भारतीय विज्ञान संस्थान

Centre For Neuroscience
Indian Institute Of Science

Profile

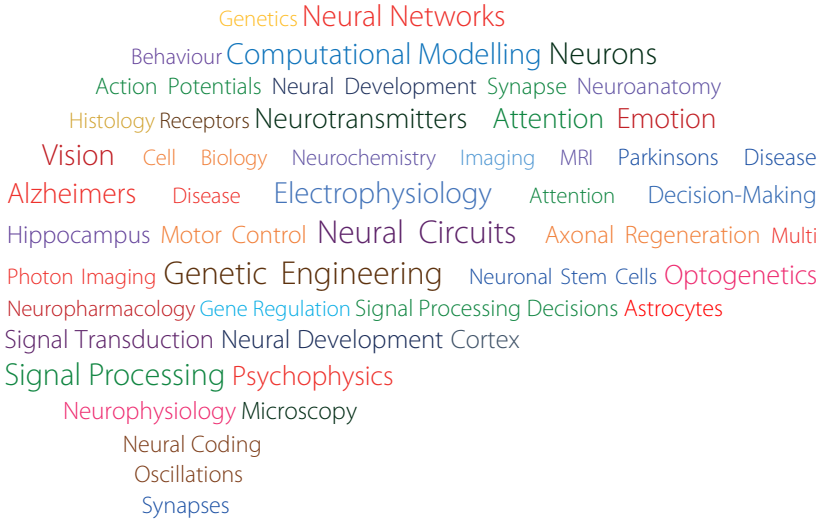
Contents

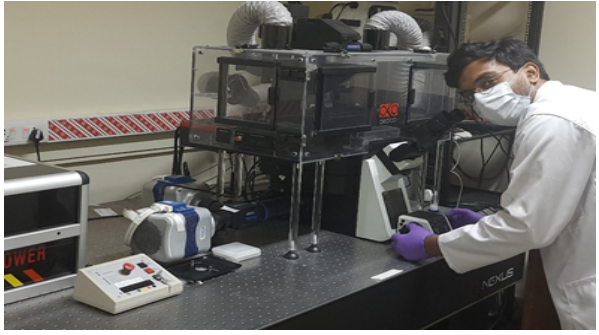
Overview

Understanding the brain is one of the great challenges in modern science. It is a prerequisite and a necessity if we are to diagnose, treat and cure brain disorders that now constitute a huge burden on modern society, including in developing countries.

The Centre for Neuroscience (CNS) was established in 2009 in the centenary year of IISc with the goal of pursuing research towards understanding the structure, function and development of the brain in health and disease. This requires studying the brain across different levels of organization using molecular, cellular, systems, behavioural and computational approaches. The diversity of these approaches is also reflected in the varied academic backgrounds of the faculty at CNS, many of whom have their undergraduate training in areas such as Engineering, Physics and Chemistry and Biology. We anticipate that such diversity is not only critical if we are to understand brain function but also provides a stimulating research environment for our students, who we anticipate, will imbibe the interdisciplinary ethos essential to neuroscience research.

In keeping with this vision, the primary faculty perform cutting edge investigator driven research at different scales using different approaches and model systems ranging from invertebrates such as C. elegans, to rodents, to non-human primates as well as human subjects and patients. In addition to investigator driven research, the faculty also leverage the expertise of researchers in other departments both within and beyond the institute to address highly complex problems and interdisciplinary questions in neuroscience that lie at the interface of clinical research, engineering and other areas of biology. In summary, the Centre is a relatively young initiative that is still in its growing years and has still many paths to traverse. One can certainly hope that with such a vibrant interdisciplinary and collaborative effort, research at the Centre for Neuroscience will contribute in a meaningful way to brain research in the years ahead.




Research Approaches

Transgenic and knockout mice and genome editing

In-vivo imaging of neural networks

Live cell imaging

Single molecule tracking using super-resolution microscopy

Nanoscale Organization and Regulation of Post-Synaptic Density

Animal cognition & behavior

Primate neurophysiology (single unit recordings, arrays, microstimulation, behaviour)

Human cognitive neuroscience (behaviour, fMRI, EEG, TMS, tDCS)

Equipment

Multi-photon microscope-based in-vivo imaging system with sub-cellular resolution

Two-photon microscope for live-cell imaging

Live-cell super-resolution imaging with PALM and STORM microscopes

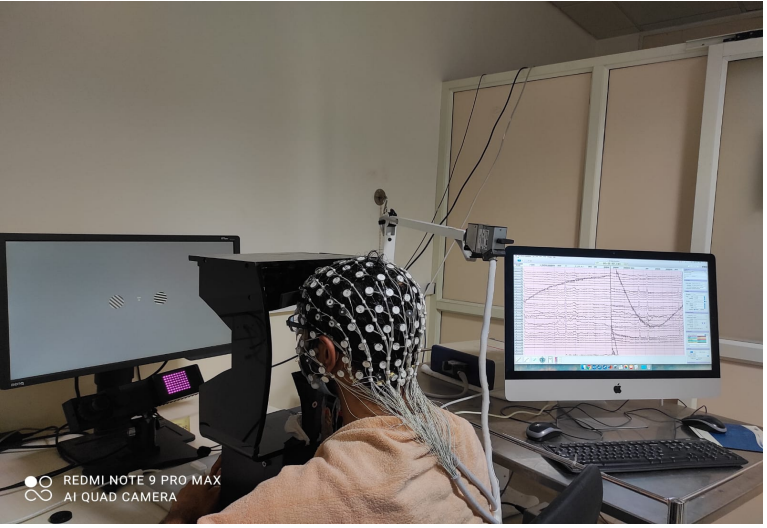
Inverted and upright Apotome and high-speed single-molecule imaging

Virus generation and purification facility

Small animal behavior monitoring and experimentation facility

Extracellular electrophysiology in awake behaving primates

fMRI compatible EEG and TMS



PhD Program At CNS

Students at CNS are exposed to cutting edge neuroscience research through the CNS faculty, whose interests span the gamut from molecular to systems and cognitive neuroscience. Research at CNS is highly interdisciplinary and reflects the diverse backgrounds of the faculty themselves. The department offers world class facilities and equipment together with a vibrant environment for research that consists of journal clubs and seminars. The department conducts national level and international level workshops regularly, where students get to interact with the best neuroscientists from India and abroad. As part of their PhD experience students are also given opportunities to travel to national and internal conferences to present their research.

The CNS PhD program is designed to provide a solid foundation of neuro-science to all students including those that do not have any prior background/experience in neuroscience. Incoming first year PhD students are not pre-assigned to an advisor but are instead asked to take the entire first semester to decide on the laboratory that they wish to join for their PhD. They are encouraged to talk to the faculty and students in each laboratory and also do a rotation in order to make an informed decision.

In addition, students take courses on molecular and systems neuro- science in the first semester and advanced readings and grant writing in the second semester, together with relevant courses offered by other departments.

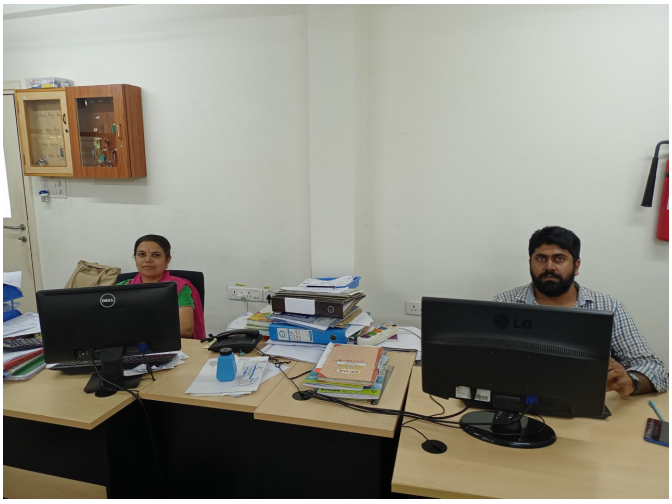
This approach helps them to understand and provides them an opportunity to carry out neuroscience research in the area that interests them the most. The students make the final choice of their thesis advisor/laboratory by the end of the first semester. During the second semester students are expected to choose one of two advanced neuroscience courses either in systems and cognitive neuroscience or in molecular and cellular neuroscience, where they get exposed to the latest research in the field through reading and discussion of relevant research papers, learn to make presentations and generate original ideas under the guidance of the course supervisors.

PhD students are required to take a total of 12 credits of coursework. Courses at IISc are rigorous and research oriented and emphasize understanding fundamentals rather than rote memory. At the end of their second year, PhD students are required to pass a comprehensive exam in which they are tested on their understanding of their course fundamentals as well as their research progress in the two years. They are also required to present their work on an annual basis in the form of a seminar.

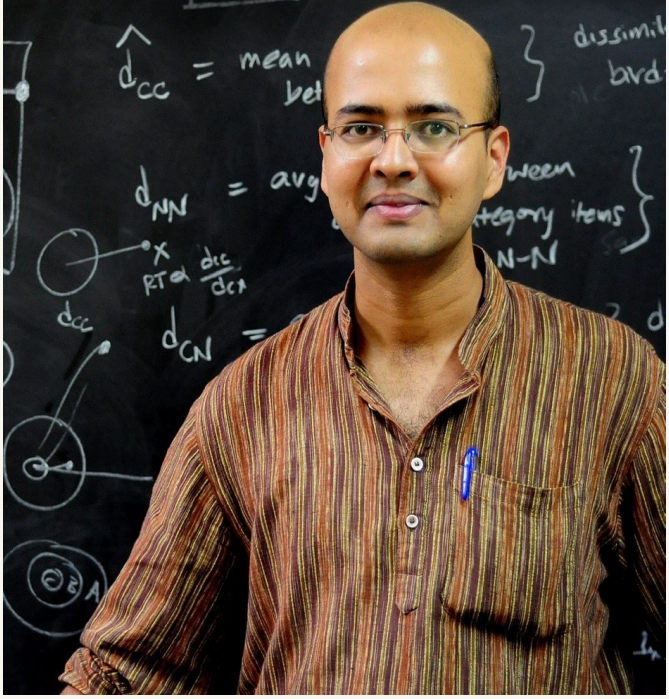
PhD students are provided with a monthly stipend (as per institute norms) and with accommodation in the student hostels at IISc. Campus life at IISc is extremely vibrant with a broad spectrum of cultural and sports activities.

For more details about the admissions process for both PhD and integrated PhD programmes please see

https://admissions.iisc.ac.in



Faculty Profiles



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Professor

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Selected Publications:

1. 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.

2. Agrawal A, Hari KVS & **Arun SP,** (2020), A compositional neural code in high-level visual cortex can explain jumbled word reading. ***eLife,*** 9:e54846.

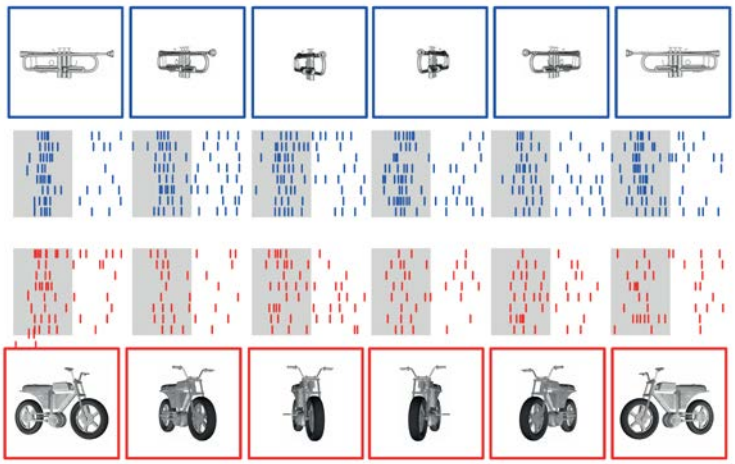
3. Agrawal A, Hari KVS & **Arun SP,** (2019), Reading Increases the Compositionality of Visual Word Representations, ***Psychological Science,*** 30:1707-23.

4. Ratan Murty NA & **Arun SP,** (2018), Multiplicative mixing of object identity and image attributes in single inferior temporal neurons. ***Proceedings of the National Academy of Sciences,*** 115:E3276-85.

5. Pramod RT & **Arun SP,** (2018), Symmetric objects become special in perception due to generic computations in neurons. ***Psychological Science,*** 29:95-109.

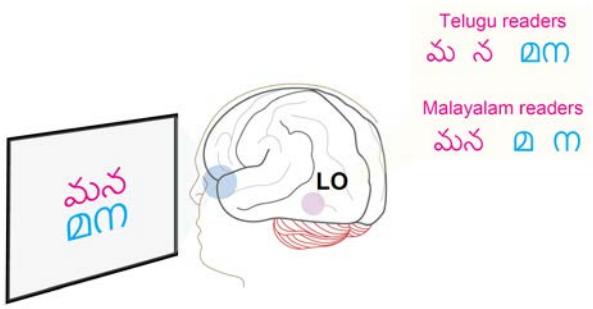
I received my B.Tech from the Indian Institute of Technology (Bombay), and MS and PhD from Johns Hopkins University, all in Electrical Engineering. I completed my postdoctoral research at Carnegie Mellon University and then joined IISc. I am fascinated by how the brain transforms sensory information into perception.

Object Recognition



Dynamics of 3D view invariance in a single IT neuron. *Responses of a single IT neuron are shown to a trumpet and a motorbike at multiple views. Each row represents a trial, and ticks represent the times of action potentials produced by the neuron. IT neurons show a gradual development of viewpoint invariance over response.*

From Ratan Murty & Arun (2015)



Reading expertise reduces adjacent letter interactions, making words more discriminable. *A Telugu reader looking at Telugu (magenta) and Malayalam (cyan) letter strings perceives Telugu letters as further apart, allowing for easier parsing. Likewise a Malayalam reader perceives Malayalam letters to be further apart. These changes in visual processing matched best with an object-selective region (LO) in the brain.*

From Agrawal, Hari & Arun, 2019

We recognize objects easily every day, but object recognition is in fact a very difficult problem. Even leading computer algorithms do not match human performance today. Object recognition is not easy for the brain either: a series of cortical areas, taking up ~40% of the brain, is dedicated to vision. But we know very little about the rules by which the brain transforms what we see into what we perceive. What is the nature of this representation? What are the underlying rules?

Approach

Our approach to this problem is best understood through an analogy to colour. We see millions of colours but it is well known that colour perception is three-dimensional. Any colour we perceive can be represented using three numbers. Can we do likewise for the millions of shapes we see? Do shapes also reside in a low-dimensional space?

To gain insight into these questions, we perform behavioural and imaging experiments in humans and record the electrical activity of neurons from monkey visual cortex.

In the human experiments, we probe the underlying perceptual representation using behavioural tasks such as visual search or categorization and investigate the underlying representation using fMRI and TMS. In the monkey experiments, we probe the representation at the level of single neurons in the inferotemporal cortex, an area critical for object recognition. We work with these diverse types of data to build, test and validate computational models of object recognition.

For more information

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I graduated with a PhD in developmental biology from the Institute of Molecular and Cell Biology (IMCB-A*STAR) that was part of The National University of Singapore. My PhD work was conducted in with Professor Bill Chia laboratory in Singapore and King's College, London. I then joined the laboratory of Professor Josh Kaplan as a postdoctoral fellow at the Department of Molecular Biology, Massachusetts General Hospital, Boston, USA. Upon completion of my postdoctoral training, I started my own laboratory as an Assistant Professor at Indian Institute of Science Education and Research (IISER), Mohali, India. In May 2019, I moved to the Centre for Neuroscience.

Selected Publications:

1. Pandey P*, Singh A*, Kaur H, Ghosh-Roy A and **Babu K** (2021). Increased dopaminergic neurotransmission results in ethanol dependent sedative behaviors in Caenorhabditis elegans. ***PLoS Genetics***, 17(2):e1009346.

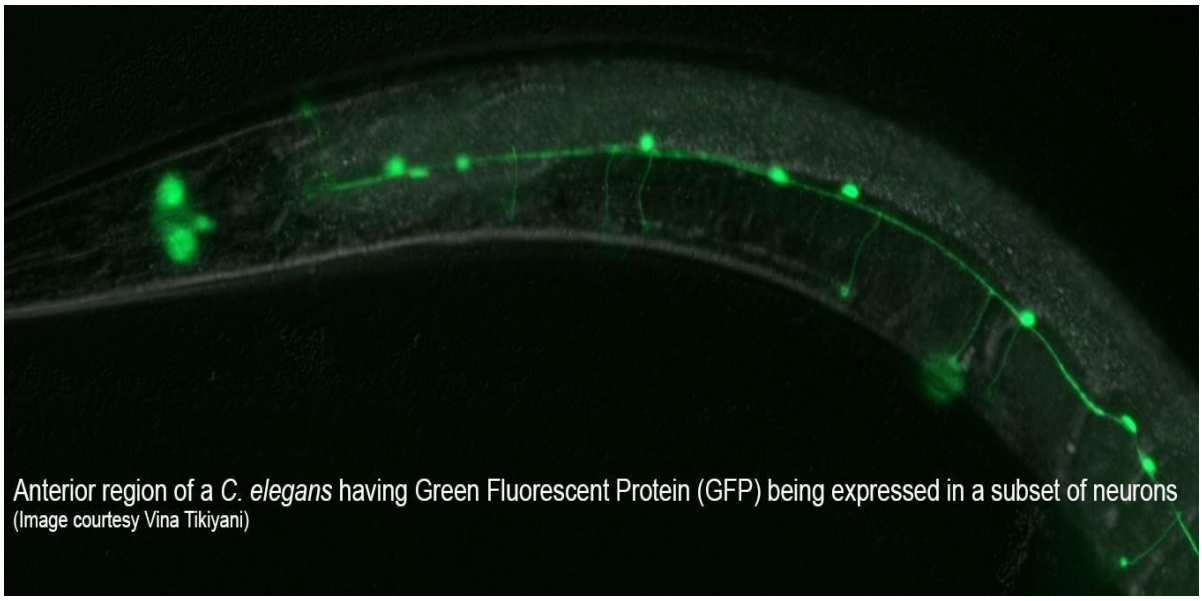
2. Dahiya Y, Rose S, Thapliyal S, Bhardwaj S, Prasad M and **Babu K** (2019); Differential regulation of innate and learned behavior by CREB1/CRH-1 in Caenorhabditis elegans. **The Journal of Neuroscience**, 39(40): 7934-46.

3. Tikiyani V, Li L, Sharma P, Liu H, Hu Z and **Babu K** (2018) Wnt is regulated by the tetraspan protein HIC-1 through its interaction with Neurabin/NAB-1. ***Cell Reports,*** 25(7): 1856-71.

4. Sharma P*, Li L*, Liu H, Tikiyani V, Hu Z© and **Babu K**© (2018)The Claudinlike protein, HPO-30, is required to maintain LAChRs at the Caenorhabditis elegans neuromuscular junction. ***Journal of Neuroscience,*** 38(32): 7072-87.

5. Bhardwaj A*, Thapliyal S*, Dahiya Y and **Babu K** (2018) FLP-18 functions through the G-protein coupled receptors NPR-1 and NPR-4 to modulate reversal length in Caenorhabditis elegans. ***Journal of Neuroscience,*** 38(20):4641-54.

Molecules And Mechanisms Underlying Synaptic Function



Anterior region of a *C. elegans* having Green Fluorescent Protein (GFP) being expressed in a subset of neurons
(Image courtesy Vina Tikiyani)

Unlike our brain that has billions of neurons and trillions of synapses, the free-living nematode *Caenorhabditis elegans* has 302 neurons and around 7000 synapses. Our laboratory is interested in understanding two fundamental questions in synaptic biology:

1. How do a class of tetra span protein called claudins function in neurons and synapses? To address this question we are looking at aspects of neuronal and synaptic development and function in claudin mutants and are looking at the expression pattern of claudins at the synapse. Our recent work has implicated two *C. elegans* claudins in maintaining normal levels of postsynaptic receptors at the neuromuscular junction.

2. We are also interested in understanding molecules and mechanisms underlying normal locomotory behavior in *C. elegans.* More specifically we want to find out how small peptides (neuropeptides) that are sent out by one neuron affect the same and/or neighboring neurons and how this action by neuropeptides and their receptors affects locomotion.

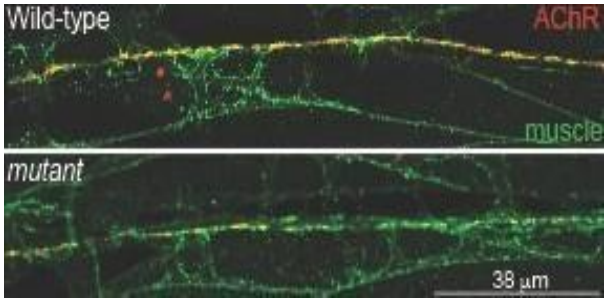


Image : Mutants in a claudin show a reduction in acetylcholine receptor levels (red) at the neuromuscular junction. The body-wall muscles are marked in green. Image from Sharma P., Lei L., et al; 2018 and image courtesy Pallavi Sharma.

Our laboratory uses genetics, imaging techniques including neuronal imaging, FRAP, optogenetic experiments, electrophysiological recordings and cell and molecular biology techniques including CRISPR-Cas9 and RNAi to better understand the molecular mechanisms underlying neuronal and synaptic function.

ARNAB BARIK

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I did my B.Tech in Biotechnology at SRM University, Chennai, and my PhD in Neuroscience with Dr Lin Mei at the Medical College of Georgia, Augusta. During my PhD, I worked on the cellular and molecular mechanisms of neuromuscular junction development and maintenance. Next, I wanted to explore another facet of the peripheral nervous system - somatosensation - specifically, what are the neural circuits underlying the sensation and perception of somatosensory information from the periphery. To pursue my interests in somatosensation, I moved to the National Institutes of Health to work in the laboratory of Dr Alexander Chesler. In my postdoctoral work, I identified a specific population of neurons in the parabrachial nucleus as being essential for generating affective responses to pain. In 2020 I joined the Center for Neuroscience as a principal investigator and plan to study the molecules, cells, and circuits that drive responses to pain and itch.

Selected Publications:

1. **Barik A**, Sathyamurthy A, Thompson J, Seltzer M, Levine A, and Chesler A, A spinoparabrachial circuit defined by Tacr1 expression drives pain. 2021. ***eLife,*** 10:e61135.

2. **Barik, A.,** & Chesler, A. T. (2020). Parallel Parabrachial Pathways Provide Pieces of the Pain Puzzle. ***Neuron,***106(6), 873-875.

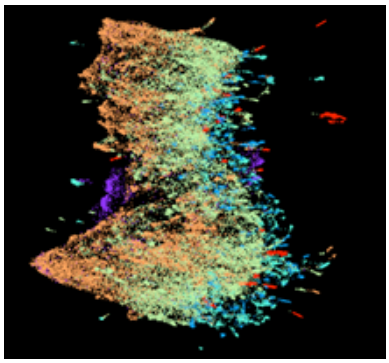
3. **Barik, A.,** Thompson, J. H., Seltzer, M., Ghitani, N., & Chesler, A. T. (2018). A brainstem-spinal circuit controlling nocifensive behavior. ***Neuron,*** 100(6), 1491-1503.

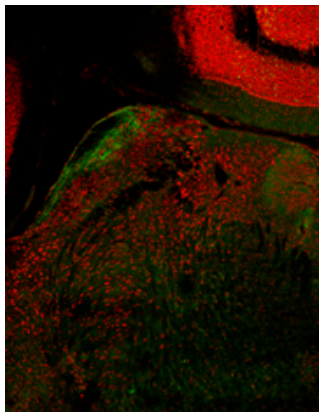
4. **Barik, A.,** & Krashes, M. J. (2018). Remembering a Bad Taste. ***Neuron,*** 100(4), 765-767.

5. Ghitani, N., **Barik, A.,** Szczot, M., Thompson, J. H., Li, C., Le Pichon, C. E., ... & Chesler, A. T. (2017). Specialized mechanosensory nociceptors mediating rapid responses to hair pull. ***Neuron,*** 95(4), 944-954.

6. **Barik, A.**, Li, L., Sathyamurthy, A., Xiong, W. C., & Mei, L. (2016). Schwann cells in neuromuscular junction formation and maintenance. ***Journal of Neuroscience,*** 36(38), 9770-9781.

Neurobiology of Pain and Itch





How does our brain direct defensive responses to noxious stimuli? Stepping barefoot on a pin could be excruciatingly painful and would evoke both a rapid physical reaction and an emotional response. We may rub our feet where it hurts, scream in pain, and move away from the spot to avoid re-stepping on the pin so as to avoid experiencing the pain a second time. We would also remember the spot on the floor where the pin was and avoid the area until we know there are no more pins lying around. In essence, all of our physical and mental faculties could be momentarily taken over by a relatively inconsequential event and produce long-lasting behavioural changes. In our laboratory, we seek to understand how specific groups of neurons in the brain are able to drive specific aspects of such defensive behaviours.

How do these neurons receive the pain information? What are their molecular characteristics? What is their anatomical architecture? How do these neurons communicate with the rest of the nervous system? We intend to answer these questions by leveraging molecular and optogenetic tools to manipulate behaviour, map circuits, and record neural activity in mice.

How are the maladaptive mechanisms underlying chronic pain and itch ? Pain and itch are fundamentally protective in nature. However, these useful protective mechanisms can become a burden when they become chronic or outlast the stimulus. When and where these otherwise beneficial mechanisms become pathological remain poorly understood. In our laboratory, we study how these conditions might be linked to alterations in specific brain areas in terms of their connectivity, molecular composition, and activity.

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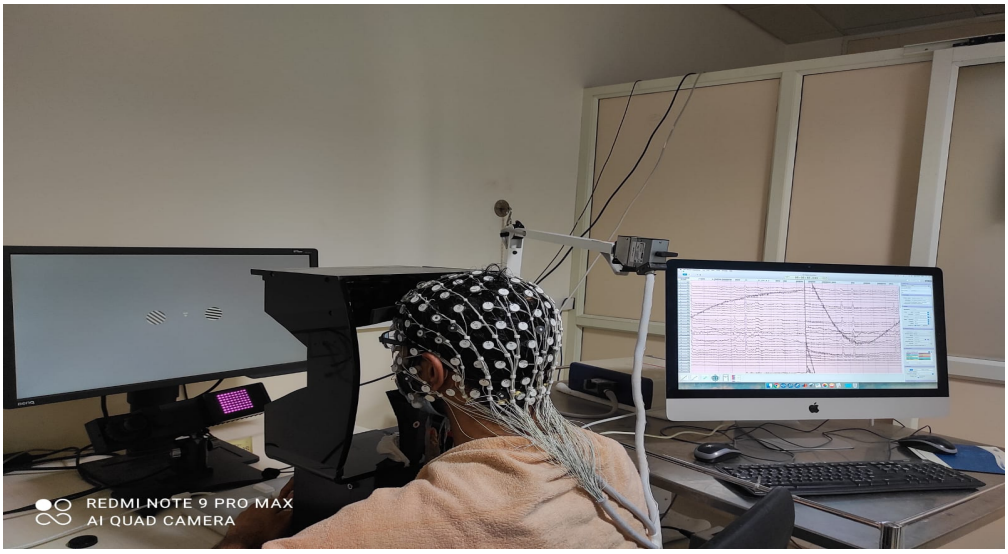
I obtained my Bachelors and Masters (Dual) engineering degrees from the Indian Institute of Technology (IIT) Madras. As a Smith Graduate Fellow at Stanford University, I studied the dynamics of attention-related brain networks using functional neuroimaging. I completed my PhD investigating the role of the midbrain in selective attention, with a combination of in-vivo and in-vitro electrophysiology (with Prof. Eric Knudsen) and neuromorphic modeling (with Prof. Kwabena Boahen). As a Dean's Postdoctoral Fellow at Stanford, I developed neurobehavioral models for attention and decision-making.

As an Associate Professor and Wellcome Trust DBT India Alliance Fellow, I lead the Cognition Lab at the Centre for Neuroscience at IISc, Our lab studies the brain basis of attention and decision-making behaviors with a focus on neural computations underlying cognition.



Selected Publications:

1. Jagatap A, Purokayastha S, Jain H and **Sridharan D** (2021). Neurally-constrained modeling of human gaze strategies in a change blindness task. ***PLoS Computational Biology***, (in press).

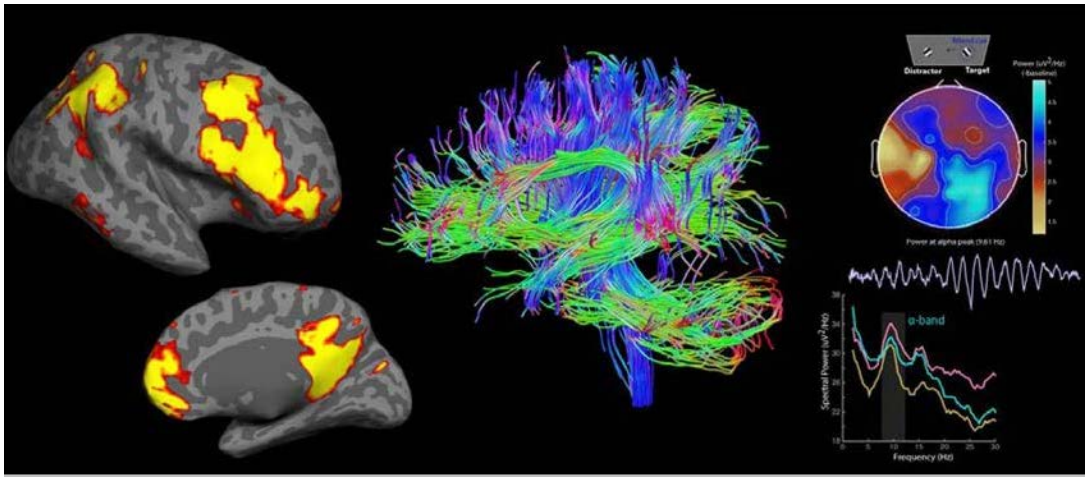
2. Ajmera S, Jain H, Sundaresan M and **Sridharan D** (2020). Decoding task-specific cognitive states with slow, directed functional networks in the human brain. ***eNeuro,*** 7(4) ENEURO.0512-19.2019.

3. Ajmera S, Rajagopal S, Rehman R and **Sridharan D** (2019). Infra-slow brain dynamics as a marker for cognitive function and decline. In proceedings of the ***35th Annual Conference on Neural Information Processing Systems (NeurIPS)***.

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

5. Kumar S, Sreenivasan V, Talukdar P, Pestilli, F, **Sridharan D** (2019) ReAl-LiFE: Accelerating the discovery of individualized brain connectomes on GPUs. In proceedings of the ***33rd AAAI Conference on Artificial Intelligence.***33:630-638.

Neural Computations Underlying Cognition



Goals:

- Investigating how brain networks interact during attention and decision-making with neuroimaging.
- Identifying differences in connectivity between healthy and diseased brains with diffusion imaging.
- Identifying the causal role of brain regions in cognition with transcranial neurostimulation.
- Linking brain and behaviour with theoretical and computational models.

How does our brain enable us to pay attention selectively to certain important objects in the world, and to ignore other, irrelevant ones? What happens in the brain when we make important decisions? Our research focuses on understanding the neural basis of cognitive phenomena such as perception, selective attention and decision-making. We seek to identify key mechanisms by which specific brain regions and neural oscillations contribute to these phenomena in humans. In order to accomplish this goal, we pursue a highly inter disciplinary approach.

First, we measure and analyze brain activity as subjects perform attention-demanding tasks involving complex decisions. For this, we employ state-of-the-art techniques such as functional magnetic resonance imaging (fMRI), electrophysiology (EEG) and machine-learning. Second, we quantify and visualize structural and functional connectivity in the brain using emerging techniques such as diffusion MRI and Granger causality.

These techniques also help us identify abnormalities in connectivity patterns in patients with cognitive disorders. Third, we investigate how specific brain regions contribute to attention and decision-making using non-invasive neuro-stimulation techniques, such as transcranial electrical and magnetic stimulation, (tES/ tMS). Finally, we seek to simultaneously perturb and record neural activity in the brain with combinations of brain stimulation and recording technologies such as interleaved fMRI-tMS and simultaneous EEG-tES.

A second, emerging area of research in the lab involves applying artificial intelligence (AI) algorithms, including deep learning, for understanding brain mechanisms of attention, in healthy individuals, and its decline, in neurodegenerative disorders.

A strategic combination of these techniques, along with quantitative analysis of behavior, has the potential to significantly advance our understanding of how cognitive phenomena emerge in the human brain and how they shape behavior.

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I received my undergraduate training in Life Sciences and Biochemistry at St. Xavier's College in Mumbai. My doctoral research was on sensory coding in the olfactory bulb and hippocampus, supervised by Dr. Upinder Bhalla at the National Centre for Biological Sciences in Bangalore. During my PhD, I also collaborated closely with Dr. Dinu Albeanu at Cold Spring Harbor Laboratory in New York to develop optogenetic approaches to study olfactory circuits. During my postdoctoral training with Dr. Bence Ölveczky at Harvard University, supported by Life Sciences Research Foundation and Charles A. King Trust fellowships, I developed new experimental platforms to study how the brain learns and executes skilled movements.

Selected Publications:

1. **Dhawale A.K.,** Wolff S.B.E., Ko R., Ölveczky B.P. (2021). The basal ganglia control the detailed kinematics of learned motor skills. ***Nature Neuroscience,*** 24, 1256–1269.

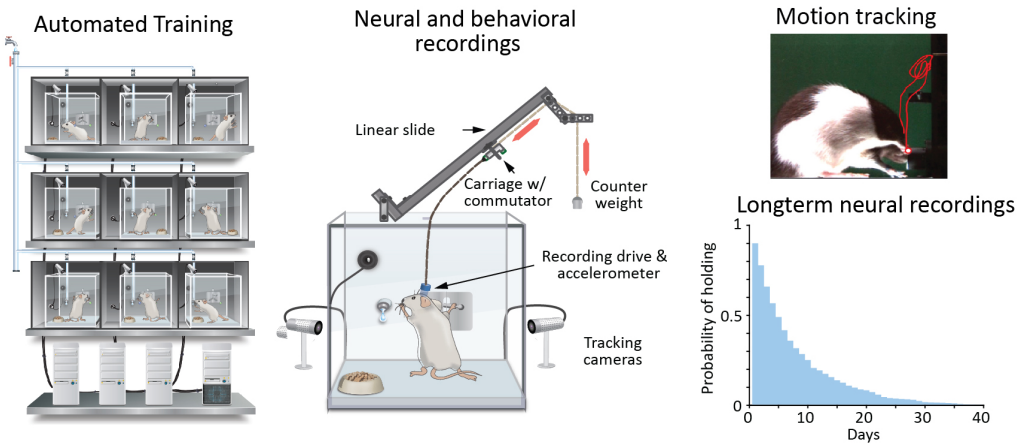
2. **Dhawale, A.** K., Miyamoto, Y. R., Smith, M. A., & Ölveczky, B. P. (2019). Adaptive regulation of motor variability. ***Current Biology,*** 29(21), 3551-3562.

3. **Dhawale, A.** K., Poddar, R., Wolff, S. B., Normand, V. A., Kopelowitz, E., & Ölveczky, B. P. (2017). Automated long-term recording and analysis of neural activity in behaving animals. ***Elife,*** 6, e27702.

4. Modi, M. N., **Dhawale, A.** K., & Bhalla, U. S. (2014). CA1 cell activity sequences emerge after reorganization of network correlation structure during associative learning. ***Elife,*** 3, e01982.

5. **Dhawale A.K.,** Hagiwara A, Bhalla US, Murthy VN, Albeanu DF (2010) Non-redundant odor coding by sister mitral cells revealed by light addressable glomeruli in the mouse. ***Nature Neuroscience*** 13(11): 1404-1412.

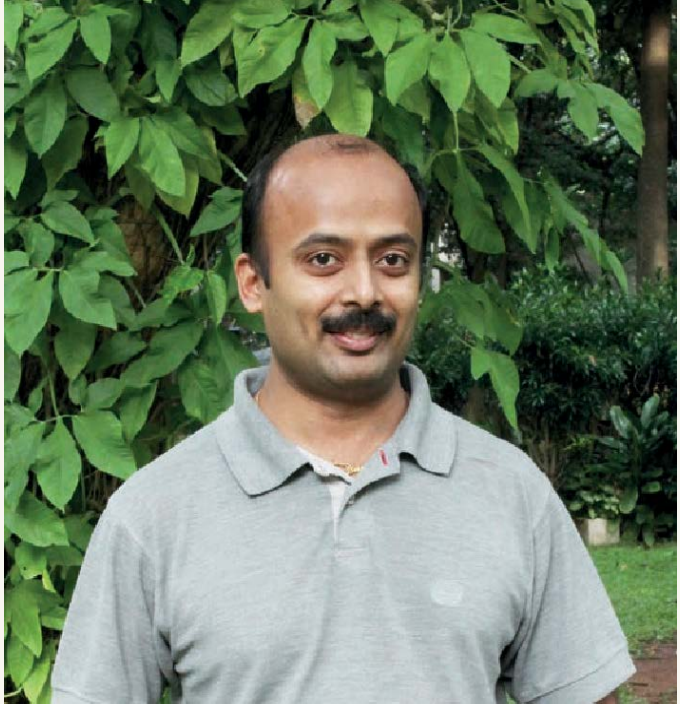
NEURAL BASIS OF SKILL LEARNING



Performing an ace tennis serve or checkmating an opponent in chess can seem like daunting tasks for a novice. Yet we take it for granted that, given enough practice and time, we can all become expert practitioners of such skills. The brain's ability to solve complex learning challenges is an incredible feat whose speed and efficiency is unmatched by machine intelligence. However, little is known about this ability and the neural circuits that underlie it.

This is because most laboratory studies of learning typically focus on simple tasks that can be solved within a few sessions. In contrast acquiring a new skill is a noisy, trial-and-error driven process that typically spans weeks and months. Thus, to understand the neural basis of skill learning, we need new approaches to monitor changes in behaviour and neural activity over these long timescales.

We employ an interdisciplinary strategy to investigate the neural basis of skill learning in rodents. (1) Using a fully-automated behavioural training system we acquire large datasets as animals learn to solve complex motor and foraging tasks. (2) We infer trial-by-trial learning strategies by performing detailed analysis of these massive datasets in concert with computational modelling utilizing reinforcement learning theory. (3) Using targeted perturbations of neural circuits in combination with a new experimental platform to automatically record the spiking activity of large ensembles of neurons continuously (24/7) over weeks and months in behaving animals, we investigate how the learning algorithms we have identified through behavioural analysis are implemented in the brain.



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Selected Publications:

1. A Singh, S Kumar, VP Singh, A Das, **J Balaji** (2017) Flavor Dependent Retention of Remote Food Preference Memory. ***Frontiers in Behavioral Neuroscience***, 11:7.

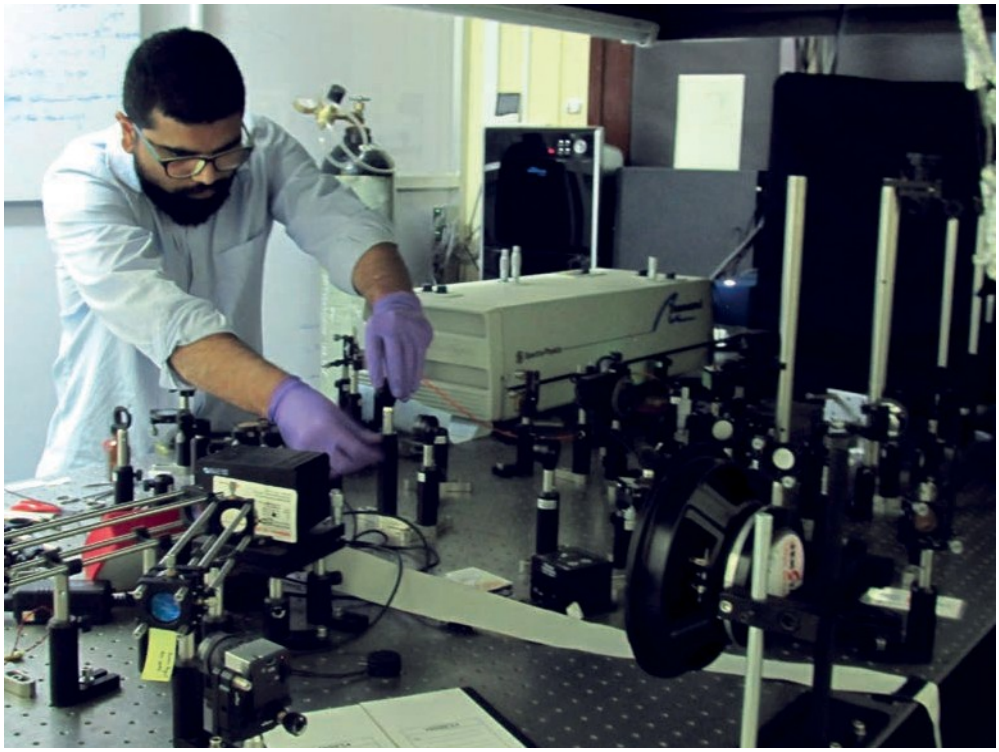
2. Singh A and **J Balaji** (2017) Sensitive Estimation of Flavor Preferences in STFP Using Cumulative Time Profiles. ***Bio-protocol***, Vol 7.

3. Kumar S, Singh A, Singh VR, George JB and **Balaji J** (2016) Saturation Dynamics Measures Absolute Cross Section and Generates Contrast within a Neuron. ***Biophysical Journal***, 111, 1328–1336.

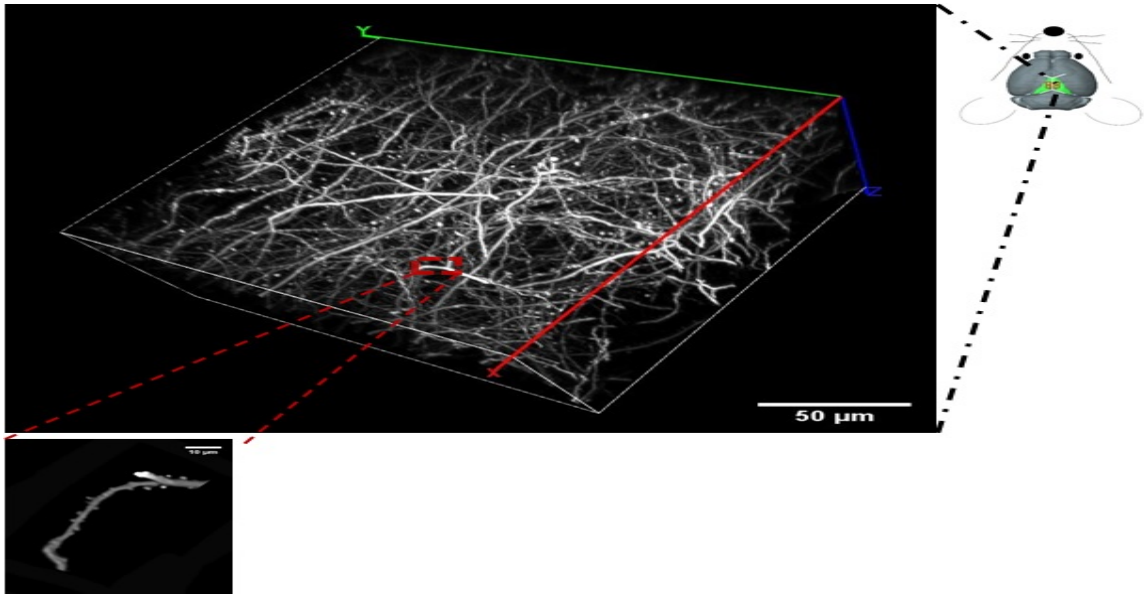
4. Rogerson T, **Balaji J**, Cai DJ, Sano Y, Lee Y-S, Zhou Y, Bekal P, Deisseroth K & Silva AJ (2016) Molecular and Cellular Mechanisms for Trapping and Activating Emotional Memories. ***Plos One***, 11(8), e0161655.

5. Singh HJ, Singh VR, Sikdar SK, **Balaji J** & Ghosh A (2016) Circular Differential Two-Photon Luminescence from Helically Arranged Plasmonic Nanoparticles. ***ACS Photonics***, 3, 863–868.

I did my undergraduate training at Jamal Mohammad College of Bharathisadan University, Trichy, where I obtained both my Bachelors and Masters Degrees. After my undergraduate training, I joined Prof. Sudipta Maiti at the Tata Institute of Fundamental Research for doctoral research where I developed several optical tools to follow the release dynamics and sequestration of serotonin using its native fluorescence in live neurons. For my post-doctoral training, I worked with Prof. Timothy Ryan at Weil Cornell Medical College of Cornell University, New York and later with Prof. Alcino Silva at the David Griffin School of Medicine, UCLA.



Neurobiology Of Learning And Memory



Section of mice brain (200 x 200 x 150 µm) that is imaged in vivo is reconstructed in 3D to show the neuronal architecture. The scale bar is 50 µm. Location of the imaging area (RSc) in the mice brain is shown as an illustration. The area shown within red square is enlarged to show the spines located on the dendrites. Bottom right panel shows portion of the dendrite in an optical section from the mice brain for four days. The green arrows indicate the new spines, and the red arrows indicate lost spines. The mice underwent two trainings one on Day3 and other at Day 4.

Research in our lab is focused on understanding how memories of past events influence the acquisition of new memory and experiences. Using mice as a model system, we follow the neuronal correlates of memory. We follow changes accompanying acquisition, formation and retrieval of memory through in-vivo two-photon imaging Longitudinal imaging of the same mice over the entire process of memory consolidation provides us a unique ability to watch, follow and study these processes as they happen. We combine this ability with small animal behaviour and molecular genetics to investigate:

i) How the internal representation of remote events (events that happened a long time ago) that are similar in nature but distinct in content are encoded.
ii) When such events are encoded in two (NMDAR dependent and NMDAR independent) molecularly independent pathways,how do their corresponding internal representations change at cellular and synaptic scale?
iii) How multiple memories interact with each other and influence future behaviour.
iv) What happens to temporal information in such representations of old memories.

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My undergraduate training was at St. Xavier's College, Mumbai and Bombay University, where I obtained my Bachelors and Masters degrees, respectively. My doctoral training was with Dr. Allen Humphrey in the Department of Neurobiology at the University of Pittsburgh where I examined the neural mechanisms involved in the processing of motion in the visual system. For my postdoctoral training, I worked with Dr. Jeffrey Schall at Vanderbilt University studying the primate visuomotor system to more directly relate neural activity to psychological functions and behaviour.

Selected Publications:

1. Basu, D., Sendhilnathan, N., & **Murthy, A.** (2021). Neural mechanisms underlying the temporal control of sequential saccade planning in the frontal eye fields. (***Proceedings of the National Academy of Sciences, USA.;*** in Press)

2. Rungta, S. P., Basu, D., Sendhilnathan, N., & **Murthy, A.** (2021). Preparatory activity links frontal eye field activity with small amplitude motor unit recruitment of neck muscles during gaze planning. ***Journal of Neurophysiology.*** 126(2):451-463.

3. Jana Sumitash, Gopal Atul PA. and **A. Murthy.** (2017). Evidence of common and separate eye and hand accumulators underlying flexible eye-hand coordination. ***Journal of Neurophysiology***, 117(1):348-364.

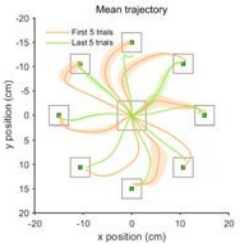
4. Singh P., Jana S., Ghosal A. and **A. Murthy.** (2016). Exploration of joint redundancy but not task space variability facilitates supervised motor learning. ***Proceedings of the National Academy of Sciences (USA),*** 113(50):14414-19.

5. Bhutani N., Sureshbabu Ramakrishnan, A. A. Farooqui, M. Behari, V. Goyal, and **A. Murthy.** (2013). Queuing of concurrent movement plans by basal ganglia. ***Journal of Neuroscience,*** 33(24), 9985-9997.

Movement Control

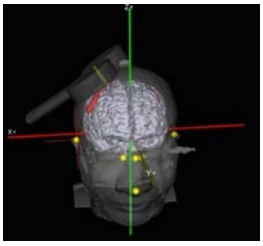
MOVEMENT CONTROL IS STUDIED AT DIFFERENT LEVELS

BEHAVIOUR



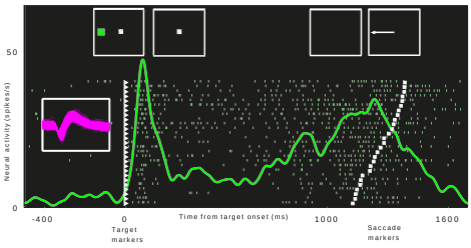
Motor learning in the presence of a force field

NETWORKS



Stimulation of parietal cortex during a reaching task

SINGLE NEURONS



Activity of a neuron in a memory-guided saccade task

All goal directed behaviour whether it involves playing an instrument or singing a song involves the precise coordination and control of many muscles together. For this to occur, the brain must decide, plan, execute and get feedback on the movement. The lab seeks to understand the computations that enable goal directed behaviour with an emphasis to understand the basis of flexibility and control that is the hallmark of intelligent action. From the perspective of behavior, we seek to understand the nature of computations that enable motor control; from the perspective of the brain we seek to understand the contribution of circumscribed neural circuits to motor behavior, and by recording the electrical activity of neurons and muscles we seek to understand how such computational processes are implemented by the brain.

Our research interests span the fields of visual perception, decision-making, and the generation of motor behavior and involve the application of cognitive/psychophysical, neuropsychological, and electrophysiological techniques. We anticipate that in the long term this work will be useful to understand the basis of different motor disorders and develop brain-machine interface systems that are only beginning to be exploited as engineering and brain sciences are starting to increasingly interface.

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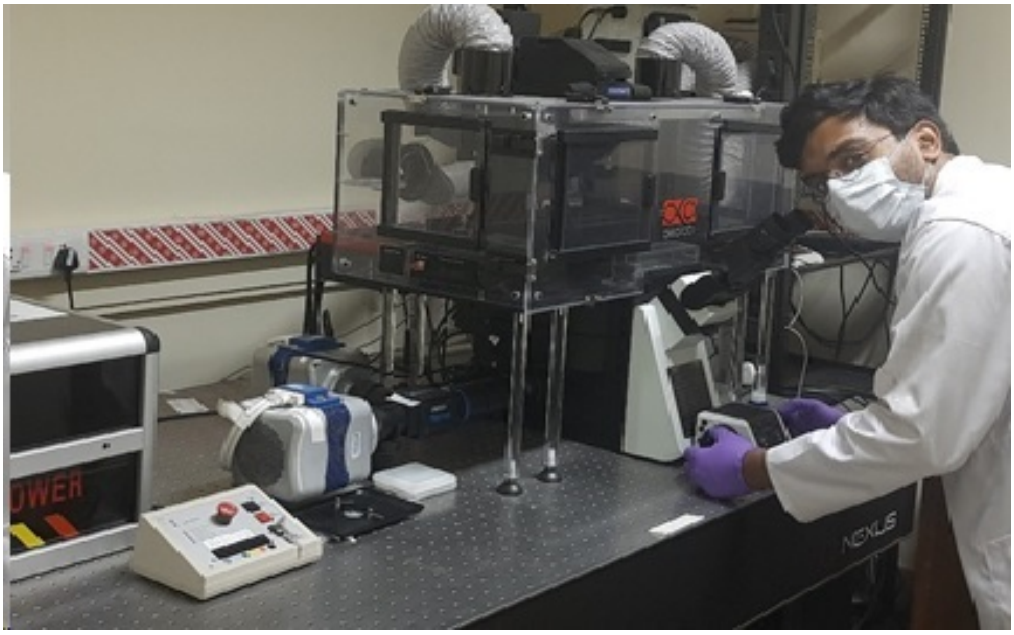
I completed my Masters in Physics at IIT Madras, Chennai before moving to Leibniz Institute for Neurobiology (LIN) in Magdeburg, Germany for my PhD. After my PhD, I moved to Bordeaux, France to pursue my post-doctoral research with Dr. Daniel Choquet. There I used state-of-the-art single molecule microscope techniques to study the localization and movement of synaptic molecules at the nanoscale.



Selected Publications:

1. Kedia, S., Ramakrishna, P., Netrakanti, P. R., Singh, N., Sisodia, S. S., Jose, M., S., Kumar., Anita Mahadevan., Ramanan, N., & **Nair, D**. (2021). Alteration in synaptic nanoscale organization dictates amyloidogenic processing in Alzheimer's disease. ***IScience***, 24(1), 101924.

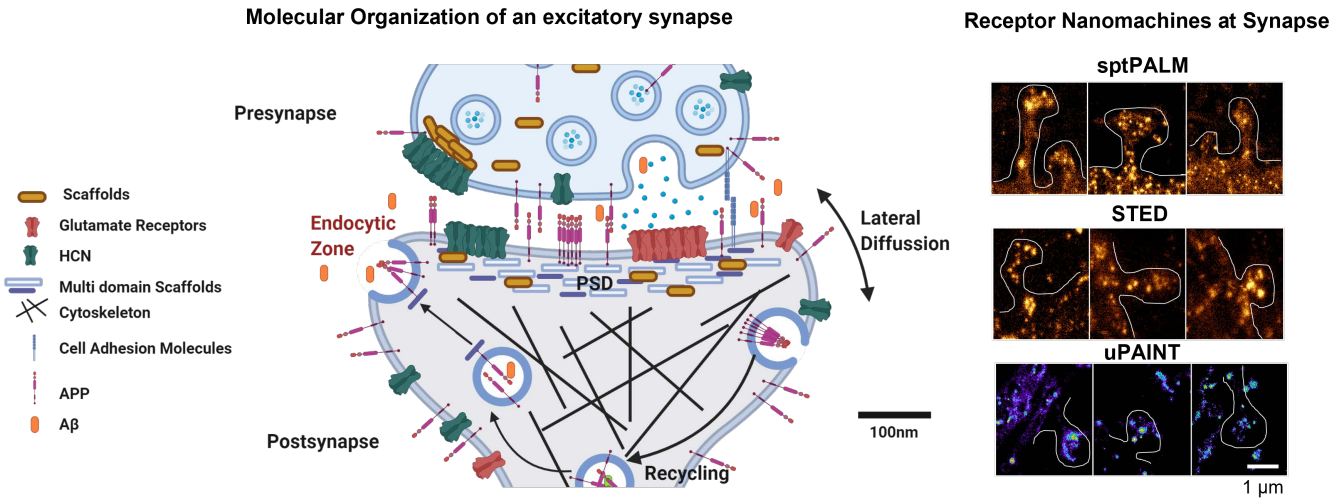
2. Kedia, S., Ramanan, N., & **Nair, D**. (2021). Quantifying molecular aggregation by super resolution microscopy within an excitatory synapse from mouse hippocampal neurons. ***STAR protocols,*** 2(2), 100470.

3. Koltun, B., Ironi, S., Gershoni-Emek, N., Barrera, I., Hleihil, M., Nanguneri, S., Sasmal, R., Agasti, S.S., **Nair, D.**, and Rosenblum, K., (2020), Measuring mRNA translation in neuronal processes and somata by tRNA-FRET, ***Nucleic Acids Research,*** 48, e32-e32.

4. Kedia, S., Ramakrishna, P., Netrakanti, P. R., Jose, M., Sibarita, J. B., Nadkarni, S., & **Nair, D**. (2020). Real-time nanoscale organization of amyloid precursor protein. ***Nanoscale***, 12(15), 8200-8215.

5. Nanguneri, S., Pramod, R. T., Efimova, N., Das, D., Jose, M., Svitkina, T., & **Nair, D.** (2019). Characterization of nanoscale organization of f-actin in morphologically distinct dendritic spines in vitro using supervised learning. ***Eneuro***, 6(4).

NANOBIOLOGY OF SYNAPSES IN HEALTH AND DISEASE



In the central nervous system, synapses form the basic functional units of connectivity between two neurons. The formation, remodeling and elimination of synapses refine the micro circuitry in the brain. The synapse is a complex molecular machine, which changes its structure and composition during neuronal development and plasticity. It contains hundreds of proteins choreographed into a micron sized machine overseeing the fidelity of brain function. The components of the synapses play a major role in synaptic transmission and synaptic plasticity, which are thought to underlie learning and memory. Interestingly most of the diseases has a direct impact on the number, position, and movement of molecules in and out of synapse contributing towards synaptic loss or dysfunction thus affecting the normal behavior of the brain. Though many of the neurological and neurodegenerative disorders are thought to begin as 'synaptopathies' or synaptic dysfunction, the minute deficits in the molecular organization that contributes the onset of such diseases still remain vague.

It has been an enigma how information is processed at a single synapse by realtime control of function and position of several molecules. This is partly because of the inaccessibility to garner information to resolve structures less than a few 100nm. The development of superresolution imaging methods that break the diffraction limit allows monitoring the real-time (milli-seconds) synaptic organization at the nanoscale (10-50nm). The observations from our group as well as others over last decade show that synapse is organized into assembly of several nanomachines, that modulates and control the efficiency of synaptic transmission. The work in our lab attempts to dissect the fundamental role of this dynamic nanoscale organization of synaptic molecules to understand how synapse process and relay information. To achieve this, we follow an inter disciplinary research paradigm at the interface of high-end microscopy, molecular biology, single cell gene editing, optogenetics and cellular neuroscience. All this information is expected to contribute towards a better understanding of how synapses function at the molecular scale and provide fundamental insights into signal processing at single synapses in health and disease.

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Selected Publications:

1. Chen G, **Padmala S,** Chen Y, Taylor PA, Cox RW, and Pessoa L, (2021), To pool or not to pool: Can we ignore cross-trial variability in FMRI?, ***NeuroImage,*** 225, 117496.

2. Limbachia C, Morrow K, Khibovska A, Meyer C, **Padmala S,** and Pessoa L (2021), Controllability over stressor decreases responses in key threat-related brain areas. **Communications Biology,** 4(1), 1-11

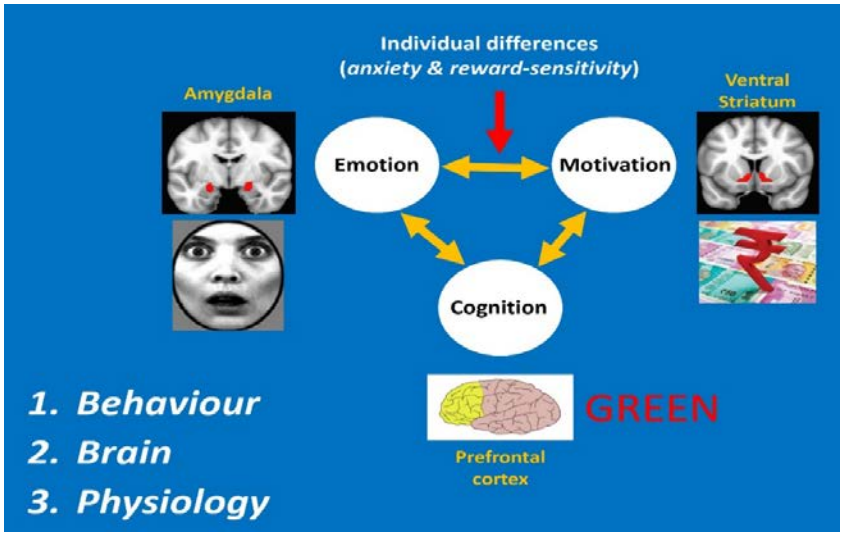
3. Meyer CT*, **Padmala S*** and Pessoa L (2019) Dynamic threat processing. ***Journal of Cognitive Neuroscience,*** 31(4):522-542.

4. **Padmala S**, Sirbu M and Pessoa L (2017) Potential reward reduces the adverse impact of negative distractor stimuli. ***Social Cognitive and Affective Neuroscience,*** 12:1402-1413.

5. Lim SL, **Padmala S** and Pessoa L (2009) Segregating the significant from the mundane on a moment-to-moment basis via direct and indirect amygdala contributions. ***Proceedings of the National Academy of Sciences,*** USA. 106, 16841-16846.

I received a Bachelor's degree in Biomedical Engineering from Osmania University, Hyderabad followed by a Master's degree in Biomedical Engineering from the University of Memphis, USA. Then, I worked for more than a decade in Dr. Luiz Pessoa's laboratory of Cognition and Emotion investigating brain mechanisms of emotional processing and interactions between emotion, motivation, and cognition in healthy adult humans using behavioural and functional MRI (fMRI) techniques. As a National Science Foundation (NSF) Graduate Research Fellow, I investigated interactions between appetitive and aversive processing during perception and attention and received my PhD from the inter-disciplinary Neuroscience and Cognitive Science (NACS) program at University of Maryland, USA. After my PhD, I continued working at the University of Maryland as an Assistant Research Scientist and joined Centre for Neuroscience as an Assistant Professor in March 2019.

Interactions Between Emotion, Motivation, And Cognition



Throughout our lives, emotional and motivational factors influence our thoughts and actions. Hence, we need to understand how emotion, motivation, and cognition interact in the human brain.

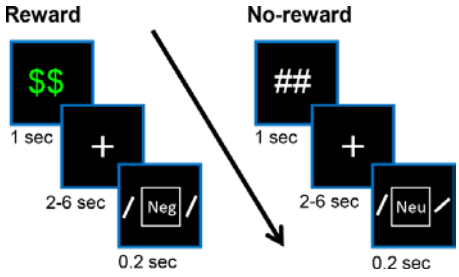
Knowledge of brain mechanisms underlying these interactions is not only relevant to our healthy lives but also has potential clinical relevance. In mental disorders such as addiction, anxiety, and depression, cognitive impairments due to compromised emotional and/or motivational processing are extensively reported. Therefore, a deeper understanding of brain mechanisms underlying interactions between emotion, motivation and cognition will help us better understand the anomalies in neurobiological mechanisms associated with these disorders and potentially improve treatment strategies.

Despite this, our understanding of how these factors-interact in the brain is rudimentary. This is because the majority of the past work focused on investigating emotional, motivational and cognitive processing in an independent fashion

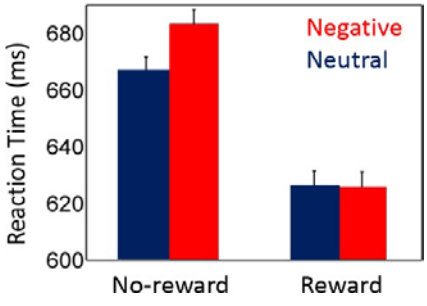
Our work attempts to fill some of these critical gaps in our knowledge base by investigating interactions between emotion, motivation, and cognition in the healthy adult human brain. We primarily employ behavioral and functional MRI (fMRI) methods combined with psycho-physiological measurements (e.g., skin conductance responses) in our research.

Additionally, we focus on understanding how individual differences in self-reported anxiety and reward-sensitivity influence these interactions.

Our most recent work is focused on investigating interactions between reward motivation and negative emotional processing.



During reward and no-reward conditions signaled by an advanced cue, participants were asked to ignore the central negative or neutral distractor image and decide whether the peripheral bars were of the same or different orientation. Potential reward reduced the adverse impact of negative distractors on task performance (Padmala et al., 2017).



Supratim Ray

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I received a B. Tech in Electrical Engineering from IIT Kanpur and a PhD in Biomedical Engineering from the Johns Hopkins School of Medicine. For the doctoral degree, I worked with Drs (Late) Kenneth Johnson, (Late) Steven Hsiao, Ernst Niebur and Nathan Crone and studied the neural mechanisms of high-gamma activity in both human and non-human primates. My post-doctoral training was with Dr. John Maunsell in the Department of Neurobiology at Harvard Medical School, where I studied the neural mechanisms of gamma oscillations in non-human primates

Selected Publications:

1. 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.

2. 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.

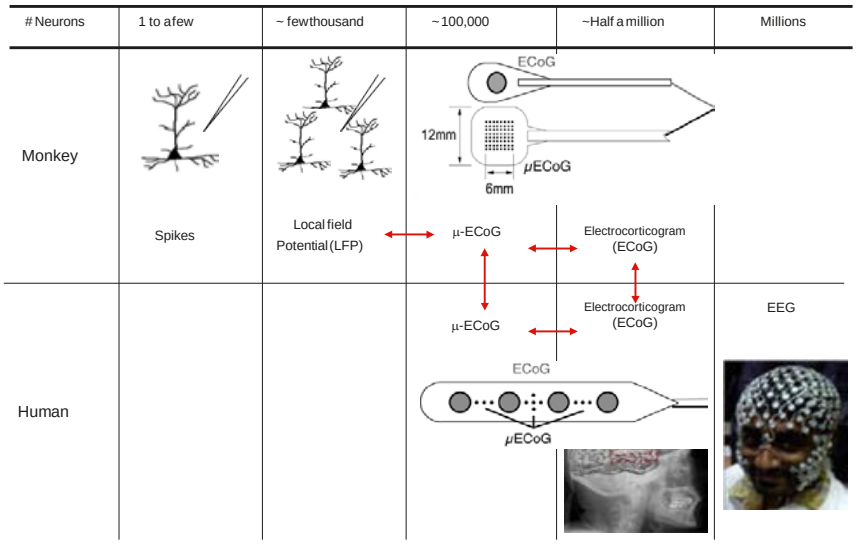
3. Murty DVPS, Manikandan K, Kumar WS, Ramesh RG, Purokayastha S, Javali M, Rao NP, **Ray S†** (2020) Gamma oscillations weaken with age in healthy elderly in human EEG. ***Neuroimage.*** Vol 215, Article 116826.

4. Dubay A and **Ray S†,** (2019), Cortical electrocorticogram (ECoG) is a local signal. ***Journal of Neuroscience***. 39(22):4299-4311.

5. Shirhatti, V., & **Ray, S.** (2018). Long-wavelength (reddish) hues induce unusually large gamma oscillations in the primate primary visual cortex. ***Proceedings of the National Academy of Sciences,*** 115(17), 4489-4494.)

Neural Mechanisms Of Selective Attention

STUDY OF ATTENTION AT MULTIPLE SCALES OF RECORDING



Our senses convey rich and detailed information about the external world, but we can selectively attend to some details while ignoring others. This capacity for selective attention is critical for survival and essential for complex tasks. Problems with controlling and directing attention, such as attention deficit hyperactivity disorder (ADHD), can impair the ability of individuals to function normally. Attentional mechanisms have been studied at several different recording scales – from single neurons in monkeys to diffuse population measures such as electro or magneto encephalography (EEG/MEG) in humans. However, the relationship between signals recorded from such different scales is poorly understood.

The long-term goal of this research is to elucidate the mechanisms of attention by linking the neural recordings obtained from these vastly different scales. In particular, we focus on particular oscillations in the brain, such as the alpha (~10 Hz) or gamma rhythms (30-80 Hz), which are modulated by the attentional load, and can readily be recorded from both micro and macroelectrodes. Several types of recording scales are investigated.

In humans, we record using EEG electrodes and also collaborate with neurosurgeons who work with epileptic patients and record from electrodes placed directly on the brain (called electrocorticogram or ECoG). In non-human primates (NHPs) trained to perform an attention task, we record from microelectrodes as well as ECoG and EEG electrodes. Apart from studying attention, this approach allows us to understand the neural basis of EEG, which has direct applications in the diagnosis of brain disorders and in brain machine interfaces. We also develop signal-processing tools to study brain signals, which are highly non-stationary and often require special analysis techniques.

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I obtained a Masters in Physics from Indian Institute of Technology Chennai. My PhD training was with Prof. Eckart Gundelfinger (Dept. of Neurochemistry & Molecular Biology) and Dr. Werner Zuschratter (Special Lab for Electron and Laserscanning Microscopy) at Leibniz institute of Neurobiology, Magdeburg, Germany. I did my postdoctoral training in the Nano-photonics group of Prof. Brahim Lounis and Dr. Laurent Cognet at the University of Bordeaux, France, and later in the Dynamics of Cell growth and Cell Division group of Dr. Derek McCusker at the European Institute Chemistry and Biology, University of Bordeaux, France. I joined CNS as a Ramalingaswami fellow in September 2015, where I study molecular mechanisms underlying neuronal polarity establishment.

Selected Publications:

1. **Jose M.*,** Sivanand A., Channakeshava C. (2021). Cholesterol is a critical determinant for hippocampal neuronal polarity. ***Frontiers in Molecular Neuroscience*** (in Press).

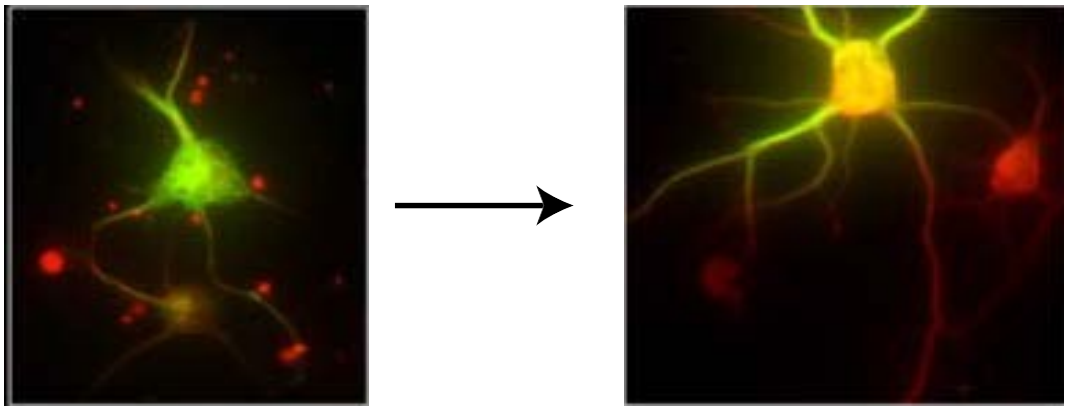
2. Kedia S., Mandal K., Netrakanti P.R., **Jose M.**, Sisodia S.S., Nair D. (2021). Nanoscale organization of Nicastrin, the Substrate Receptor of the γ-Secretase Complex, as Independent Molecular Domains. ***Molecular Brain*** (in Press)

3. Nair, D., Kedia, S., **Jose,M.,** (2021). Does altered probability of real-time diffussional collissions of membrane molecules trigger or delay Alzheimer's Disease. ***iScience Notes,*** 5(3), 2020.

4. Tanwar, M., Kateriya, S., Nair, D., & **Jose, M***. (2021). Optogenetic modulation of real-time nanoscale dynamics of HCN channels using photoactivated adenylyl cyclases. RSC ***Chemical Biology,*** 2(3), 863-875.

5. Kedia S., Ramakrishna P., Netrakanti P.R., Sisodia SS, **Jose M.**, Kumar S, Mahadevan A, Ramanan N. Nadkarni S., Nair D. (2021). Alteration in synaptic nanoscale organization dictates amyloidogenic processing in Alzheimer's disease. ***IScience***, 24(1), 101924.

Neuronal Polarity And Development



How do neurons differentiate?

Differentiating mouse hippocampal neurons (Left-24 hrs and Right-4 days in vitro), colabelled with a combination of antibodies against beta tubulin III (red) and Map2 (green). The neurons exhibit a symmetric to asymmetric growth along development.

Establishment of cell polarity plays a crucial role for development, motility and survival in all eukaryotic systems. Diffusion of bio molecules on the plasma membrane creates asymmetry, generating cell polarity. Lipid homeostasis plays a major role in creating this molecular asymmetry. My group focuses on addressing a fundamental, yet important question in neuroscience.

How is cell polarity established during neuronal development or how do the neurons differentiate? Differentiation of neuronal processes into subtypes namely, axons and dendrites, remain to be a highly intriguing but critical mechanism for survival during neuronal development. It plays a key role in establishing specialized neuronal processes to form cell-cell contacts or synapses, crucial for signal processing in the brain. Early in development, the short neuronal processes called neurites grow similar to each other in a symmetric manner. A sharp transition during the growth period allows one of the processes to grow at a much faster rate compared to the other processes, which develops as the axon.

It has been found that there are molecular and structural differences between axons and the dendrites. Interestingly, though different approaches have been adopted to intercept the molecular mechanism behind, a clear model on this critical transition during development, which determines neuronal survival, remains to be understood.

Lipid metabolism has been shown to hold the key to major fundamental processes including neuronal differentiation. In my project, I try to unravel the molecular mechanisms underlying neuronal polarity using a multidisciplinary approach combining molecular biology, genetic engineering and single molecule based superresolution microscopy. The role of lipid metabolism in neuronal differentiation is studied using rodent hippocampal neurons as a model system.

In summary, these studies would help us to identify molecular mechanisms generating cell polarity and allow us to understand how it contributes to neuronal differentiation and development.

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Selected Publications:

1. **Marathe S**, et al (2017) Jagged1 Is Altered in Alzheimer's Disease and Regulates Spatial Memory Processing. ***Frontiers in Cellular Neuroscience***, 9;11:220.

2. Brai E**, Marathe S**, et al (2015) Notch1 Regulates Hippocampal Plasticity Through Interaction with the Reelin Pathway, Glutamatergic Transmission and CREB Signaling. ***Frontiers in Cellular Neuroscience***, 26;9:447.

3. **Marathe S**, et al (2015) Notch signaling into excitotoxicity induces neurode generation via erroneous cell cycle re-entry. ***Cell Death Differentiation***, 22(11):1775-84.

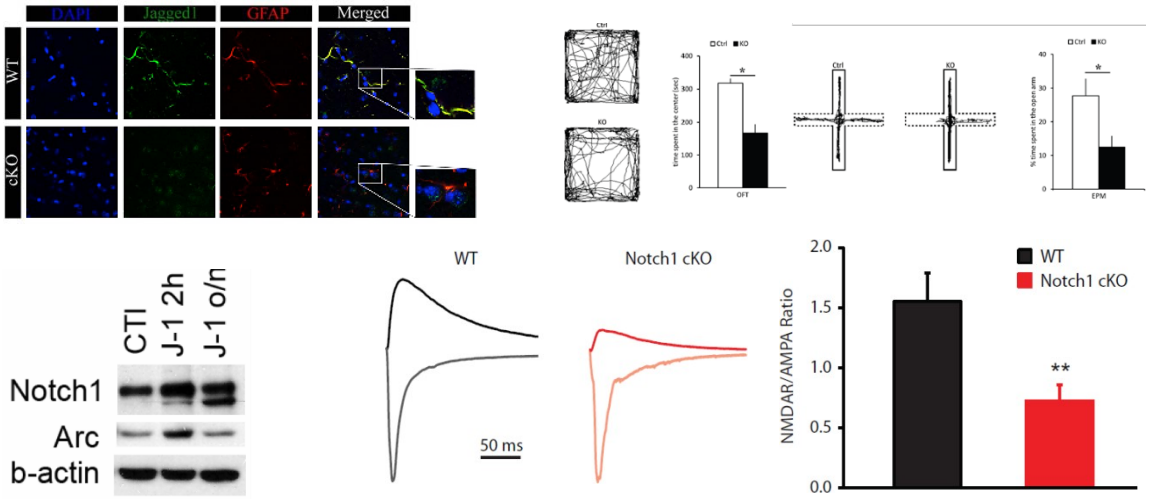
4. Marathe S, et al (2015) Notch in memories: points to remember. ***Hippocampus*** , 25(12):1481-8.

5. Yanpallewar S, Fernandes K, **Marathe S**, et al (2010) Alpha2-adrenoceptor blockade accelerates the neurogenic, neurotrophic, and behavioral effects of chronic antidepressant treatment. ***Journal of Neuroscience,*** 30(3):1096-109.

I received my Bachelor of Science degree in Microbiology from Ramnarain Ruia College, Mumbai University. I later joined Prof. Vidita Vaidya's lab at the Tata Institute of Fundamental Research, Mumbai, where I received Master of Science degree in Biology. Here I worked on the effects of norepinephrine receptors on neurogenesis, with a particular emphasis on developing fast acting antidepressant drugs.

I received a PhD in Neuroscience at the Department of Medicine, University of Fribourg, Switzerland. I worked on Notch signaling cascade in neurodegenerative disorders for my thesis. During my PhD work, a serendipitous discovery got me interested in studying astrocyte physiology in mood disorders. After completing my PhD, I did a short postdoc at EPFL, Switzerland studying astrocyte-neuron metabolic coupling in depressive disorders. I joined Centre for Neuroscience in May 2017. Here we study the role of astrocytes in stress resilience and depressive disorders.

Astrocyte-neuron Interactions In Mood Disorders



Although how neurons influence behavior has been investigated in great detail, there has been little clarity on the role played by astrocytes, a far more abundant cell type, in orchestrating behavior. Astrocytes form an integral part of the synaptic machinery and a single astrocyte can contact and influence the function of about 100,000 synapses. They are extremely important for normal synaptic function and many brain disorders are associated with astrocyticdys function.

We are interested in studying how astrocytes and neurons communicate with each other to modulate synaptic plasticity. We investigate the role of astrocytes in behavior with a particular emphasis on mood-related disorders such as anxiety and depression. We are currently studying Jagged-Notch signaling at astrocyte-neuron interfaces.

We have discovered that the mice lacking Jagged1 in astrocytes have an anxiety and depressive-like phenotype. Glutamate is able to induce upregulation and extracellular secretion of Jagged1 by the astrocytes, and the secreted Jagged1 is able to activate neurons through Notch1 receptors. Furthermore, Notch1 receptors expressed in neurons interact with the NR1 subunit of the NMDA receptors and the loss of Notch1 expression in neurons results in reduced NMDA currents. We are exploring theseJagged1-Notch1 mediated astrocyte-neuron interactions that are at the heart of astrocyte-dependent pathophysiology of anxiety and depressive disorders.

We are also investigating morphological and molecular plasticity as well as novel mediators of astrocyte-neuron interactions relevant to stress resilience and depressive disorders.

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I received my B.Tech in Biotechnology from SRM University, India (2008), and Ph.D in Neuroscience (2014) from the Medical College of Georgia, USA. During my Ph.D work in Dr Lin Mei's lab, I focused on the cellular and molecular mechanisms underlying cerebellar development. I then joined Dr Ariel Levine's laboratory at the National Institutes of Health, USA, where I focused on understanding the molecular basis for functional heterogeneity in the spinal cord and how spinal neurons are integrated into CNS-wide circuits for motor control. This work led to the identification of a previously-unappreciated, circumscribed population of neurons in the cerebellum - cerebellospinal neurons - which provides direct inputs to the spinal cord and contribute to distinct aspects of motor control.

I joined the Center for Neuroscience, Indian Institute of Science, as a Ramalingaswami Faculty Fellow in October 2020, and my lab is interested in understanding how the integrative action of the brain and the spinal cord enables movement and how dysfunction of the underlying neural circuitry leads to sensori-motor disorders.

Selected Publications:

1. Chaterji S, Barik A, **Sathyamurthy A.** Intraspinal injection of adeno-associated viruses into the adult mouse spinal cord. ***Star Protocols***, Sept 2021.

2. **Sathyamurthy A**, Barik A**,** Dobrott CI, Matson KJE, Stoica S, Pursley R, Chesler A, Levine AJ, (2020), Direct Cerebellospinal Pathways Regulate Motor Performance and Motor Learning, ***Cell Reports,*** 31(6), 107595.

3. Dobrott C, **Sathyamurthy A**, Levine AJ, (2019), Decoding cell type diversity within the spinal cord, ***Current Opinion in Physiology***, 8, 1-6.

4. **Sathyamurthy A*,** Johnson KR*, Matson KJE, Dobrott CI, Li L, Ryba AR, Bergmann TB, Kelly MC, Kelley MW, Levine AJ, (2018), Massively Parallel Single Nucleus Transcriptional Profiling Defines Spinal Cord Neurons and Their Activity during Behavior, ***Cell Rep,*** 22(8):, 2216-2225 (* authors contributed equally).

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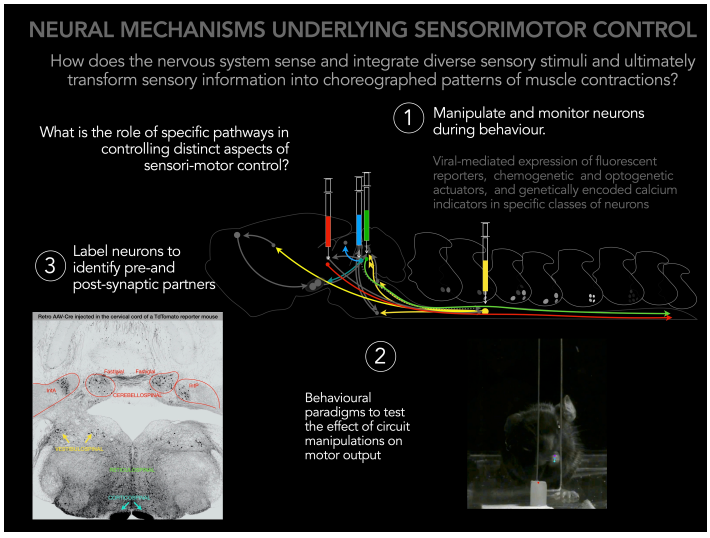
NEURAL MECHANISMS UNDERLYING SENSORIMOTOR CONTROL



From walking on the road to talking to a friend, movements are the only way we can interact with the world around us in meaningful ways. Although these day-to-day activities may seem simple and effortless, the underlying neural computations are quite complex - the nervous system needs to sense both what's happening in the outside world (is the path clear, did i just step on something?) and also what's happening within the body (where are your arms, where are your legs?), and then rapidly integrate these diverse sensory inputs to generate appropriate motor commands (adjust your step to avoid a tree bark) that bring about orchestrated contractions of multiple muscle groups across the body.

Unsurprisingly, the neural circuits that sense, integrate, and ultimately transform diverse sensory stimuli into choreographed patterns of muscle contractions are quite extensive and intricate. Our research is geared towards unraveling the neural cells and circuits underlying sensori-motor control and understanding how these circuits are altered in certain disorders. To address this, we use genetic strategies to selectively monitor the activity of distinct classes of neurons in behaving mice and manipulate their activity to determine its effect on sensori-motor control.

EVENTS @ CNS


BRAIN AND COGNITION
at IISc, Bengaluru
July 5th-14th, 2011
SELECTION
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The 3rd Bangalore Cognition Workshop
Where Minds meet the Brain
December 8-21, 2013
Indian Institute of Science, Bangalore
WHO CAN APPLY
DEADLINE Oct 1, 2013
WORKSHOP WEBSITE
SPEAKERS
Vision | Dec 9-11
Thomas Albright Salk Institute
Wyeth Bair U Washington
Basabi Bhaumik IIT Delhi
Patrick Cavanagh U. Paris Descartes
Karen Dobkins UCSD
Jack Gallant UC Berkeley
Carl Olson Carnegie Mellon
Anitha Pasupathy U Washington
SP Arun IISc
Motor Systems | Dec 16-18
Srinivasa Chakravarthy IIT Madras
Nicholas Hatsopoulos U Chicago
Neeraj Jain NBRC
Michael Shadlen U Columbia
Reza Shadmehr Johns Hopkins
Peter Strick U Pittsburgh
Madhusudan Venkadesan NCBS
Daniel Wolpert U Cambridge
Aditya Murthy IISc
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The 4th Bangalore Cognition Workshop
Where Minds meet the Brain
June 19 – July 2, 2016
Indian Institute of Science, Bangalore
WHO CAN APPLY
The 5th Bangalore Cognition Workshop
Where Minds meet the Brain
June 17 – June 29, 2018
Indian Institute of Science, Bangalore
WHO CAN APPLY
Application deadline: April 5, 2018 (11:59 p.m. CET)
Workshop website: https://sites.google.com/site/bangalorecognition5/
Application website: http://ibro.info/events/applications-open-for-ibro-aprc-school-on-cognitive-neuroscience-the-5th-bangalore-cognition-workshop//
SPEAKERS
VISION MODULE June 16-19
Coordinators: Tom Albright and SP Arun
Winrich Freiwald, Rockefeller University
Kalanit Grill-Spector, Stanford University
Peelen, Donders Institute, Netherlands
Angels, KU Leuven, Belgium
Salk Institute for Biological Studies,
Science, Bangalore
MOTOR SYSTEMS June 25-28
Coordinator: Aditya Murthy
John Rothwell, University College, London
Jeff Schall, Vanderbilt University
Theresa Desrochers, Brown University
Bapi Raju, University of Hyderbad, Hyderbad
Shyam Diwaker, Amrita Vishwa Vidyapeetham
Pratik Mutha, IIT Gandhinagar
Pramod Pal, NIMHANS, Bangalore
Aditya Murthy, Indian Institute of Science, Bangalore
MEMORY & SPACE June 27-29
Coordinators: Balaji Jayaprakash & Sachin Deshmukh
Michael Fanselow, University of California, Los Angeles
Barbara Knowlton, University of California, Los Angeles
Kyriaki Sidiropoulou University of Crete, Greece
Cliff Kentros, Kavli Institute for Systems Neuroscience, Trondheim
Kaori Takehara-Nishiuchi, University of Toronto
Upinder Bhalla, NCBS, Bangalore
Collins Assisi, IISER Pune, Pune
Yoganarashimha Doreswamy, NBRC, Guragon
Balaji Jayaprakash, Indian Institute of Science, Bangalore
Sachin Deshmukh, Indian Institute of Science, Bangalore
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Recording from Single Neurons in Humans: The Entorhinal-Hippocampal Memory Circuit
Itzhak Fried, MD, PhD
Professor of Neurosurgery
University of California, Los Angeles
MONDAY, FEB 19 | 4 PM | FACULTY HALL
Dr. Itzhak Fried is a prominent epilepsy neurosurgeon who pioneered the use of single neuron studies in epileptic patients undergoing treatment for intractable seizures. He will present insights about memory circuits involving the entorhinal cortex and hippocampus at a single neuron level. His research provides fundamental insights into perception, memory, sleep, imagery, and volition.
BCL 2019: Third Workshop on Brain, Computation and Learning
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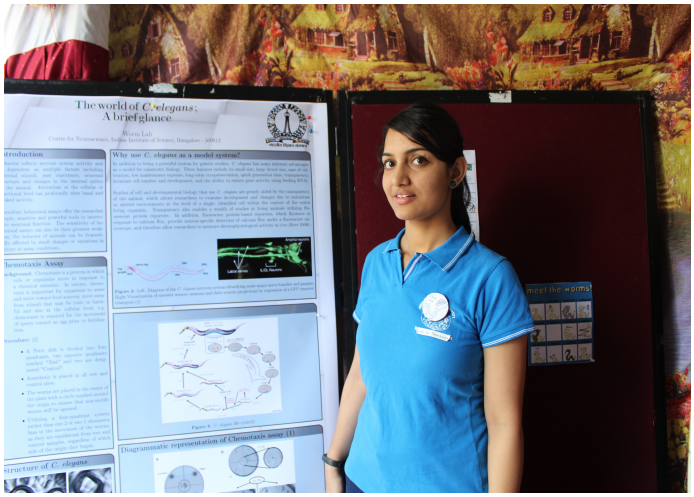
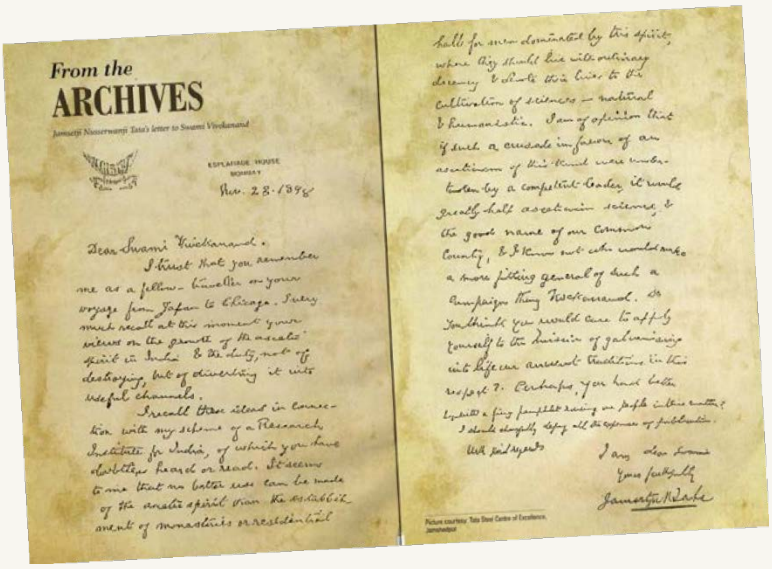
Shantanu Chakrabartty WUSTL
Stephen David OHSU
Sachin Deshmukh IISc
Vasant Honavar Penn State
Julian Jara-Ettinger Yale
Kishore Kuchibhotla Johns Hopkins
Arvind Kumar KTH Stockholm
Mayank Mehta UCLA
Vinay Nambodiri IIT Kanpur
Anirvan Nandy Yale
Srikanth Padmala IISc
Barani Raman
ABOUT THE WORKSHOP
WHO CAN APPLY
The making, keeping and losing of memories
Richard G M Morris, CBE, FRS
Professor of Neuroscience, University of Edinburgh
Mon, Jan 16 | 4 pm | Faculty Hall, IISc
Tea will be served at 3.30pm
Memory is fundamental. Qualitatively distinct types of memory enable us to change our behaviour in response to experience, to acquire and use a repository of knowledge, to recollect events from the past, and to plan for the future. The use of memory is changing, with so much human knowledge now externalised and sought on-demand on the web. Nonetheless, the loss of memory remains greatly feared. The inability to recollect the events of our life can develop from a minor irritation to a condition that undermines normal existence. A "Grand Challenge" for neuroscience is to understand the neural mechanisms of the capacity to encode, store and retrieve information, and how these mechanisms go wrong.
In this lecture, I shall outline what we know of the neurobiological mechanisms by which we make (encode) new information with a focus on the role of the NMDA receptor in detecting associations and setting in train changes in synaptic strength between neurons. I shall discuss how new memory traces may be retained (consolidation) with reference to both the likely structural and functional changes at synapses that make this possible, and the systems-level interactions between subcortical and cortical brain areas that are the eventual repository of stored traces. And I shall outline some ideas about how memory traces are lost, through forgetting, interference and/or degenerative decay.
Indian Institute of Science
Bangalore
IISc Centenary Lecture
Do We Learn to Se
An Exploration of the Neural Basis of
Prof. Torsten Wi
Nobel Laureate
November 15, 2010 | 4pm | Fac
Prof. P. Balaram, Director, IISc will pre
Prof. Torsten Wiesel will discuss nearly 20 years
Hubel on the central visual pathways, which led
Physiology or Medicine in 1981. Dr Wiesel identi
of this exploration of the central visual pathway
Stephen Kuffler of the center-surround receptiv
ganglion cells. Hubel-Wiesel in turn recorded fr
central visual pathways of the cat and monkey. Th
in making a number of unexpected discoveries
cells respond to different forms of light stimula
eyes work together, (3) the columnar architectu
cells with similar response properties and (4) t
environmental factors in the development of th
well-organized structure. These studies have pro
of research on the neural basis of perception in th
that is still going on in laboratories all over the w
From birds & bees to bots
Mandyam Srinivasan
University of Queensland
Tue Nov 29 2016 4:00 PM
Faculty Hall, IISc
A glance at a fly evading a swatter, or a bird moving rapidly through dense foliage would convince anybody that these flying creatures possess vison systems *par excellence*, despite carrying brains that are minuscule compared to our own. Our laboratory seeks to discover how these creatures use their vision to avoid collisions with obstacles, fly safely through narrow passages, orchestrate smooth landings, and gauge distance flown. We are also using these discoveries to design novel, biologically inspired systems for the guidance of autonomous aircraft and drones that will navigate autonomously, without relying on external infrastructure such as GPS or radar.
About the speaker
Srinivasan is presently Professor of Visual Neuroscience at the Queensland Brain Institute and the School of Information Technology and Electrical Engineering of the University of Queensland. Among his awards are Fellowships of the Australian Academy of Science, of the Royal Society of London, and of the Academy of Sciences for the Developing World, the 2006 Australia Prime Minister's Science Prize, the 2008 U.K. Rank Prize for Optoelectronics, the 2009 Distinguished Alumni Award of IISc, the Membership of the Order of Australia (AM) in 2012, the Queensland Science Championship in 2014, and the Harold Spencer-Jones Gold Medal of the Royal Institute of Navigation in 2014.

Open Days @ CNS



Pages From History


From the
ARCHIVES

Jamsetji Nusserwanji Tata's letter to Swami Vivekanand

Historic Letter Of J.N. Tata To Swami Vivekananda On 23 November 1898

Dear Swami Vivekananda,

I trust, you remember me as a fellow traveler on your voyage from Japan to Chicago. I very much recall at this moment your view on the growth of the ascetic spirit in India and the duty, not of destroying, but of diverting it into useful channels. I recall these ideas in connection with my scheme of Research Institute of Science for India, of which you have doubtless heard or read. It seems to me that no better use can be made of the ascetic spirit than the establishment of monasteries or residential halls for men dominated by this spirit, where they should live with ordinary decency and devote their lives to the cultivation of science, natural and humanistic. I am of the opinion that, if such a crusade in favor of an asceticism of this kind were undertaken by a competent leader, it would greatly help asceticism, science, and the good name of our common country; and I know not who would make a more fitting general of such a campaign than Vivekananda. Do you think you would care to apply yourself to the mission of galvanizing into life our ancient traditions in this respect? Perhaps, you had better begin with a fiery pamphlet rousing our people in this matter. I should cheerfully defray all the expenses of publication.

With kind regards,
I am dear Swami
Yours faithfully,
Jamsetji Tata

Jamsetji Nusserwanji Tata
(1839 - 1904)

H.H. Sri Krishnaraja Wodeyar IV
(1884 -1940)

The Indian Institute of Science (IISc) was founded in 1909 as a result of the joint efforts of Jamsetji Nusserwanji Tata, the Government of India, and the Maharaja of Mysore. In 1886, Jamsetji Tata conceived of a university of science that will work for the benefit of India, and in 1898 created an endowment for establishing such an institution. The Government of India then took up the effort, and, in consultation with scientists in England and in India, decided to locate the Institute in Bangalore, where the Maharaja of Mysore, Shri Krishnaraja Wodeyar IV, donated 372 acres of land. The Institute was formally vested in 1909, the foundation stone was laid in 1911, and the first batch of students started their studies in the same year.

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