing multi-contact miniaturised intracortical depth implant

GOAL 2
Designing and developing a micro-pillar-based multi-contact cortical array implant

TEAM 6 Molecular Nanotechnology-enabled Platforms

Sreetosh Goswami (PI)

Navakanta Bhat

GOAL 1
Development of platform with molecular neuromorphic accelerator integrating a 64x64 selector-less crossbar of Ru-complex memristors on a PCB, offering 14–bit analog precision

GOAL 2
Functional demonstration of advanced real-time processing by executing Fourier, wavelet, and cosine transforms with high energy and computational efficiency

GOAL 3
On-chip integration demonstrates a mixed signal SoC that integrates analog neurons, RRAM synapses, spike-based and high accuracy inference with ultra-low power in real time

Pratiksha Trust 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.

Here is the list of Pratiksha Trust YIs:

1. Sriram Ganapathy, Department of Electrical Engineering (2017-19)
2. Prasanta Kumar Ghosh, Department of Electrical Engineering (2017-19)
3. Sridharan Devarajan, Centre for Neuroscience (2017-19)
4. Chetan Singh Thakur, Department of Electronic Systems Engineering (2017-19)
5. Siddharth Barman, Department of Computer Science and Automation (2018-20)
6. Anirban Chakraborty, Department of Computational and Data Sciences (2018-20)
7. Anand Louis, Department of Computer Science and Automation (2019-21)
8. Sundeep Prabhakar Chepuri, Department of Electrical Communication Engineering (2019-21)
9. Arkaprava Basu, Department of Computer Science and Automation (2020-22)
10. Chirag Jain, Department of Computational and Data Sciences (2020-22)
11. Aditya Sadhanala, Centre for Nano Science and Engineering (2020-22)
12. Arindam Khan, Department of Computer Science and Automation (2021-23)
13. Shishir Kolathaya, Robert Bosch Centre for Cyber-Physical Systems and Department of Computer Science and Automation (2021-23)
16. Sreetosh Goswami, Centre for Nano Science and Engineering (2021-23)
14. Utsav Banerjee, Department of Electronic Systems Engineering (2022-24)
15. Gugan Thoppe, Department of Computer Science and Automation (2022-24)
17. Danish Pruthi, Department of Computational and Data Sciences (2023-25)
18. Debayan Das, Department of Electronic Systems Engineering (2023-25)
19. Vaanathi Sundaresan, Department of Computational and Data Sciences (2023-25)
20. Vini Gautam, Centre for Nano Science and Engineering (2023-25)

Danish Pruthi

BIOGRAPHY

Danish Pruthi is an Assistant Professor at the Indian Institute of Science (IISc), Bengaluru. He received his PhD from the School of Computer Science at Carnegie Mellon University. He is broadly interested in the areas of natural language processing and deep learning, with a focus towards inclusive development and evaluation of AI models. He completed his Bachelor's degree in Computer Science from BITS Pilani, Pilani. He is also a recipient of the Schmidt Sciences AI2050 Early Career Fellowship, Siebel Scholarship, the CMU Presidential Fellowship and industry awards from Google and Adobe Inc.

WEB PAGE

RESEARCH HIGHLIGHTS

As large language models find increasing use in everyday activities, it is crucial that their output is geo-culturally relevant and inclusive. In our research, we recently examined large language models for two common scenarios that require geographical knowledge: (a) travel recommendations and (b) geo-anchored story generation. Specifically, we studied five popular language models, and across about 100 K travel requests, and 200 K story generations, and observed that travel recommendations corresponding to poorer countries are less unique with fewer location references, and stories from these regions more often convey emotions of hardship and sadness compared to those from wealthier nations. Our work was published in the Findings of NAACL [1], a top conference in the field of natural language processing, and complements a large body of work that inspects language models for biases concerning gender and race. Given how large parts of publicly available text are crawled to pretrain large language models, data creators increasingly worry about the inclusion of their proprietary data for model training without attribution or licensing. Their concerns are also shared by benchmark curators whose test-sets might be compromised. In another recent work, we developed STAMP, a new technique to watermark datasets, enabling creators to examine whether their content was used for training language models. This work was recently accepted to ICML [2], a top machine learning conference.

Uniqueness Scores of Travel Recommendations

Reference:

1. Richer Output for Richer Countries: Uncovering Geographical Disparities in Generated Stories and Travel Recommendations. By Kirti Bhagat, Kinshuk Vasisht, Danish Pruthi.
2. Findings of the Annual Conference of the Nations of the Americas Chapter of the Association for Computational Linguistics (NAACL 2025) STAMP Your Content: Proving Dataset Membership via Watermarked Rephrasings. By Saksham Rastogi, Pratyush Maini, Danish Pruthi. International Conference on Machine Learning (ICML 2025)

Debayan Das

BIOGRAPHY

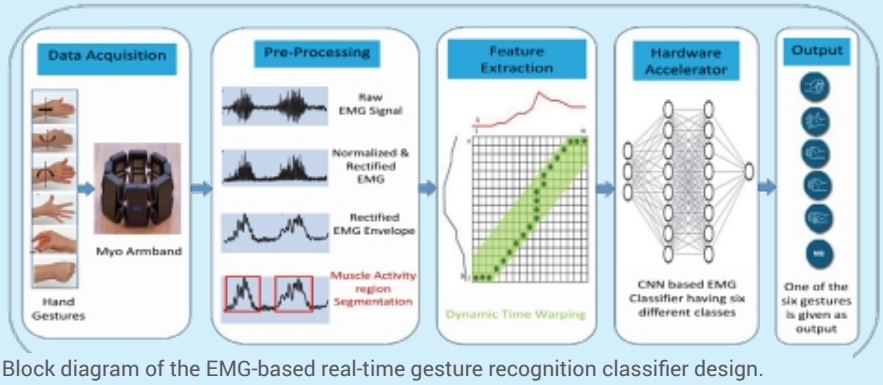
Debayan Das is an Assistant Professor with the Department of Electronic Systems Engineering (DESE) at the Indian Institute of Science, Bengaluru. He received his PhD and MS in Electrical and Computer Engineering from Purdue University, USA, in 2021 and his Bachelor of Electronics and Telecommunication 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 PhD, 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.

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 recognised as a Top Pick in Hardware and Embedded Security. He was recognised as the winner (third place) of the ACM ICCAD 2020 Student Research Competition (SRC). During his PhD, he was awarded the ECE Fellowship during 2016–2018, the Bilsland 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, and VLSI Design.

WEB PAGE

RESEARCH HIGHLIGHTS



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

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 focussed 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, 3], 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 utilised a combination of statistical correlational power analysis (CPA) along with linear discriminant analysis (LDA) to perform a machine-learning (ML) assisted SCA attack.

In the IEEE Design & Test paper [2] under review, we proposed a fully synthesisable low-overhead circuit-level countermeasure against power SCA attack on an FPGA. This work utilised 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 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 (Figure).

Some of my technical contributions over the last year include: (1) Currently serving as a Guest Editor for the IEEE Solid-State Circuit Letters (SSCL). (2) Currently serving 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, Bengaluru, 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' organised by IIT Roorkee in March 2025.

Reference:

1. Harshit Saurabh, Suparna Kundu, Samarth S T, Anupam Golder, KK Soundra Pandian, Chaoyun Li, Angshuman Karmakar, and Debayan Das. "Full Key Extraction of SNOW-V Using ML-assisted Power SCA." IEEE Design & Test (2024).
2. Samarth S T, Harshit Saurabh, and Debayan Das. "TYLOR: TDC-based Low-Overhead Synthesizable Power SCA Countermeasure on FPGAs." IEEE Design & Test (2024).
3. 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.

Gugan Chandrashekhar Mallika Thoppe

BIOGRAPHY

Gugan Chandrashekhar Mallika Thoppe is an Assistant Professor in the Computer Science and Automation department at the Indian Institute of Science since 2019. He is also an Associate Researcher at the Robert Bosh Centre, IIT Madras. He received his PhD in 2016 from the Tata Institute of Fundamental Research (TIFR), Mumbai. Following this, he completed postdoctoral research at two places: Technion Institute of Technology, Israel (2015–17) and Duke University, USA (2017–19). His research is supported by the CEFIPRA Indo-French grant, the Walmart CSR grant, DST-SERB's core research grant, and the Pratiksha Trust's Young Investigator award. He is also the winner of the IISc Award for Excellence in Teaching, the TIFR award for the best PhD thesis, and also part of ACM India's Eminent Speaker Panel. His research interests include reinforcement learning, federated learning, and stochastic approximation.

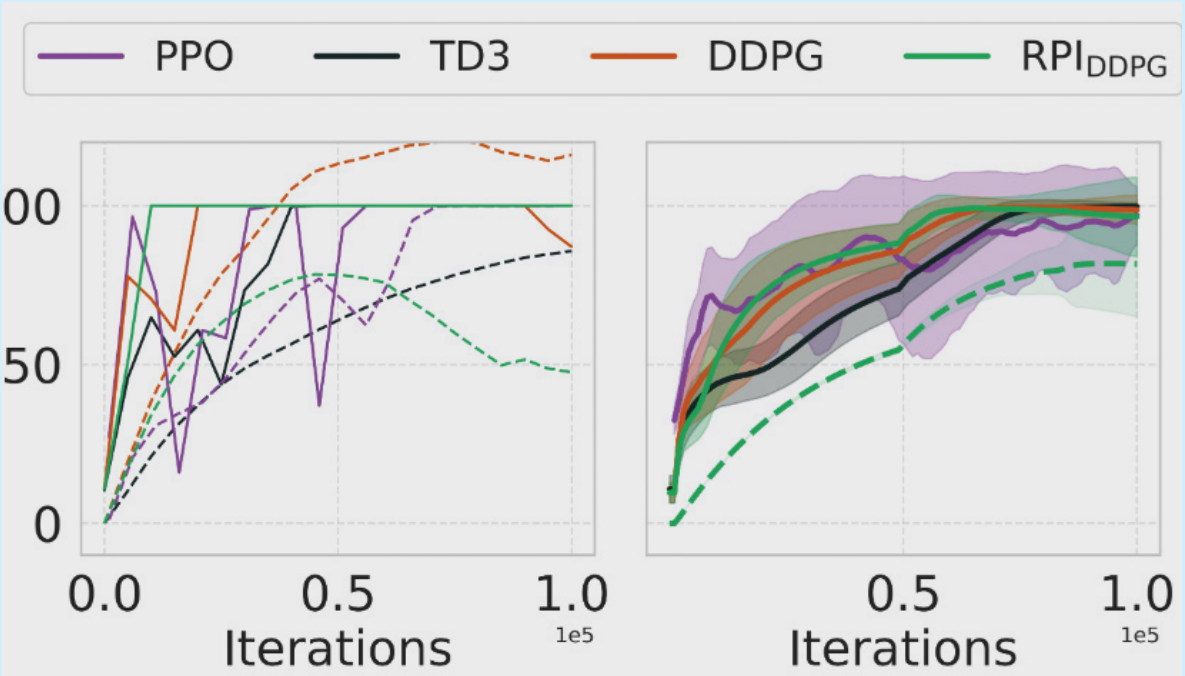
WEB PAGE

RESEARCH HIGHLIGHTS

Function approximation (FA) in reinforcement learning (RL) creates a fundamental challenge: while necessary for handling large state–action spaces, it has also led to unreliability in ensuring the obtained solutions reliably improve. The risk is most evident in policy iteration (PI), which alternates between a policy evaluation step (deciding how good a strategy is) and a policy update step (updating the current strategy). In the tabular (or no approximation) setting, PI provably guarantees that the strategies/policies monotonically improve and converge to the optimal one. With existing FA approaches, though, such guarantees collapse: a policy's value can no longer be represented exactly; so, they rely on to its projection or finding the closely related projected Bellman fixed point. This workaround also underlies popular deep-RL algorithms such as DQN and DDPG.

In a recent work, we show that DQN can in fact return a policy that performs worse than its initial one. We provide a theoretical explanation using linear DQN, a simplification that replaces neural networks with linear function approximation. Employing differential-inclusion analysis, we prove that linear DQN's limit points are precisely the fixed points of projected Bellman operators. Crucially, these fixed points can be highly sub-optimal, even the worst possible, explaining several of DQN's observed pathologies.

In a separate work, we eliminate this vulnerability by introducing reliable policy iteration (RPI). RPI replaces the standard mean-squared projection in policy evaluation with a Bellman-based constrained optimisation. We prove that RPI restores the classic PI properties under FA: its value estimates increase monotonically, lower-bound the true return, and converge to a limit that partially satisfies the unprojected Bellman equation. RPI is, to our knowledge, the first FA-based algorithm with monotonicity and convergence guarantees. For practical use, we develop a model-free version of RPI that serves as a drop-in critic (in the actor–critic paradigm) for algorithms such as DQN and DDPG. On standard control benchmarks, RPI-enhanced DQN and DDPG retain their lower-bound guarantee while matching or surpassing the performance of leading baselines.



Algo.	Timesteps to solve ($\times 10^3$) (Mean $\pm$ Std)	Lower Bound Holding (%) (Mean $\pm$ Std)
DDPG	11.2 ± 4.6	39.6 ± 6.4
TD3	29.5 ± 6.0	**99.6 + (- 1.6, 0.4)**
PPO	25.1 ± 7.9	78.4 ± 10.3
RPI$_{DDPG}$	**8.8 $\pm$ 2.0**	96.7 + (-6.1, 3.3)

Performance evaluation on Inverted Pendulum-v5 (solid: true [Monte Carlo], dashed: estimated). **Left**: Training curve of a representative run. With respect to the true values, RPI$_{DDPG}$ and TD3 estimates are mostly lower bounds, PPO estimates are almost accurate, DDPG mostly overestimates. **Center**: Cumulative performance over 25 runs. RPI$_{DDPG}$ performance is best among all, maintaining lower bound property. Right: Mean±std of time to first solve the environment, and percentage of time steps where lower-bound property holds. **Summary**: RPI$_{DDPG}$ outperforms all baselines methods with reliable lower bound guarantees.

Reference:

1. Gopalan, A. and Thoppe, G., 2022. Does DQN learn?. Conditionally accepted to the IEEE Transactions on Automatic Control.
2. Eshwar S. R., Thoppe, G., Gopalan, A., and Dalal, G., 2025. Reliable Critics: Monotonic Improvement and Convergence Guarantees in Reinforcement Learning. Under review.

Utsav Banerjee

BIOGRAPHY

Utsav Banerjee received his BTech degree in Electronics and Electrical Communication Engineering from IIT Kharagpur in 2013, and his SM and PhD degrees in Electrical Engineering and Computer Science from MIT in 2017 and 2021 respectively. He is currently an Assistant Professor in the Department of Electronic Systems Engineering at IISc. His research interests include cryptography, hardware security, emerging computing paradigms, digital circuits and embedded systems. He received the President of India Gold Medal from IIT Kharagpur in 2013, the Irwin and Joan Jacobs Presidential Fellowship from MIT in 2015, the Qualcomm Innovation Fellowship in 2016, the Pratiksha Trust Young Investigator award from IISc in 2022, the ABB Research Award in 2022, and the Intel Rising Star Faculty Award in 2023.

WEB PAGE

RESEARCH HIGHLIGHTS

Security and privacy of data communicated and processed by network-connected electronic devices has become a major concern, especially with the advent of the Internet of Things (IoT). Two important emerging research directions are post-quantum cryptography and privacy-preserving computation. At IISc, Utsav leads the Secure Intelligent and Efficient Systems (SINESys) Lab where he and his students are working towards efficient software implementations and hardware architectures for post-quantum cryptography and privacy-preserving computation. Here are some recent research highlights:

GLOBECOM 2023: Pairing-based inner product functional encryption provides an efficient theoretical construction for privacy-preserving edge computing secured by widely deployed elliptic curve cryptography. In this work, an efficient software implementation framework for pairing-based function-hiding inner product encryption (FHIPE) is presented using the recently proposed and widely adopted BLS12-381 pairing-friendly elliptic curve. Algorithmic optimisations provide 2.6x and 3.4x speedup in FHIPE encryption and decryption respectively, and extensive performance analysis is presented using a Raspberry Pi 4B edge device. The proposed optimisations enable this implementation framework to achieve performance and ciphertext size comparable to previous work despite being implemented on an edge device with a slower processor and supporting a curve at much higher security level with a larger prime field. Practical privacy-preserving edge computing applications such as encrypted biomedical sensor data classification and secure wireless fingerprint-based indoor localisation are also demonstrated using the proposed implementation framework.

ICASSP 2025: The number theoretic transform (NTT) is an indispensable tool for computing efficient polynomial multiplications in post-quantum lattice-based cryptography. It has strong resemblance with the fast fourier transform (FFT), which is the most widely used algorithm in digital signal processing. This work demonstrates a unified hardware accelerator supporting both 512-point complex FFT as well as 256-point NTT for the recently standardised NIST post-quantum key encapsulation and digital signature algorithms ML-KEM

and MLDSA respectively. The proposed architecture effectively utilises the arithmetic circuitry required for complex FFT, and the only additional circuits required are for modular reduction along with modifications in the control logic. The implementation achieves performance comparable to state-of-the-art ML-KEM/ ML-DSA NTT accelerators on FPGA, thus demonstrating how an FFT accelerator can be augmented to support NTT and the unified hardware can be used for both digital signal processing and post-quantum lattice-based cryptography applications.

CiC 2025: Plaintext-ciphertext matrix multiplication (PC-MM) is an indispensable tool in privacy-preserving computations such as secure machine learning and encrypted signal processing. While there are many established algorithms for plaintext–plaintext matrix multiplication, efficiently computing plaintext–ciphertext (and ciphertext–ciphertext) matrix multiplication is an active area of research which has received a lot of attention. Recent literature has explored various techniques for privacy-preserving matrix multiplication using fully homomorphic encryption (FHE) schemes with ciphertext packing and single instruction multiple data (SIMD) processing. On the other hand, there has not been any attempt to speed up PC-MM using unpacked additively homomorphic encryption (AHE) schemes beyond the schoolbook method and Strassen's algorithm for matrix multiplication. This work proposes an efficient PC-MM from unpacked AHE, which applies Cussen's compression–reconstruction algorithm for plaintext–plaintext matrix multiplication in the encrypted setting. The proposed technique is experimentally validated using a concrete instantiation with the additively homomorphic elliptic curve ElGamal encryption scheme and its software implementation on a Raspberry Pi 5 edge computing platform. The proposed approach achieves up to an order of magnitude speedup compared to state-of-the-art for large matrices with relatively small element bit-widths. Extensive measurement results demonstrate that the proposed fast PC-MM is an excellent candidate for efficient privacy-preserving computation even in resource-constrained environments.

Reference:

1. U. Banerjee, "Privacy-Preserving Edge Computing from Pairing-Based Inner Product Functional Encryption," IEEE Global Communications Conference (GLOBECOM), pp. 2184-2189, December 2023.
2. R. Shrivastava, C. P. Ratnala, D. M. Puli, U. Banerjee, "A Unified Hardware Accelerator for Number Theoretic Transform and Fast Fourier Transform," IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), pp. 1-5, April 2025.
3. K. S. T. Ramapragada, U. Banerjee, "Fast Plaintext-Ciphertext Matrix Multiplication from Additively Homomorphic Encryption," IACR Communications in Cryptology, vol. 2, no. 1, pp. 1-33, April 2025.

Vaanathi Sundaresan

BIOGRAPHY

Vaanathi Sundaresan is an Assistant Professor at the Department of Computational and Data Sciences (CDS), Indian Institute of Science (IISc), Bengaluru. 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.

WEB PAGE

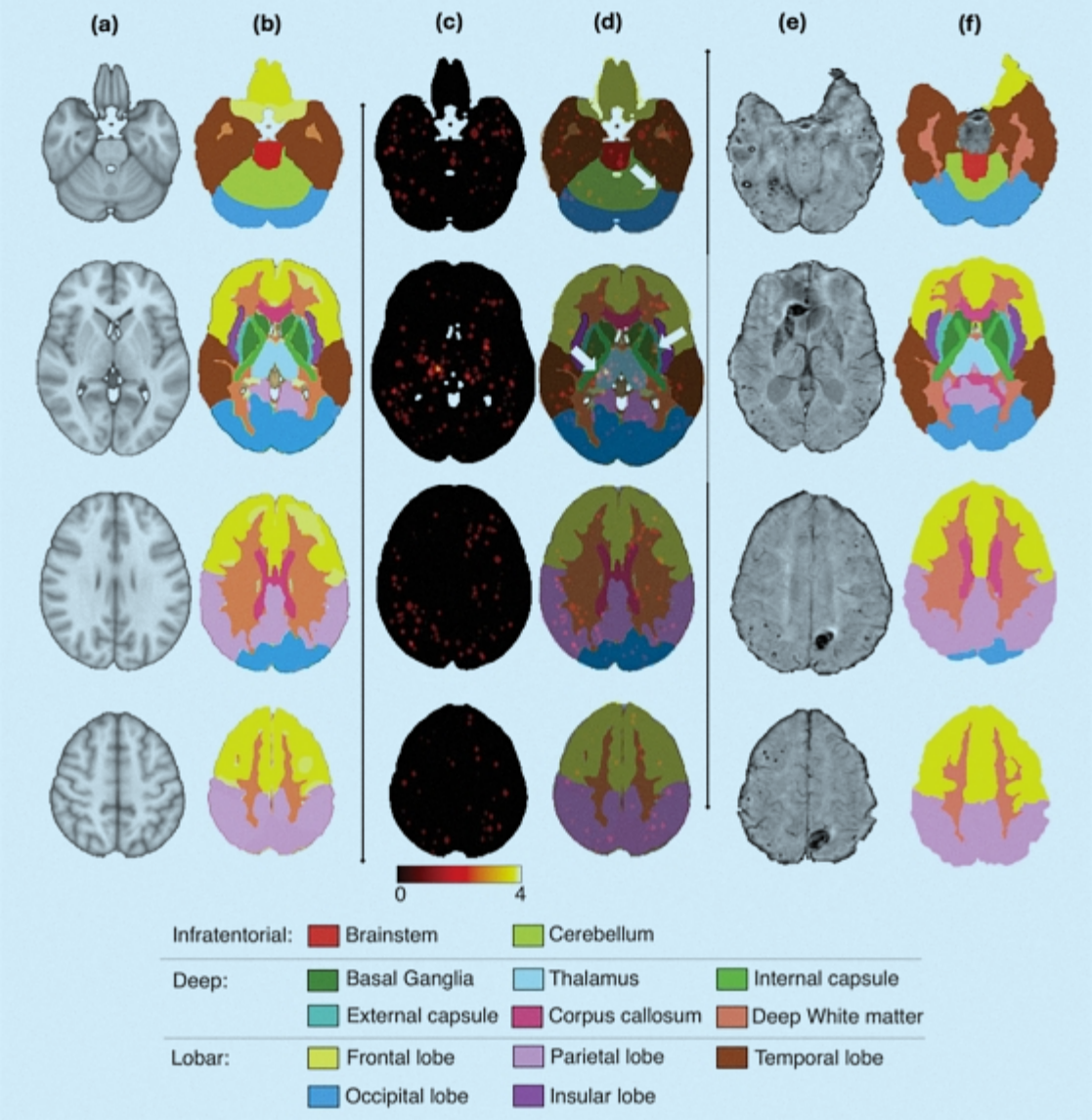
RESEARCH HIGHLIGHTS

Vascular cognitive impairment (VCI) accounts for ~40% of late-life dementia cases in India. This project aims to develop AI-based tools for automated segmentation of VCI-related neuroimaging biomarkers using semi-supervised methods requiring minimal manual annotation. It focusses on exploring voxel-level associations between imaging biomarkers and clinical or demographic data to improve differential diagnosis. The tools will support robust, privacy-preserving detection across diverse centers and modalities. Voxel-wise analysis will identify biomarker interactions and regional co-occurrence. Validation will be conducted using large, publicly available datasets to ensure accuracy across populations, sample sizes, and varying pathologies.

Our recent Medical Physics paper involves development of weakly-supervised and foundation model-based methods for detecting vascular biomarkers like lacunar infarcts on brain MRIs. These approaches reduce annotation effort and false positives, while radiomics-based vascular anomaly analysis aids in understanding lesion characteristics relevant to neurodegeneration in resource-constrained clinical settings.

In our MedLesSynth-LD paper, we performed synthetic lesion generation using physics-based noise models, improving model robustness in low-data settings. Additionally, we employed heterogeneous federated learning and filter-based model pruning to enhance domain adaptability and efficiency, enabling effective biomarker detection across varied imaging modalities and resource-limited environments.

In our recent work that was selected as Editor's pick in European Radiology Experimental, we initiated population-level analysis of cerebral microbleeds, examining their size and spatial distribution. Using heatmaps aligned with a standardised atlas, we identified region-specific patterns of vulnerability, laying the groundwork for understanding lesion burden and exploring associations with clinical and demographic factors in neurovascular disease.



Reference:Journals

1. Sundaresan, V., Lehman, J. F., Maffei, C., Haber, S. N., & Yendiki, A. (2025). Self-supervised segmentation and characterization of fiber bundles in anatomic tracing data. Imaging Neuroscience.
2. Ramananda S.H., Sundaresan, V*. "Label-efficient Sequential model-based Weakly supervised Intracranial Hemorrhage Segmentation in Low-data Non-Contrast CT imaging." Medical Physics 2025.
3. Sundaresan, V*, Zamboni G, Dineen R.A, Auer D.P., Sotiropoulos S.N, Sprigg N, Jenkinson M, and Griffanti L. "Automated characterisation of cerebral microbleeds using their size and spatial distribution on brain MRI." European radiology experimental 9, no. 1 (2025): 5. (Selected as Editor's pick in Feb 2025).
4. Narayanan, R, and Sundaresan, V*. "MedLesSynth-LD: Lesion synthesis using physics-based noise models for robust lesion segmentation in low-data medical imaging regimes." Pattern Recognition Letters 188 (2025): 155-163.

Reference - Book Chapters

1. Sundaresan, V.*, NK Dinsdale., Automated quality assessment using appearance - based simulations and hippocampus segmentation on low - field paediatric brain MR images. (2024). (Secured Top Rank in LISA Challenge in MICCAI 2024).

Reference - Conferences

1. Patra A*, Wu J, Sundaresan V, Wu H, Scordis P. Attentive latent replay for continual learning in pathology. International Symposium on Biomedical Imaging, 2025. ISBI 2025 (accepted, in press).
2. Dhamale V.S, Sundaresan V*. "Inter-class separability loss for weakly supervised mutually exclusive multiclass segmentation of brain tumor lesions", Medical Image Computing and Computer Assisted Intervention, 2025 (accepted, in press).

Vini Gautam

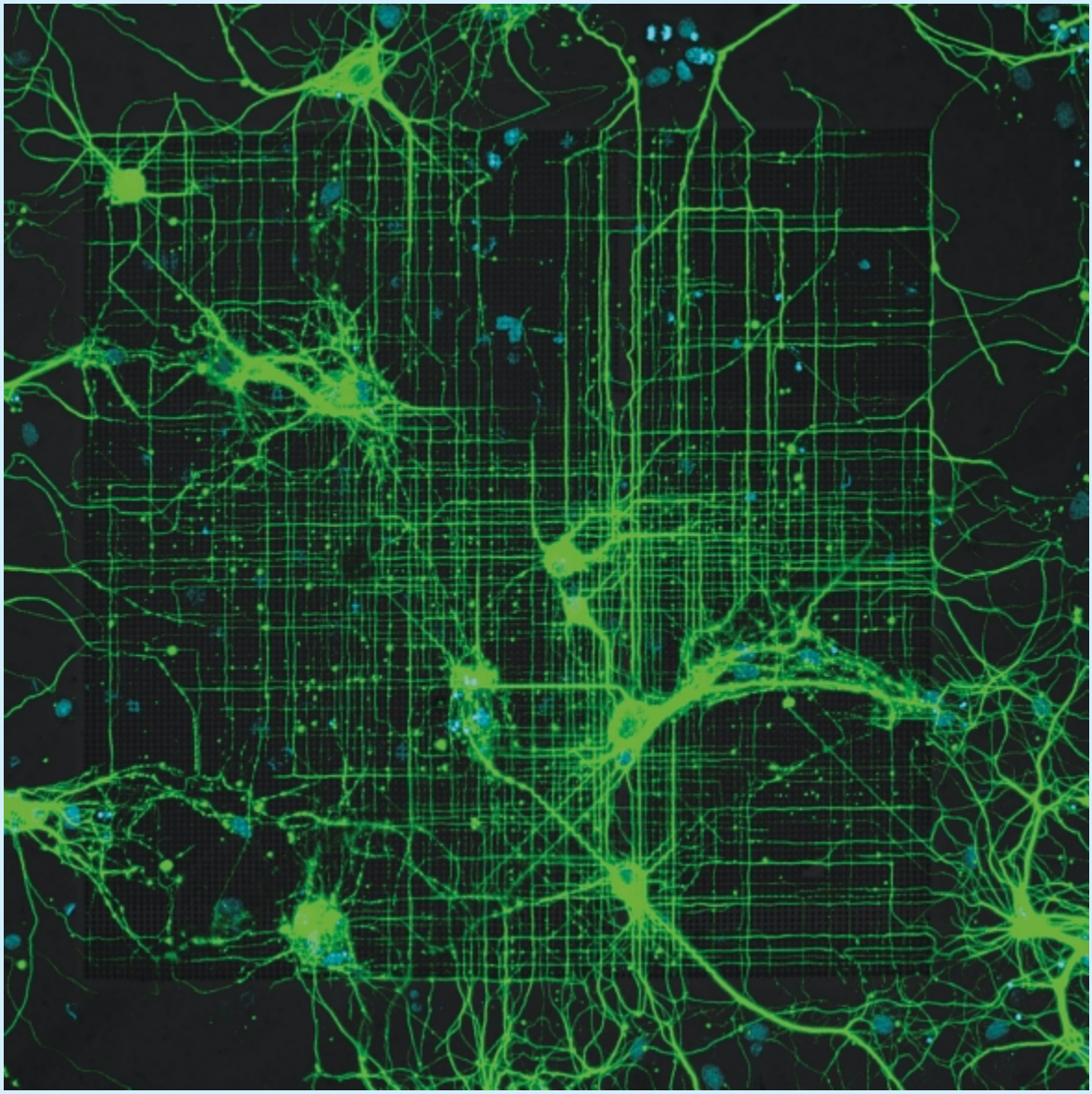
BIOGRAPHY

Vini Gautam is an Assistant Professor at the Centre for Nano Science and Engineering (CeNSE) at the Indian Institute of Science (IISc), Bengaluru, where she leads the NeuroElectronics Lab. Her research focusses on the intersection of materials science, electronics, and neurobiology, aiming to develop advanced neural interfaces and devices. Her recent work includes creating nano-scaffolds to study and engineer neural circuits, as well as developing photodetectors to stimulate blind retinal tissues. She completed her BSc in Physics from the University of Delhi in 2007, followed by an integrated MS–PhD in Materials Science from the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru, in 2014. Her doctoral research focussed on optoelectronic polymer devices for biomimicking visual responses and developing neuronal interfaces for artificial retina applications. She has held research and academic positions internationally, including as a DECRA Fellow at the Australian National University and as a Lecturer at the University of Melbourne. Her research has been supported by prestigious grants, including the Australian Research Council's Discovery Early Career Researcher Award (DECRA) and the Westpac Research Fellowship. Her contributions to science have been recognised with several awards, such as the ACT Young Tall Poppy Science Award in 2018 and being named among the 40 most influential Asian Australians in 2020.

WEB PAGE

RESEARCH HIGHLIGHTS

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 µm, 3 µm, 4 µm, 5 µm, and 10 µm. The micropillars are isotropically arranged as vertical arrays over 0.25 mm^2 (500 µmx500 µm) on the PDMS substrate. Simultaneously, PDMS base elastomer:curing agent ratio was modified to achieve micropillars of varying stiffness. The micropillars were fabricated using varying base elastomer and curing agent ratio - 5:1 PDMS, 10:1 PDMS, 20:1 PDMS and 50:1 PDMS where the 5:1 PDMS micropillars were the stiffest and 50:1 PDMS micropillars were the softest. Primary hippocampal neurons from post-natal rat pups were plated on the scaffolds and the neuronal growth characteristics on the scaffolds were analysed 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 µm (G2) and G = 3 µm (G3) features, irrespective of the W dimensions. With increasing G; e.g. G = 4 µm (G4) or G = 5 µm (G5), the neurites also exhibited growth at angles of 45°. At G = 10 µm (G10), the extent of alignment was gradually reduced to become completely random. The size of the cell nucleus was also observed to be different on scaffolds with nano topography compared to the flat controls. The studies were done on scaffolds with varying stiffness modulus and the same parameters were quantified in relation to both stiffness and topography. Our studies give an insight into how the combined effect of substrate stiffness and topography can be used to modulate functional neuronal networks in vitro.

Reference:
Manuscripts are currently under preparation.

Interdisciplinary PhD programme in Brain, Computation, and Data Science

CONVENER
Prasanta Kumar Ghosh

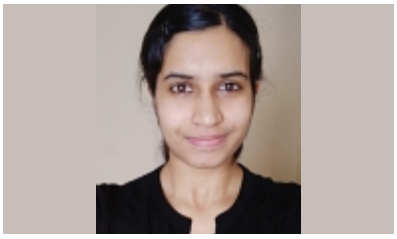
DCC CHAIR
Supratim Ray

The interactions among the faculty members involved in the Brain, Computation, and Data Science group led to the proposal for an inter-disciplinary 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 would be 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 Yadav

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 Bandyopadhyay

YEAR 2024–25

AD1 - Balaji Jayaprakash

AD2 - Rishikesh Narayanan

AD1 - Adviser 1 | AD2 - Adviser 2

Activities in 2024

Engagement with Chair Professors

Prof Barbara Shinn-Cunningham visited IISc from 12th–22nd June 2024

Prof Barbara Shinn-Cunningham participated in the Bengaluru Cognition Workshop (BCW2024) held from 15th–22nd June 2024, including presenting a talk on 17th June, attending other talks and mingling with attendees. A dinner meeting was held with Shri Kris Gopalakrishnan, Founder of the Pratiksha Trust and Brain, Computation, and Data Science Initiative, and other Distinguished Chair Professors supported by the Pratiksha Trust. Additionally, from 12th–21st June, she held various meetings to discuss about common research interests and potential connections to neuroscience researchers at Carnegie Mellon University with faculty and students from IISc, including Prof S P Arun, Prof Sridharan Devarajan, Prof Ashesh Dhawale, Prof Aditya Murthy, Prof Hardik Pandya, Prof Balaji Jayaprakash, and Prof Chandra Sekhar Seelamantula.

Prof Rajesh Rao visited IISc from 15th–21st June 2024

Prof Rajesh Rao attended and delivered a talk at the Sixth Bengaluru Cognition Workshop (BCW2024), held from 15th–21st June 2024. He met Prof Sridharan Devarajan and other PIs involved in the Pratiksha Trust moonshot project on brain co-processors, receiving progress updates and discussed next steps for the moonshot project. He explored US–India joint funding opportunities, focussing on the US grant agency AFOSR. He participated in a moonshot PI meeting alongside visiting researcher, Dr Sameer Sheth, Baylor College of Medicine. Prof Rao visited the labs of the Pratiksha grant PIs and engaged with students to grasp ongoing research. He visited the Centre for Brain Research (CBR), met the Director of CBR, Prof K V S Hari. He met the IISc Director Prof Rangarajan and discussed opportunities for research collaboration.

Visit to IISc from 6th–7th December 2024

Prof Rajesh Rao was involved in the progress updates of the Pratiksha Trust moonshot project on brain co-processors, and discussed the next steps for the moonshot project. He also met Dr Abhishek Singh, Chair of the Office of International Relations at IISc to discuss an MoU for research collaboration and exchange programme with the University of Washington.

Prof. Maneesh Sahani visited IISc from 17th–23rd June 2024

Prof Maneesh Sahani attended and spoke at the week-long Bangalore Cognition Workshop (BCW2024) held from 15th–22nd June 2024. Additionally, he held scientific meetings with faculty and students from IISc, including Prof S P Arun, Prof Sridharan Devarajan, Prof Ashesh Dhawale, and Prof Aditya Murthy. There was progress on plans for the exchange of students between IISc and the Gatsby Unit and Sainsbury Wellcome Center at UCL.

Visit to IISc from 16th–23rd December 2024

Prof Maneesh Sahani participated in scientific, advisory, and planning meetings with IISc scientists, including faculty involved in the Pratiksha Trust moonshot project. The discussions focussed on progress updates, strategic input, and planning for the next phase. He also held scientific discussions with IISc faculty and students, including Prof Narahari, Prof Sridharan Devarajan, Prof Ashesh Dhawale, and Prof Aditya Murthy. There was progress on plans for student exchange programs between IISc and both the Gatsby Unit and the Sainsbury Wellcome Centre at UCL. He also met Prof Hari at CBR to review the administrative progress on the Pratiksha EMSTAR Programme and discuss the upcoming first-year review.

6th Bangalore Cognition Workshop

The 6th Bangalore Cognition Workshop (BCW24) was organised in the Centre for Neuroscience, IISc, Bengaluru from 15th–21st June 2024. The workshop was organised into five modules: (1) Sensation and Neural Circuits, (2) Learning & Decision-making, (3) Emotion, Motivation, and Cognitive Control, (4) Motor Systems, and (5) Memory. The primary goal of the workshop was to promote systems, cognitive, and computational neuroscience in India by bringing together eminent cognitive scientists from the USA, Europe, and Australia. In addition, it was aimed at facilitating new collaborations and mutual exchange of students and ideas. The BCW24 foreign faculty speakers included the three current Pratiksha Chair Professors and two faculty from the CMU-IISc Brain Hub grant programme. The national speakers were from different IITs, IISERs, and a few faculty from various departments in IISc (CNS, MBU, and CBR). The participants of the workshop were advanced undergraduate and Master's level students from various science and engineering colleges all across India.

Each module of the workshop lasted 1 day, during which there were 5 lecture sessions of 75 minutes each, with plenty of interspersed breaks to give time for discussions. In addition, there were 5 lab visit sessions during the evenings on (1) Human Functional Neuroimaging (fMRI, EEG, etc.), (2) Primate Research Laboratory, (3) Centre for Brain Research, (4) Neural Circuits & Behaviour, and (5) Memory, where the students got a first-hand look at the cutting-edge research techniques and experiments used in neuro and cognitive sciences. In order to further promote cognitive neuroscience among the larger community, one of the foreign speakers, Prof Deanna Barch, was requested to give a public lecture in the Faculty Hall, IISc. This lecture, titled 'Mechanisms of Motivational Impairments in Psychosis and Depression', was open to the general public and was well-attended. The workshop was attended by 40 participants from colleges all over India, in addition to the student population at the Centre for Neuroscience and the IISc student community in general.

A survey conducted at the end of the workshop revealed that the 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 the tea and lunch breaks. Thus, the workshop successfully achieved its primary goal of promoting systems and cognitive neuroscience in India. Secondly, some scientific interactions between the Indian speakers, and between the Indian and foreign speakers (including the Pratiksha Chair Professors) have the potential to become long-term national and international collaborations. Finally, the organisers believed that the active participation of students from various disciplines and their interactions with Indian speakers in BCW24 would eventually increase the student enrollment in cognitive and computational neuroscience-related programmes in IISc and across the country.

Selection Procedure and Participants

To publicise the workshop, a workshop poster was e-mailed to over 300 colleges all over India. More than 200 applications were received from colleges across India, and the participants were selected based on their merit, statement of purpose, and geographic uniformity. A preference was given to students who were in their final year of Bachelor's or Master's education, as there is a greater chance of such students applying for PhD programmes in the area of cognitive science in the subsequent academic year. More importantly, affirmative action were taken to select students from different reserved categories. By doing so, some good prospective PhD students were identified, especially from the reserved categories. All selected students were Indian nationals and half of them were women.

List of BCW24 Speakers

INDIA

S. NO.	TITLE	NAME	AFFILIATION	E-MAIL
1	Prof	Nixon Abraham	IISER Pune	nabraham@iiserpune.ac.in
2	Prof	Srinivasa Chakravarthy	IIT Madras	schakra@ee.iitm.ac.in
3	Prof	Rashmi Gupta	IIT Bombay	r.gupta@iitb.ac.in
4	Prof	Shantala Hegde	NIMHANS	shegde@nimhans.ac.in
5	Prof	Raghav Rajan	IISER Pune	raghav@iiserpune.ac.in
6	Prof	Neeta Kanekar	IIT Bombay	nkanekar@iitb.ac.in
7	Prof	Laxmi Rao	NIMHANS	trlaxmi@nimhans.kar.nic.in
8	Prof	Suhita Nadkarni	IISER Pune	suhita@iiserpune.ac.in
9	Prof	Chinnakkarupann Adaikkan	CBR	chinna@cbr-iisc.ac.in
10	Prof	Rishikesh Narayanan	IISc	rishi@iisc.ac.in
11	Prof	Anupama Sathyamurthy	IISc	anupamasathy@iisc.ac.in
12	Prof	Arnab Barik	IISc	arnabbarik@iisc.ac.in
13	Prof	Balaji Jayaprakash	IISc	jbalaji@iisc.ac.in
14	Prof	Ashesh Dhawale	IISc	ashesh@iisc.ac.in
15	Prof	Aditya Murthy	IISc	adi@iisc.ac.in
16	Prof	Srikanth Padmala	IISc	spadmala@iisc.ac.in

List of BCW24 Speakers

USA/EUROPE/AUSTRALIA

S. NO.	TITLE	NAME	AFFILIATION	E-MAIL
1	Prof	Barbara Shinn-Cunningham (Pratiksha Chair Professor)	Carnegie Mellon University, USA	bgsc@andrew.cmu.edu
2	Prof	Thomas Albright	Salk Institute, USA	tom@salk.edu
3	Prof	Maneesh Sahani (Pratiksha Chair Professor)	University College London, England	maneesh@gatsby.ucl.ac.uk
4	Prof	Eric Yttri (CMU–IISc Brain Hub faculty)	Carnegie Mellon University, USA	eyttri@andrew.cmu.edu
5	Prof	Jesse Goldberg	Cornell University, USA	jesse.goldberg@cornell.edu
6	Prof	Todd Braver	Washington University in St Louis, USA	tbraver@wustl.edu
7	Prof	Deanna Barch	Washington University in St Louis, USA	dbarch@wustl.edu
8	Prof	Rajesh Rao (Pratiksha Chair Professor)	University of Washington, Seattle, USA	rao@cs.washington.edu
9	Prof	Douglas Weber (CMU–IISc Brain Hub faculty)	Carnegie Mellon University, USA	dougweber@cmu.edu
10	Prof	Lucy Palmer	University of Melbourne, Australia	lucy.palmer@florey.edu.au

Release of the BCD Moonshot Report on Brain Co-Processors

Release of the BCD Moonshot Report on Brain Co-Processors by itihaasa Research and Digital

The Brain, Computation, and Data Science (BCD) Initiative at the Indian Institute of Science (IISc) marked a significant milestone with the release of the report 'Brain Co-Processors: A Moonshot Neuroscience Project in India' by itihaasa Research and Digital. The report was launched in the presence of esteemed dignitaries including Prof Govindan Rangarajan, Director, IISc; Prof K V S Hari, Director, Centre for Brain Research (CBR), IISc; and Shri Kris Gopalakrishnan, Co-Founder of Infosys and Chairman of the IISc Council.

The BCD moonshot project envisions the development of brain co-processors - AI-based technologies, both invasive and non-invasive, aimed at restoring or augmenting brain functions such as memory, vision, attention, and motor control. These devices are designed to decode neural signals, process them using AI algorithms, and re-encode the information back into the brain or external systems, enabling functional restoration in individuals affected by neurological disorders.

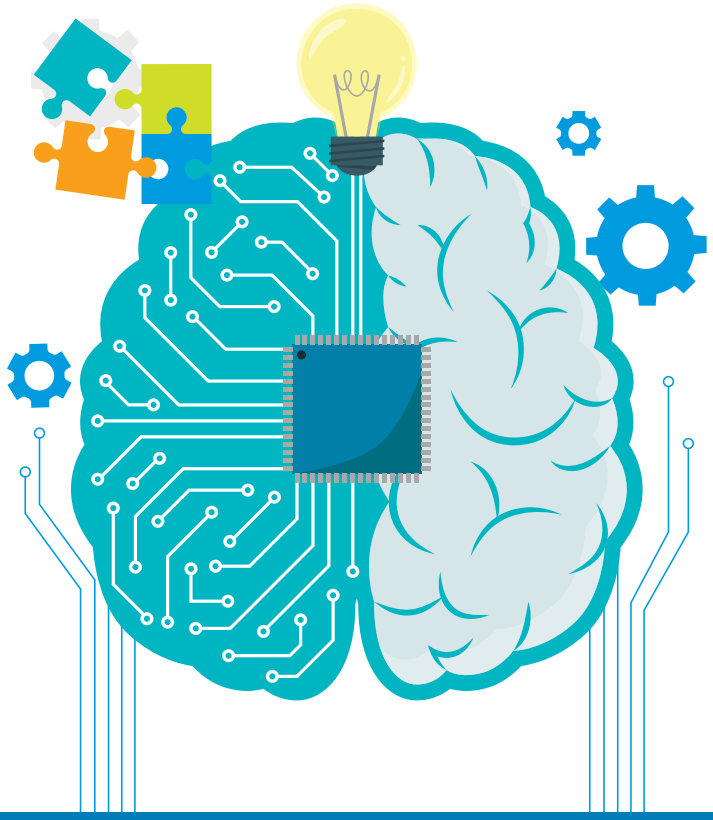
This long-term project, led by a multidisciplinary team of principal investigators from IISc, IIT Kanpur, and clinical partners such as Ramaiah Hospital, is structured into two major phases: 'MindReader' (focussed on decoding brain signals) and 'MindHacker' (focussed on re-encoding and intervention). A central goal is to develop technologies for stroke rehabilitation, especially targeting cognitive deficits – a largely unexplored space in global brain–computer interface research.

The presence of academic leadership and visionary philanthropists at the release underscores the national significance of this initiative. As highlighted by Shri Gopalakrishnan, such grand challenge projects can position India at the forefront of neuroscience innovation, bridging academia, healthcare, and industry in the quest for affordable, scalable neurotechnologies.

Activities Planned for 2025

The fifth edition of a workshop on Brain, Computation, and Learning (BCL5) will be held at the Indian Institute of Science (IISc), Bengaluru from 30 June–4 July 2025. There will be five 1-day modules, namely Vision (30 June), Motor and Cognition (1 July), Clinical (2 July), NeuroEngineering (3 July), and a new feature this year, NeuroTech (4 July), where startups and companies will showcase their products in this space.

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



Two PhD 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.

Visits of the three Chair Professors – Professors Rao, Sahani, and Shinn-Cunningham – to IISc to speak at BCL5 in June, and to engage in interactions with faculty and students in December.

Research Publications

Research Publications

2024

Prakash SS, Mayo JP and Ray S† (2024) Dissociation of attentional state and behavioral outcome using local field potentials. eNeuro. 11(11): ENEURO.0327-24.2024

Kanth and Ray S† (2024) Gamma responses to colored natural stimuli can be predicted from local low-level stimulus features. eNeuro. 11(7): ENEURO.0417-23.2024

Gulati D and Ray S† (2024) Auditory and visual gratings elicit distinct gamma responses. eNeuro. 11(4): ENEURO.0116-24.2024

Das A, Nandi N and Ray S† (2024) Alpha and SSVEP power outperforms Gamma power in capturing Attentional Modulation in Human EEG. Cerebral Cortex. 34(1), bhad412

Cherian T & Arun SP (2024) What do we see behind an occluder? Amodal completion of statistical properties in complex objects, Attention Perception and Psychophysics, 86:2721–2739

Thoppe, G., Prashanth, L. A., & Bhat, S. P. (2024). Risk Estimation in a Markov Cost Process: Lower and Upper Bounds. In International Conference on Machine Learning (pp. 48124-48138). PMLR

Eshwar, S. R., Felipe, L. L., Reiffers-Masson, A., Menasche, D. S., & Thoppe, G. (2024). Online Learning of Weakly Coupled MDP Policies for Load Balancing and Auto Scaling. In 2024 IFIP Networking Conference (IFIP Networking) (pp. 496-501). IEEE

Ganesh, S., Chen, J., Thoppe, G., & Aggarwal, V. (2024) Global Convergence Guarantees for Federated Policy Gradient Methods with Adversaries. Transactions on Machine Learning Research

Naskar, A., Thoppe, G., Koochakzadeh, A., & Gupta, V. (2024). Federated TD Learning in Heterogeneous Environments with Average Rewards: A Two-timescale Approach with Polyak-Ruppert Averaging. In IEEE 63rd Conference on Decision and Control (CDC) (pp. 387-393). IEEE

Eshwar, S. R., Motwani, M., Roy, N., & Thoppe, G. (2024) Reinforcement Learning with Quasi-Hyperbolic Discounting. In IEEE 63rd Conference on Decision and Control (CDC) (pp. 387-393). IEEE

Sengupta A, Banerjee S, Suhas G, Chandrasekaran AN & Sridharan D* (2024). The right posterior parietal cortex mediates spatial reorienting of attentional choice bias. Nature Communications, 15, 6938

Halder S, Raya DV & Sridharan D* (2024). Distinct neural bases of subcomponents of the attentional blink. eLife 13:RP97098

Chandrasekaran AN, Vermani A, Gupta P, Steinmetz N, Moore T & Sridharan D* (2024). Dissociable components of attention exhibit distinct neuronal signatures in primate visual cortex. Science Advances 10, eadi0645

Gupta P & Sridharan D* (2024). Presaccadic attention does not benefit the detection of changes in the visual field. PLOS Biology 22(1): e3002485

Harshit Saurabh, Suparna Kundu, Samarth S T, Anupam Golder, KK Soundra Pandian, Chaoyun Li, Angshuman Karmakar, and Debayan Das. "Full Key Extraction of SNOW-V Using ML-assisted Power SCA." IEEE Design & Test (2024)

Samarth S T, Harshit Saurabh, and Debayan Das. "TYLOR: TDC-based Low-Overhead Synthesizable Power SCA Countermeasure on FPGAs." IEEE Design & Test (2024)

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

Rastogi, S., Maini, P., & Pruthi, D. (2025). STAMP Your Content: Proving Dataset Membership via Watermarked Rephrasings. International Conference on Machine Learning (ICML 2025)

Bhagat, K., Vasisht, K. and Pruthi, D., 2024. Richer Output for Richer Countries: Uncovering Geographical Disparities in Generated Stories and Travel Recommendations. Findings of the Annual Conference of the Nations of the Americas Chapter of the Association for Computational Linguistics (NAACL 2025)

Gupta, T. and Pruthi, D., 2025. All that glitters is not novel: Plagiarism in AI Generated Research. Association for Computational Linguistics (ACL 2025)

2023

Sreebrata Goswami, R. Stanley Willaims and Sreetosh Goswami* (2023), Molecular Redox Computing Redux. Nature Materials, 2023. As the last and corresponding author.

Sruthi Gorantla, Anay Mehrotra, Amit Deshpande, Anand Louis (2023) “Sampling Individually Fair Rankings that are Always Group Fair.” AIES 2023 Sruthi Gorantla, Amit Deshpande, Anand Louis (2023) “Sampling Ex-Post Group-Fair Rankings.” IJCAI 2023

Sruthi Gorantla, Kishen N. Gowda, Amit Deshpande, Anand Louis (2023) “Socially Fair Center-Based and Linear Subspace Clustering.” ECML/PKDD 2023 Arindam Khan, Eklavya Sharma: (2023) Tight Approximation Algorithms for Geometric Bin Packing with Skewed Items. Algorithmica 85(9): 2735-2778 (2023)

Waldo Gálvez, Fabrizio Grandoni, Afrouz Jabal Ameli, Klaus Jansen, Arindam Khan, Malin Rau: (2023)

A Tight (3/2+ε)-Approximation for Skewed Strip Packing. Algorithmica 85(10): 3088-3109 (2023) Max A. Deppert, Klaus Jansen, Arindam Khan, Malin Rau, Malte Tutas: (2023)

Peak Demand Minimization via Sliced Strip Packing. Algorithmica 85(12): 3649-3679 (2023)

Siddharth Barman, Arindam Khan, Sudarshan Shyam,
K. V. N. Sreenivas: (2023) Finding Fair Allocations under Budget Constraints. AAAI 2023: 5481-5489
Siddharth Barman, Arindam Khan, Arnab Maiti, Ayush Sawarni: (2023) Fairness and Welfare Quantification for Regret in Multi-Armed Bandits. AAAI 2023: 6762-6769

Arindam Khan, Aditya Lonkar, Saladi Rahul, Aditya Subramanian, Andreas Wiese: (2023) Online and Dynamic Algorithms for Geometric Set Cover and Hitting Set. SoCG 2023: 46:1-46:17
Vishakha Patil, Vineet Nair, Ganesh Ghalme, Arindam Khan: (2023) Mitigating Disparity while Maximizing Reward: Tight Anytime Guarantee for Improving Bandits. IJCAI 2023: 4100-4108

Siddharth Barman, Arindam Khan, Sudarshan Shyam,
K. V. N. Sreenivas: (2023) Guaranteeing Envy-Freeness under Generalized Assignment Constraints. EC 2023: 242-269

Ghanshyam Chandra, Chirag Jain. (2023) “Sequence to graph alignment using gap-sensitive co- linear chaining” International Conference on Research in Computational Molecular Biology. (RECOMB) 2023 https://doi.org/10.1007/978-3-031-29119-7_4

Chirag Jain. (2023) “Coverage-preserving sparsification of overlap graphs for long-read assembly”Bioinformatics 2023. https://doi.org/10.1093/bioinformatics/btad124
U. Banerjee, (2023)“Privacy-Preserving Edge Computing from Pairing-Based Inner Product Functional Encryption,” IEEE Global Communications Conference (GLOBECOM), pp. 2185-2190, December 2023

Fraiman, N., Mukherjee, S. and Thoppe, G., (2023) "The Shadow Knows: Empirical Distributions of Minimum Spanning Acycles and Persistence Diagrams of Random Complexes”, Discrete Analysis, 2023:2, 1-18

Ganesh, S., Deb, R., Thoppe, G. and Budhiraja, A., (2023) "Does Momentum Help in Stochastic Optimization? A Sample Complexity Analysis”, Conference on Uncertainty in Artificial Intelligence, 2023, pp. 602-612, PMLR

Eshwar, S.R., Kolathaya, S. and Thoppe, G., (2023) "Improving sample efficiency in evolutionary RL using off-policy ranking”, EAI International Conference on Performance Evaluation Methodologies and Tools, pp. 33-50

Ganesh, S., Reiffers-Masson, A. and Thoppe, G., (2023) "Online Learning with Adversaries: A Differential-Inclusion Analysis", Conference on Decision and Control (CDC), 2023

Naskar A. and Thoppe, G., (2023) "Convergence of Momentum-based Distributed Stochastic Approximation with RL Applications," Indian Control Conference, 2023

A. Tripathi, R. R. Dani, A. Mishra, A. Chakraborty, (2023) "Multimodal query-guided object localization", Multimedia Tools and Applications (2023): 1-25

Krishnakumaran R and Ray S (2023) Temporal characteristics of gamma rhythm constrain properties of noise in an inhibition-stabilized network model. Cerebral Cortex. 33, 10108-21

Kanth and Ray S (2023) Gamma responses to colored natural stimuli can be predicted from local low-level stimulus features. bioRxiv https://doi. org/10.1101/ 2023.07.17.549318

P. Phillip, K. Jainwal, A. v. Schaik and C. S. Thakur, (2023) "Tau-cell-based Analog Silicon Retina with Spatio- Temporal Filtering and Contrast Gain Control," in IEEE Transactions on Biomedical Circuits and Systems, doi: 10.1109/ TBCAS.2023.3332117

R. M. Srivatsav, S. Chakrabartty and C. S. Thakur, (2023) "Neuromorphic Computing With Address- Event-Representation Using Time-to-Event Margin Propagation," in IEEE Journal on Emerging and Selected Topics in Circuits and Systems, vol. 13, no. 4, pp. 1114-1124, Dec. 2023, doi: 10.1109/ JETCAS.2023. 3328916

A. Krishna etal, (2023) "A Sparsity-driven tinyML Accelerator for Decoding Hand Kinematics in Brain-Computer Interfaces," 2023 IEEE Biomedical Circuits and Systems Conference (BioCAS), Toronto, ON, Canada, 2023, pp. 1-5, doi: 10.1109 / BioCAS58349.2023.1038 9094

Suman Chatterjee, Rathin K Joshi, Tushar Sakorikar, Bhagaban Behera, Nitu Bhaskar, Shabari Girishan K V, Mahesh Jayachandra, and Hardik J Pandya, (2023) "Design and fabrication of a microelectrode array for studying epileptiform discharges from rodents." Biomedical Microdevices, 25, 31 (2023). DOI: https:// doi.org/10.1007/ s10544-023-00672-0

Arjun B S, Varun Canamedi, Sharmila Sree Vandrangi, and Hardik J. Pandya, (2023) "Brain Biopsy Imaging using Electrical Impedance Tomography (BBI-EIT)." IEEE-EMBS International Conference on Biomedical and Health Informatics (BHI'23)), Pittsburgh, Pennsylvania, USA, October 15 – 18, 2023

Arjun B S, Ajay Krishnan A, and Hardik J. Pandya, (2023) "MRI-Compatible Patient-specific Continuum Robots using Parametric Modelling." IEEE-EMBS International

Conference on Body Sensor Networks: Sensor and Systems for Digital Health (IEEE BSN 2023), Boston, Massachusetts, USA, October 9 – 11, 2023. DOI: https://doi.org/10.1109/BSN58485.2023.10331197

Arjun B S, Ajay Krishnan A, and Hardik J. Pandya, (2023) "Soft-Robotic Probe for Tissue Characterization using TinyML." IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2023), Detroit, Michigan, USA, October 1 – 5, 2023

Suman Chatterjee, Rathin K. Joshi, Shabari Girishan K V, Hardik J. Pandya, (2023) "Flexible Microelectrode Array for Chronic Electrocorticography Recording under Different Neurophysiological Conditions." 11th International IEEE EMBS Conference on Neural Engineering (NER), April 25- 28, 2023, Baltimore, USA. DOI: https://doi.org/10.1109/NER52421.2023.10123820

A. Krishna, V. Ramanathan, S. S. Yadav, S. Shah, A. van Schaik, M. Mehendale, and C. S. Thakur, (2023) "A Sparsity- driven tinyML Accelerator for Decoding Hand Kinematics in Brain-Computer Interfaces," in IEEE BIOCAS 2023, Toronto, Canada, 2023

Adithya K., Shankaranarayanan H., Hitesh P. O., Anand C., A. van Schaik, M. Mehendale, C. S. Thakur., (2023) "TinyML Acoustic Classification using RAMAN Accelerator and Neuromorphic Cochlea," 2023 IEEE Asia Pacific Conference on Circuits and Systems (APCCAS), Hyderabad, India, 2023

2022

Liza K and Ray S (2022) Local interactions between steady- state visually evoked potentials at nearby flickering frequencies. Journal of Neuroscience. Accepted.

Ray S (2022) Spike-Gamma phase relationship in visual cortex. Annual Review of Vision Sciences. Accepted.

Murty DVPS and Ray S (2022) Stimulus-induced robust narrow-band gamma oscillations in human EEG using cartesian gratings. Bio-protocol. 12(7):e4379

Krishnakumaran R, Raees M, Ray S (2022) Shape analysis of gamma rhythm supports a superlinear inhibitory regime in an inhibition-stabilized network. PLoS Computational Biology. 18:e1009886

Kumar WS, Manikandan K, Murty DVPS, Ramesh RG, Purokayastha S, Javali M, Rao NP and Ray S (2022). Stimulus-induced narrowband gamma oscillations are test-retest reliable in healthy elderly

in human EEG. Cerebral Cortex Communications. Vol 3(1): tgab066

"Leveraging Persistent Memory from a GPU" Shweta Pandey, Aditya K. Kamath, Arkaprava Basu. In the proceedings of 27th International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS), February 2022

Kamath, Abijith Jagannath, and Chandra Sekhar Seelamantula. "Differentiate-and-Fire Time-Encoding of Finite-Rate-of-Innovation Signals." ICASSP 2022-2022 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP). IEEE, 2022.

Katti H & Arun SP (2022) A separable neural code in monkey IT enables perfect CAPTCHA decoding, Journal of Neurophysiology, 127: 869-884

Pramod RT & Arun SP (2022) Improving Machine Vision using Human Perceptual Representations: The Case of Planar Reflection Symmetry for Object Classification, IEEE Transactions in Pattern Analysis and Machine Intelligence, 44: 228-241

Somraj N, Kashi MS, Arun SP, Soundararajan R (2022) Understanding the perceived quality of video predictions, Signal Processing: Image Communication, 102:116626

N. Somraj, M. S. Kashi, S. P. Arun, and R. Soundararajan, "Understanding the Perceived Quality of Video Predictions,"Signal Processing: Image Communication, vol. 102, pp. 116626, Mar 2022

Arjun B. S., Alekya B, Hari R S, Vikas V, Anita Mahadevan, and Hardik J. Pandya, "Electromechanical Characterization of Human Brain Tissues: A Potential Biomarker for Tumor Delineation." IEEE TBME. Impact Factor: 4.538

Arjun B. S., Anil Vishnu G. K., Shilpa Rao, Manish Beniwal, and Hardik J. Pandya, "Electrical Phenotyping of Human Brain Tissues: An Automated System for Tumor Delineation." IEEE Access, 2022. Impact Factor: 3.367

Sreenivas Bhaskara, Tushar Sakorikar, Suman Chatterjee, Shabari Girishan K V, and Hardik J. Pandya*, "Recent Advancements in Micro-engineered Devices for Surface and Deep Brain Animal Studies: A Review.", Sensing and Bio-Sensing Research 36 (2022): 100483.
Impact Factor: 4.124

Arjun B. S., V S N Sitaramgupta V, Aswin S, Shilpa Rao and Hardik J. Pandya, "A System-based Approach for the Evaluation of Electromechanical Properties of Brain Tumors." 44th IEEE EMBC International Engineering in Medicine and Biology Conference, Glasgow, Scotland, July 11-15, 2022.

Santi Prasad Rath, Yi Suin, Navakanta Bhat, Sreebrata Goswami, R. Stanley Williams, & Sreetosh Goswami* (2022) Energy and Space Efficient Parallel Adder Using Molecular Memristors. Advanced Materials, 2022, 2206128. As the last and corresponding author.

Santi P. Rath, Damien Thompson, Sreebrata Goswami* and Sreetosh Goswami* (2022)"Many-body molecular interactions in a memristor", Advanced Materials, 2022, 2204551. As the last and corresponding author.

Chirag Jain, Daniel Gibney, Sharma Thankachan. (2022) "Co-linear chaining with overlaps and gap costs" International Conference on Research in Computational Molecular Biology (RECOMB) 2022. https://doi.org/10.1007/978-3-031-04749-7_15

Saurabh Kalikar, Chirag Jain, Vasimuddin Md, Sanchit Misra. (2022) "Accelerating minimap2 for long- read sequencing applications on modern CPUs" Nature Computational Science 2022. https://doi.org/10.1038/s43588-022-00201-8

F. Ahsan, U. Banerjee, (2022) "Embedded Software Implementation of Privacy Preserving Matrix Computation using Elliptic Curve Cryptography for IoT Applications," IEEE International Symposium on Advanced Networks and Telecommunication Systems (ANTS), pp. 353-358, December 2022

Murty DVPS, Manikandan K, Kumar WS, Ramesh RG, Purokayastha S, Nagendra B, Abhishek ML, Balakrishnan A, Javali M, Rao NP and Ray S (2021). Stimulus-induced Gamma rhythms are weaker in human elderly with Mild Cognitive Impairment and Alzheimer's Disease. eLife. 10:e61666 DOI: 10.7554/eLife.61666

Prakash SS, Das A, Kanth ST, Mayo JP, Ray S (2021) Decoding of attentional state using high-frequency local field potential is as accurate as using spikes. Cerebral Cortex. Vol 31(9): 4314-4328

Das A and Ray S (2021) Effect of cross-orientation normalization on different neural measures in macaque primary visual cortex. Cerebral Cortex Communications. Vol 2(1), Article tgab009.
"iGUARD: In-GPU Advanced Race Detection" Aditya K. Kamath, Arkaprava Basu. In the proceedings of 28th ACM Symposium on Operating Systems Principles (SOSP), October 2021

"Trident: Harnessing Architectural Resources for All Page Sizes in x86 Processors" Venkat Sai Ram, Ashish Panwar, Arkaprava Basu. In the proceedings of 54th IEEE/ACM International Symposium on Microarchitecture (MICRO), October 2021

"Faastlane: Accelerating Function-as-a-Service Workflows" Jaya Jyothiswaroop Kotni, Ajay Nayak, Vinod Ganapathy, Arkaprava Basu. In the proceedings of 2021

USENIX Annual Technical Conference (USENIX ATC), July 2021

"Improving GPU Multi-tenancy with Page Walk Stealing" Pratheek B., Neha Jawalkar, Arkaprava Basu. In the proceedings of 27th IEEE International Symposium on High-Performance Computer Architecture (HPCA), Seoul, South Korea, February 2021

"On the problem of underranking in group-fair ranking" Sruthi Gorantla, Amit Deshpande, and Anand Louis. International Conference on Machine Learning (ICML), 2021

"Matchings with group fairness constraints: Online and offine algorithms" Govind S. Sankar, Anand Louis, Meghana Nasre, and Prajakta Nimbhorkar. International Joint Conference on Artificial Intelligence (IJCAI), 2021

"Independent sets in semi-random hypergraphs" Yash Khanna, Anand Louis, and Rameesh Paul. Algorithms and Data Structures Symposium (WADS), 2021

Kamath, Abijith Jagannath, Sunil Rudresh, and Chandra Sekhar Seelamantula. "Time Encoding of Finite-Rate- of-Innovation Signals" arXiv preprint arXiv:2107.03344 (2021)

Jacob G, Pramod RT, Katti H & Arun SP (2021) Qualitative similarities and differences in visual object representations between brains and deep networks. Nature Communications, 12, 1872

U. Shreemali, A. Chakraborty, "Robust Gait Based Human Identification on Incomplete and Multi-view Sequences", Multimedia Tools and Applications (2021) 80(7): 10141-10166

2020

Aravind Illa, and Prasanta Kumar Ghosh. "Closed-set speaker conditioned acoustic-to-articulatory inversion using bi-directional long short term memory network." The Journal of the Acoustical Society of America Vol.147(2), EL171-EL176, 2020

Aravind Illa and P. K. Ghosh,"The impact of speaking rate on acoustic-to-articulatory inversion", Computer Speech & Language, Volume 59, pp.75-90, January 2020

Siddharth Barman and Sanath Kumar Krishnamurthy, "Approximation Algorithms for Maximin Fair Division", ACM Transactions on Economics and Computation (TEAC), 2020

S.A. Ajmera, H. Jain, M. Sundaresan, and D. Sridharan, "Decoding task-specific cognitive states with slow, directed functional networks in the human brain" eNeuro, 7 April, 2020

S. Rudresh, A. J. Kamath, and C. S. Seelamantula,"A time- based sampling framework for finite-rate-of-innovation signals," Proceedings of IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), May 4-8, 2020

A. Sravanti, N. Gaurav, C. Anirban, and R. Venkatesh Babu, "DeGAN : Data-enriching GAN for retrieving Representative Samples from a Trained Classifier", Conference of the American Association for Artificial Intelligence (AAAI) 2020

A. Tripathi, R. R. Dani, A. Mishra, A. Chakraborty, "Sketch- Guided Object Localization in Natural Images", European Conference on Computer Vision (ECCV), 2020

S. Aggarwal, J. N. Kundu, R. Venkatesh Babu, A. Chakraborty, "WAMDA: Weighted Alignment of Sources for Multi-source Domain Adaptation", British Machine Vision Conference (BMVC), 2020

S. Aggarwal, R. Venkatesh Babu, A. Chakraborty, "Text- based Person Search via Attribute-aided Matching", Winter Conference on Applications of Computer Vision (WACV), 2020

J. N. Kundu, S. Seth, R. M. Venkatesh, R. Mugalodi, R. Venkatesh Babu, A. Chakraborty, "Kinematic-Structure- Preserved Representation for Unsupervised 3D Human Pose Estimation", Conference of the American Association for Artificial Intelligence (AAAI), 2020

Siddharth Barman, Umang Bhaskar, and Nisarg Shah, "Settling the Price of Fairness for Indivisible Goods", Conference on Web and Internet Economics (WINE), 2020.

Siddharth Barman, Umang Bhaskar, Anand Krishna, and Ranjani Sundaram, "Tight Approximation Algorithms for p-Mean Welfare Under Subadditive Valuation", European Symposium on Algorithms (ESA), 2020

Siddharth Barman and Nidhi Rathi, "Fair Cake Division Under Monotone Likelihood Ratios", ACM Conference on Economics and Computation (EC), 2020

Siddharth Barman and Federico Echenique, "The Edgeworth Conjecture with Small Coalitions and Approximate Equilibria in Large Economies", ACM Conference on Economics and Computation (EC), 2020

Siddharth Barman and Ranjani Sundaram, "Uniform Welfare Guarantees Under Identical Subadditive Valuations", International Joint Conference on Artificial Intelligence (IJCAI), 2020

Siddharth Barman, Omar Fawzi, Suprovat Ghoshal, and Emirhan Gurpinar, "Tight Approximation Bounds for Maximum Multi-Coverage", Conference on Integer Programming and Combinatorial Optimization (IPCO), 2020

Arpita Biswas, Siddharth Barman, Amit Deshpande, and Amit Sharma "Inframarginality Audit of Group-Fairness", Symposium on Foundations of Responsible Computing (FORC), 2020

Navaneet, K. L., Ansu Mathew, Shashank Kashyap, Wei- Chih Hung, Varun Jampani, and R. Venkatesh Babu, "From image collections to point clouds with self- supervised shape and pose networks", In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition, pp. 1132-1140. 2020

G. Gurusamy, V. Sreenivasan, R.G. Ramesh, S. Purokayastha, M. Javali, N.P. Rao, and D. Sridharan, "Diffusion MRI-based structural connectivity robustly predicts "brain-age", NeurIPS Workshop on Medical Imaging (Med-NeurIPS), 2020

Anusuya, P. K., Aravind Illa, and Prasanta Kumar Ghosh"A Data-Driven Phoneme-Specific Analysis of Articulatory Importance", International Seminar on Speech Production (ISSP), 2020

Renuka Mannem, Himajyothi Rajamahendravarapu, Aravind Illa, Prasanta Kumar Ghosh, "peech rate estimation using representations learned from speech with convolutional neural network", SPCOM 2020

Siddharth Subramani, Achuth Rao M V, Divya Giridhar, Prasanna Suresh Hegde, Prasanta Kumar Ghosh,"Automatic Classification of Volumes of Water using Swallow Sounds from Cervical Auscultation", In Proc. IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), Barcelona, Spain, 2020

Abhayjeet Singh, Aravind Illa, Prasanta Kumar Ghosh, "A Comparative Study of Estimating Articulatory Movements from Phoneme Sequences and Acoustic Features", In Proc. IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), Barcelona, Spain, 2020

Aravind Illa and Prasanta Kumar Ghosh, "Complexity- Performance Trade-off In Acoustic-to-Articulatory Inversion", International Seminar on Speech Production (ISSP) 2020

2019

A. Krishna, S. Rudresh, V. Shaw, H. R. Sabbella, C. S. Seelamantula, and C. S. Thakur, "Unlimited dynamic range analog-to-digital conversion," arXiv:1911.09371, 2019

Gupta S, Kumar P, Paul T, van Schaik A, Ghosh A, Thakur C S, "Low Power, CMOS-MoS2 Memtransistor based Neuromorphic Hybrid Architecture for Wake- Up Systems", Scientific Reports (Nature Group), Vol.9, 15604, 2019

Achuth Rao MV and P. K. Ghosh, "Glottal Inverse Filtering Using Probabilistic Weighted Linear Prediction" IEEE/ ACM Transactions on Audio, Speech, and Language Processing 27.1 (2019): 114-124

Aravind Illa and Prasanta Kumar Ghosh. "The impact of speaking rate on acoustic-to-articulatory inversion", Computer Speech & Language, 2019

Sreenivasan V and Sridharan D, "Subcortical connectivity correlates selectively with attention's effects on spatial choice bias", Proceedings of the National Academy of Sciences USA, Vol.116 (39), pp.19711-19716, 2019

Sagar V, Sengupta R and Sridharan D*, "Dissociable sensitivity and bias mechanisms mediate behavioral effects of exogenous attention", Scientific Reports, Vol.9(1), 12657, 2019

Banerjee S, Grover S, Ganesh S and Sridharan D, "Sensory and decisional components of endogenous attention are dissociable", Journal of Neurophysiology, Vol.122(4), pp.1538-1554, 2019

Navaneet, K.L., Sarvadevabhatla, R.K., Shekhar, S., Babu, R.V. and Chakraborty, A., "Operator-in-the- Loop Deep Sequential Multi-camera Feature Fusion for Person Re-identification", IEEE Transactions on Information Forensics and Security, 2019

P. Agrawal and S. Ganapathy, "Modulation Filter Learning Using Deep Variational Networks for Robust Speech Recognition", IEEE Journal of Selected Topics in Signal Processing (J-STSP), Special Issue on Data Science: Machine Learning for Audio Signal Processing, April 2019

A.Soman,C.R.Madhavan,K. Sarkar,andS.Ganapathy, "An EEG Study On The Brain Representations in Language Learning", IOP Journal on Biomedical Physics and Engineering Express, Vol.5(2), pp.25-41, 2019

S. Ramoji and S. Ganapathy, "Supervised I-vector Modeling for Language and Accent Recognition", Elsevier Journal on Computer, Speech and Language, Oct. 2019

B. R. Pradhan, Y. Bethi, S. Narayanan, A. Chakraborty, and C.S. Thakur, "n-HAR: A Neuromorphic Event-Based Human Activity Recognition System Using Memory Surfaces", IEEE

International Symposium on Circuits and Systems (ISCAS), 2019

R. Sharma, S. Gupta, K. Kumar, P. Kumar, and C.S. Thakur, “Real-Time Image Segmentation Using Neuromorphic Pixel Array”, IEEE International Symposium on Circuits and Systems (ISCAS), 2019

S.Gupta, P. Kumar, K. Kumar, S. Chakraborty, and C.S. Thakur, “Low Power Neuromorphic Analog System based on Sub-Threshold Current Mode Circuits”, IEEE International Symposium on Circuits and Systems (ISCAS), 2019

A. Tripathi, M. Arabizadeh, S. Khandelwal, and C.S. Thakur, “Analog Neuromorphic System based on Multi Input Floating Gate MOS Neuron Model”, IEEE International Symposium on Circuits and Systems (ISCAS), 2019

Vidyadhar Upadhya and P.S. sastry, “Efficient Learning of Restricted Boltzmann Machines Using Covariance estimates”, Asian Conference on Machine Learning (ACML), Nagoya, Japan, 2019

B. N. Suhas, Deep Patel, Nithin Rao, Yamini Belur, Pradeep Reddy, Nalini Atchayaram, Ravi Yadav, Dipanjan Gope and P. K. Ghosh, “Comparison of Speech Tasks and Recording Devices for Voice Based Automatic Classification of Healthy Subjects and Patients with Amyotrophic Lateral Sclerosis”, Interspeech 2019, Graz, Austria

Manoj Kumar Ramanathi, Chiranjeevi Yarra and P. K. Ghosh, “ASR inspired syllable stress detection for pronunciation evaluation without using a supervised classifier and syllable level features”, Interspeech 2019, Graz, Austria

Abinay Reddy Naini, Achuth Rao MV and P. K. Ghosh, “Whisper to neutral mapping using cosine similarity maximization in i-vector space for speaker verification”, Interspeech 2019, Graz, Austria

Renuka Mannem, Jhansi Mallela, Aravind Illa and P. K. Ghosh, “Acoustic and articulatory feature based speech rate estimation using a convolutional dense neural network”, Interspeech 2019, Graz, Austria

Atreyee Saha, Chiranjeevi Yarra and P. K. Ghosh, “Low resource automatic intonation classification using gated recurrent unit (GRU) networks pre-trained with synthesized pitch patterns”, Interspeech 2019, Graz, Austria

Sweekar Sudhakara, Manoj Kumar Ramanathi, Chiranjeevi Yarra and P. K. Ghosh, “An improved goodness of pronunciation (GoP) measure for pronunciation evaluation with DNN-HMM system considering HMM transition probabilities”, Interspeech 2019, Graz, Austria

Aravind Illa and P. K. Ghosh, “An investigation on speaker specific articulatory synthesis with speaker independent articulatory inversion”,

Interspeech 2019, Graz, Austria

Chiranjeevi Yarra, Aparna Srinivasan, Sravani Gottimukkala and P. K. Ghosh, "SPIRE-fluent: A self-learning app for tutoring oral fluency to second language English learners", Interspeech 2019, Graz, Austria

Aravind Illa and P. K. Ghosh, "Representation learning using convolution neural network for acoustic- to-articulatory inversion", Proc. IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), Brighton, UK, pp. 5931-5935, 2019

Gokul Srinivasan, Aravind Illa and P. K. Ghosh, "A study on robustness of articulatory features for automatic speech recognition of neutral and whispered speech", Proc. IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), Brighton, UK, pp.5936-5940, 2019

C.A. Valliappan, Avinash Kumar, Renuka Mannem, Karthik Girija Ramesan, P. K. Ghosh, "An improved air tissue boundary segmentation technique for real time magnetic resonance imaging video using segnet", Proc. IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), Brighton, UK, pp.5921- 5925, 2019

Renuka Mannem and P. K. Ghosh, "Air-tissue boundary segmentation in real time magnetic resonance imaging video using a convolutional encoder-decoder network", Proc. IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP) , Brighton, UK, pp.5941-5945, 2019

Abinay Reddy Naini, Achuth Rao M V and P. K. Ghosh, "Formant-gaps features for speaker verification using whispered speech", Proc. IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), Brighton, UK, pp.6231-6235, 2019

Ajmera SA, Rajagopal S, Rehman R and Sridharan D, "Infra-slow brain dynamics as a marker for cognitive function and decline", Advances in Neural Information Processing Systems (NeurIPS), 2019

Kumar S, Sreenivasan V, Talukdar P, Pestilli, F and Sridharan D, "ReAl-LiFE: Accelerating the discovery of individualized brain connectomes on GPUs", AAAI Conference on Artificial Intelligence Proceedings, 33(01), pp.630-638, 2019

Eshwar Arunachaleswaran, Siddharth Barman, and Nidhi Rathi, "Fully Polynomial-Time Approximation Schemes for Fair Rent Division", ACM-SIAM Symposium on Discrete Algorithms (SODA), 2019

Eshwar Arunachaleswaran, Siddharth Barman, and Nidhi Rathi, "Fair Division with a Secretive Agent", AAAI Conference on

Artificial Intelligence, 2019

Siddharth Barman and Sanath Krishnamurthy, “On the Proximity of Markets with Integral Equilibria”, AAAI Conference on Artificial Intelligence, 2019

Siddharth Barman, Ganesh Ghalme, Shweta Jain, Pooja Kulkarni, and Shivika Narang,“Fair Division of Indivisible Goods Among Strategic Agents”, International Conference on Autonomous Agents and Multiagent Systems (Extended Abstract), 2019

Eshwar Arunachaleswaran, Siddharth Barman, Rachitesh Kumar, and Nidhi Rathi, “Fair and Efficient Cake Division with Connected Pieces”, Conference on Web and Internet Economics(WINE), 2019

K.L. Navaneet, P. Mandikal, M. Agarwal, and R.V. Babu, “CAPNet: Continuous approximation projection for 3D point cloud reconstruction using 2D supervision”, In Proceedings of the AAAI Conference on Artificial Intelligence (Vol. 33, pp. 8819-8826), 2019

K. Praveen, A. Gupta, A. Soman and S. Ganapathy “Second Language Transfer Learning in Humans and Machines Using Image Supervision”, IEEE ASRU, Dec. 2019

P. Agrawal and S. Ganapathy, “Unsupervised Raw Waveform Representation Learning for ASR”, INTERSPEECH, 2019

N. Sharma, S. Ganesh, S. Ganapathy and L. Holt, “Analyzing human reaction time for talker change detection”, ICASSP, 2019

P. Agrawal and S. Ganapathy, “Deep variational filter learning models for speech recognition”, ICASSP, 2019

A. Mishra, S. Shekhar, A. K. Singh, A. Chakraborty, “OCR-VQA: Visual Question Answering by Reading Text in Images”, International Conference on Document Analysis and Recognition (ICDAR), 2019

Pratiksha Trust

Brain, Computation, and
Data Science, IISc

pratiksha.sac@iisc.ac.in,
office.bcd@iisc.ac.in

www.brain-computation.iisc.ac.in