RISHIKESH NARAYANAN

Professor and Chair
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Doctor of Philosophy in the Faculty of Engineering from the Department of Electrical Engineering, Indian Institute of Science, Bangalore, Karnataka, India, in March 2002.

Thesis title : A computational model for the development of simple-cell receptive fields spanning the regimes before and after eye-opening
Thesis advisor : Prof. Y. V. Venkatesh

Master of Science (Engineering), *by research*, in the Faculty of Engineering from the Department of Electrical Engineering, Indian Institute of Science, Bangalore, Karnataka, India, in December 1997.

Thesis title : Neural architectures for active contour modelling and for pulse-encoded shape recognition
Thesis advisor : Prof. Y. V. Venkatesh

Bachelor of Engineering in Electronics and Communication Engineering (*first class with distinction*) from the Mepco Schlenk Engineering College, Sivakasi, affiliated to the Madurai Kamaraj University, Madurai, Tamil Nadu, India, in April 1995.

ACADEMIC AND RESEARCH CAREER

Mar. 2025 – : Chair, Molecular Biophysics Unit,
Indian Institute of Science, Bangalore, India.

Jul. 2021 – : Professor, Molecular Biophysics Unit,
Indian Institute of Science, Bangalore, India.

Jul. 2015 – Jul. 2021 : Associate Professor, Molecular Biophysics Unit,
Indian Institute of Science, Bangalore, India.

Jul. 2009 – Jul. 2015 : Assistant Professor, Molecular Biophysics Unit,
Indian Institute of Science, Bangalore, India.

Jun. 2008 – Aug. 2008 : Summer researcher, Marine Biological Laboratory,
Woods Hole, MA, USA.

Jan. 2005 – Jul. 2009 : Postdoctoral Fellow, Center for Learning and Memory,
The University of Texas at Austin, Austin, TX, USA.
Advisor: Prof. Daniel Johnston.

Feb. 2002 – Dec. 2004 : Postdoctoral Fellow, National Centre for Biological Sciences,
Tata Institute of Fundamental Research, Bangalore, India.
Advisor: Prof. Sumantra Chattarji.

Jun. 1997 – Dec. 2001 : Research Scholar (PhD), Department of Electrical Engineering,
Indian Institute of Science, Bangalore, India.

Aug. 1995 – Jun. 1997 : Research Scholar (MS), Department of Electrical Engineering,
Indian Institute of Science, Bangalore, India.

GRANTS, FELLOWSHIPS, AWARDS, AND DISTINCTIONS

- Elected as a Fellow of the Indian National Science Academy, New Delhi (2025);
- Elected as a Fellow of the Indian Academy of Sciences, Bangalore (2020);
- Revati and Satya Nadham Atluri Chair Professorship, Indian Institute of Science, Bangalore (2018–2021);
- Senior fellow, DBT-Wellcome Trust India Alliance (2017–2023);
- Shanti Swarup Bhatnagar Prize in Biological Sciences, 2016;
- Grant from DST, India through the Cognitive Science Initiative (2013–2016);
- Grant jointly from DBT, India and NIH, USA, through the US-India brain research collaborative partnership program, with Prof. Daniel Johnston, UT Austin (2011–2013, extended to May 2016);
- HFSP career development award, Human Frontier Science Program Organization (HFSPO), France (Jan. 2010 – Dec. 2012, extended to Dec. 2013);
- HFSP cross-disciplinary fellowship, Human Frontier Science Program Organization (HFSPO), France (Sep. 2005 – Aug. 2008);
- Attended course on "Methods in Computational Neuroscience" conducted by the Marine Biological Laboratory, Woods Hole, Massachussetts, USA, 3–31 August 2003.
- Postdoctoral fellowship, Department of Biotechnology (DBT), India (Aug. 2002 – Jul. 2004);
- Ranked seventh at the Madurai Kamaraj University (BE, 1995); and
- Gold medalist (ranked first) from the Mepco Schlenk Engineering College (BE, 1995).

RESEARCH ADVISORY ROLE

Postdoctoral research fellows

Dr. Rahul Kumar Rathour
Period: August 2014 to January 2016

Dr. Sufyan Ashhad
Period: January 2016 to July 2016

Dr. Manisha Sinha
Period: August 2016 to February 2018

Dr. Poonam Mishra
Period: August 2019 to July 2020

Dr. Reshma Basak
Period: August 2019 to October 2020

Dr. Pavithraa Seenivasan
Period: January 2021 to October 2022

Dr. Divyansh Mittal
Period: August 2022 to October 2022

Doctor of Philosophy students (Indian Institute of Science)

Total: 10 completed and 6 ongoing

- Ph.D. thesis advisor, Dr. Rahul Kumar Rathour
  Thesis title: Emergence and homeostasis of functional maps in hippocampal neurons
  Period: August 2009 to July 2014
  Recipient of the Prof. B. H. Iyer Medal for best Ph.D. thesis in the Molecular Biophysics Unit (2014–2015).

- Ph.D. (Integrated) thesis advisor, Dr. Sufyan Ashhad
  Thesis title: Physiological interactions between neuronal active conductances and inositol trisphosphate receptors in neurons and astrocytes
  Period: May 2010 to December 2015

- Ph.D. thesis advisor, Dr. Manisha Sinha
  Thesis title: Subthreshold conductances regulate theta-frequency local field potentials and spike phase
  Period: August 2011 to July 2016

- Ph.D. (Integrated) thesis advisor, Dr. Anindita Das
  Thesis title: Theta-band spectral selectivity and gamma-range coincidence detection in spike initiation dynamics of hippocampal pyramidal neurons
  Period: May 2011 to July 2017
  Recipient of the Prof. B. H. Iyer Medal for best Ph.D. thesis in the Molecular Biophysics Unit (2017–2018).

- Ph.D. thesis advisor, Dr. Poonam Mishra
  Thesis title: Network heterogeneities, intrinsic plasticity and decorrelation in the dentate gyrus
  Period: August 2013 to July 2019
  Recipient of the Prof. B. H. Iyer Medal for best Ph.D. thesis in the Molecular Biophysics Unit (2019–2020).

- Ph.D. thesis advisor, Dr. Reshma Basak
  Thesis title: Robust emergence of sharply tuned place cell responses in hippocampal neurons with structural and biophysical heterogeneities
  Period: August 2014 to July 2019

- Ph.D. thesis advisor, Dr. Pavithraa Seenivasan
  Thesis title: Temporal patterns of neural activity governing spatial representation in the hippocampus
  Period: August 2015 to December 2020

- Ph.D. (Integrated) thesis advisor, Dr. Divyansh Mittal
  Thesis title: Robustness of neural activity dynamics in the medial entorhinal cortex
  Period: May 2016 to January 2022

- Ph.D. thesis advisor, Dr. Rituparna Roy
  Thesis title: Neuronal complex bursts and network information transfer in the hippocampus are robust to biophysical heterogeneities
  Period: August 2018 to April 2023

- Ph.D. thesis advisor, Ms. Richa Sirmaur
  Thesis title: Distinct extracellular signatures of active-dendritic chemical and electrical synapses differentially contribute to ripple-frequency oscillations
  Period: August 2019 to September 2024

- Ph.D. (Integrated) thesis advisor, Ms. Sanjna Kumari
  Period: May 2020 to present (ongoing)

- Ph.D. thesis advisor, Ms. Anjana Santhosh
  Period: October 2020 to present (ongoing)

- Ph.D. (Integrated) thesis advisor, Mr. Sarang Saini
  Period: July 2021 to present (ongoing)

- Ph.D. thesis advisor, Ms. Gajbhiye Gargi Jayant
  Period: July 2024 to present (ongoing)

- Ph.D. thesis advisor, Ms. Sampratikshya Das
  Period: August 2024 to present (ongoing)

- Ph.D. thesis advisor, Mr. Priyam Garg
  Period: August 2024 to present (ongoing)

Master's/Bachelor's thesis project students

Total: 4 Master's theses and 7 Bachelor's theses completed; 2 Master's thesis projects ongoing

Unless otherwise stated, the following list contains names of students who registered for their respective degrees at the Indian Institute of Science, Bangalore.

- M.Tech. thesis advisor, Ms. Neha Dhupia (Student at University of Rajasthan)
  Report title: lmpact of dendritic morphology on impedance and resonance properties of hippocampal pyramidal neurons
  Period: May–June 2013 and October 2013 to April 2014

- B.S. (Research) thesis advisor, Ms. Sunandha Srikanth
  Report title: Intrinsic plasticity during state-dependent calcium homeostasis in hippocampal neurons
  Period: January 2014 to April 2015

- B.S. (Research) thesis advisor, Ms. Abha Jain
  Report title: Determination of the operating mode of neurons with good synchrony transfer characteristics
  Period: January 2016 to April 2017

- M.S. (Research) thesis advisor, Ms. Abha Jain
  Report title: Are neurons that exhibit efficient synchrony transfer necessarily coincidence detectors?
  Period: April 2017 to April 2018

- B.S. (Research) thesis advisor, Mr. Ankit Roy
  Report title: Regulation of information encoding and routing in the brain by neuronal and network components
  Period: January 2019 to June 2020

- B.S. (Research) thesis advisor, Mr. Harshith Nagaraj
  Report title: Ion channel degeneracy and plasticity manifolds govern the emergence of circadian oscillations of neuronal intrinsic properties in the Suprachiasmatic nucleus
  Period: March 2020 to June 2021

- M.S. (Research) thesis advisor, Mr. Harshith Nagaraj
  Report title: Sensory noise and border cells regulate path integration and grid-patterned firing in a continuous attractor network
  Period: July 2021 to April 2022

- B.S. (Research) thesis advisor, Ms. Minnal Balaji
  Report title: Emergence of sequential neural activity in heterogeneous recurrent networks
  Period: July 2021 to April 2022

- B.S. (Research) thesis advisor, Mr. Barnopriyo Dutta
  Report title: Adaptive and efficient information encoding and homeostasis in neurons responding to time-varying stimuli
  Period: January 2023 to April 2024

- B.S.–M.S. thesis advisor, Ms. Mahima Gautam (Student at IISER Pune)
  Report title: Role of electrical synapses in multidimensional population activity of Golgi cell network in cerebellar cortex
  Period: June 2023 to March 2024

- B.S. (Research) thesis advisor, Mr. Shreshth Jaiswal
  Report title: Heterogeneities shape degeneracy in dopaminergic neuromodulation of neuronal intrinsic properties and synaptic plasticity profiles
  Period: April 2024 to April 2025

- M.Sc. (Life sciences) thesis advisor, Ms. Pushkarini Rohidas
  Period: August 2024 to present (ongoing)

- M.S. (Research) thesis advisor, Mr. Shreshth Jaiswal
  Period: April 2025 to present (ongoing)

Short-term researchers

Mr. Suraj Honnuraiah (Research trainee)
Period: January 2011 to August 2012

Dr. Arun Anirudhan (INSA visiting fellow)
Period: June 2013 to December 2013

Ms. Chinmayee LM (Research trainee)
Period: March 2015 to August 2016

Mr. Subhash Chandran (Research trainee)
Period: August 2017 to July 2018

Ms. Sameera Shridhar (Research trainee)
Period: August 2019 to August 2021

Ms. Poonam Mishra (Research trainee)
Period: February 2013 to July 2013

Ms. Reshma Basak (Research trainee)
Period: July 2013 to July 2014

Ms. Neha Soman (Research trainee)
Period: August 2016 to July 2018

Ms. Arunima Banerjee (Research trainee)
Period: July 2018 to July 2019

Mr. Harshith Nagaraj (Research trainee)
Period: August 2022 to December 2022

TEACHING

- Instructor, course on "Neuronal Physiology and Plasticity" taught at the Indian Institute of Science, Bangalore, for eight semesters: August–December of 2018–2025.
- Instructor, course on "Theoretical and Computational Neuroscience" taught jointly with Prof. Arun Sripati at the Indian Institute of Science, Bangalore, for fourteen semesters: January–April of 2011–2012, January–April of 2014–2025.
- Instructor, course on "Molecular and Cellular Neurophysiology" taught jointly with Prof. S. K. Sikdar at the Indian Institute of Science, Bangalore, August–December of 2017.
- Instructor, course on "Cellular Neurophysiology" taught jointly with Prof. S. K. Sikdar at the Indian Institute of Science, Bangalore, for four semesters: August–December of 2013–2016.
- Instructor, course on "Molecular basis of signal propagation and synaptic transmission in neurons" taught jointly with Prof. S. K. Sikdar at the Indian Institute of Science, Bangalore, for four semesters: January–April of 2010; August–December of 2010–2012.
- Instructor, lecture modules in course on "Introduction to neuroscience" taught at the Indian Institute of Science, Bangalore, for two semesters: August–December of 2010–2011.

PROFESSIONAL ACTIVITY

- Member, Research Grant Review Committee, Human Frontiers Science Program (HFSP), France (2026–).
- Member, SRG–NPDF Life Sciences Expert Committee, Science and Engineering Research Board, Department of Science and Technology, India (2021–2024).

- Member, SRG/ECRA–NPDF Life Sciences Expert Committee, Science and Engineering Research Board, Department of Science and Technology, India (2018–2021).

- **Editorial board member:** Frontiers in Systems Biology: Associate editor (2021–). Frontiers in Cellular Neuroscience: Review editor (2020–2025); Associate editor (2025–). eNeuro: Review editor (2026–).

- **Grant review:** Reviewer for proposals submitted to the following grant agencies: Agence Nationale de la Recherche, France; Anusandhan National Research Foundation (ANRF), India; Bionational Science Foundation (BSF), USA-Israel; CEFIPRA, France; Department of Biotechnology (DBT), India; DBT Wellcome Trust India Alliance, India; Department of Science and Technology, India; European Research Council (ERC), Europe; European Science Foundation (ESF), Europe; Israel Science Foundation (ISF), Israel.

- **Journal review:** Reviewer for research articles submitted to the following journals: BioEssays, Cell Reports, eLife, eNeuro, European Journal of Neuroscience, Frontiers in Cellular Neuroscience, Frontiers in Computational Neuroscience, Frontiers in Physiology, Hippocampus, Journal of Computational Neuroscience, Current Opinion in Neurobiology, Current Research in Neurobiology, iScience, Journal of Mathematical Neuroscience, Journal of Neurochemistry, Journal of Neurophysiology, Journal of Neuroscience, The Journal of Physiology (London), Nature Communications, Neurobiology of Learning and Memory, Neuroinformatics, Neuroscience, PLOS computational biology, Proceedings of the National Academy of Sciences (USA).

- **Faculty evaluation:** Faculty recruitment/promotion committees for the following institutions: Indian Institute of Science Education and Research, Pune; National Brain Research Centre, Gurgaon; Tata Institute of Fundamental Research, Hyderabad; Tata Institute of Fundamental Research, Mumbai.

- Member, Society for Neuroscience, USA (2003–).

- Member, Molecular and Cellular Cognition Society, USA (2005–).

- Member, American Physiological Society, USA (2011–).

- Member, Biophysical Society, USA (2016–).

LIST OF PUBLICATIONS

I. Research Articles in Peer-Reviewed Journals

1. Sanjna Kumari, Archana Iyer, Shubha Tole, and **Rishikesh Narayanan**, LHX2 regulates biophysical properties of astrocytes in the postnatal mouse hippocampus, *Journal of Neurophysiology*, In press, January 2026.

2. Sarang Saini and **Rishikesh Narayanan**, Degeneracy explains diversity in interneuronal regulation of pattern separation in heterogeneous dentate gyrus networks, *Function*, 6 (5): zqaf035, September 2025.

3. Mahima Bose, Sreenath Ravindran, Sanjna Kumari, Achintya Srivastava, Archana Iyer, Binita Vedak, Ishita Talwar, **Rishikesh Narayanan**, and Shubha Tole, LHX2 regulates dendritic morphogenesis in layer II/III neurons of the neocortex, *Science Advances*, 11 (27): ado1384, July 2025.

4. Archana Iyer, Reanne Fronteiro, Prachi Bhatia, Sanjna Kumari, Amrita Singh, Jiafeng Zhou, Riccardo Bocchi, **Rishikesh Narayanan**, and Shubha Tole, Transcription factor LHX2 suppresses astrocyte proliferation in the postnatal mammalian cerebral cortex, *Development*, 152 (20): dev204358, October 2025.

5. Richa Sirmaur and **Rishikesh Narayanan**, Dichotomy between extracellular signatures of active dendritic chemical synapses and gap junctions, *eLife*, 14: RP103046, February 2025.

6. Sanjna Kumari and **Rishikesh Narayanan**, Ion-channel degeneracy and heterogeneities in the emergence of signature physiological characteristics of dentate gyrus granule cells, *Journal of Neurophysiology*, 132 (3): 991–1013, September 2024.

7. Pavithraa Seenivasan, Reshma Basak and **Rishikesh Narayanan**, Cross-*strata* co-occurrence of ripples with theta-frequency oscillations in the hippocampus of foraging rats, *The Journal of Physiology*, 602 (10): 2315–2341, May 2024.

8. Sunandha Srikanth and **Rishikesh Narayanan**, Heterogeneous off-target impact of ion-channel deletion on intrinsic properties of hippocampal model neurons that self-regulate calcium, *Frontiers in Cellular Neuroscience*, 17: 1241450, October 2023.

9. Harshith Nagaraj and **Rishikesh Narayanan**, Plasticity manifolds and degeneracy govern circadian oscillations of neuronal intrinsic properties in the suprachiasmatic nucleus, *iScience*, 26 (4): 106503, April 2023.

10. Divyansh Mittal and **Rishikesh Narayanan**, Heterogeneous stochastic bifurcations explain intrinsic oscillatory patterns in entorhinal cortical stellate cells, *Proceedings of the National Academy of Sciences (USA)*, 119 (52): e2202962119, December 2022.

11. Rituparna Roy and **Rishikesh Narayanan**, Ion-channel degeneracy and heterogeneities in the emergence of complex spike bursts in CA3 pyramidal neurons, *The Journal of Physiology*, 601 (15): 3297–3328, August 2023.

12. Sameera Shridhar[#], Poonam Mishra[#] and **Rishikesh Narayanan**, Dominant role of adult neurogenesis-induced structural heterogeneities in driving plasticity heterogeneity in dentate gyrus granule cells, *Hippocampus*, 32 (7): 488–516, July 2022. [#]: Equal contribution.

13. Poonam Mishra and **Rishikesh Narayanan**, Conjunctive changes in multiple ion channels mediate activity-dependent intrinsic plasticity in rat hippocampal granule cells, *iScience*, 25 (3): 103922, March 2022.

14. Divyansh Mittal and **Rishikesh Narayanan**, Resonating neurons stabilize heterogeneous grid-cell networks, *eLife*, 10: e66804, July 2021.

15. Ankit Roy and **Rishikesh Narayanan**, Spatial information transfer in hippocampal place cells depends on trial-to-trial variability, symmetry of place-field firing, and biophysical heterogeneities, *Neural Networks*, 142: 636–660, October 2021.

16. Poonam Mishra and **Rishikesh Narayanan**, Ion-channel degeneracy: Multiple ion channels heterogeneously regulate intrinsic physiology of rat hippocampal granule cells, *Physiological Reports*, 9 (15): e14963, 1–28, August 2021.

17. Poonam Mishra and **Rishikesh Narayanan**, Ion-channel regulation of response decorrelation in a heterogeneous multi-scale model of the dentate gyrus, *Current Research in Neurobiology*, 2: 100007, 1–19, March 2021.

18. Adithya Krishna[#], Divyansh Mittal[#], Siri Garudanagiri Virupaksha, Abhishek Ramdas Nair, **Rishikesh Narayanan** and Chetan Singh Thakur, Biomimetic FPGA-based spatial navigation model with grid cells and place cells, *Neural Networks*, 139: 45–63, July 2021. [#]: Equal contribution.

19. Pavithraa Seenivasan and **Rishikesh Narayanan**, Efficient phase coding in hippocampal place cells, *Physical Review Research*, 2(3), 033393: 1–24, September 2020.

20. Poonam Mishra and **Rishikesh Narayanan**, Heterogeneities in intrinsic excitability and frequency dependent response properties of granule cells across the blades of the rat dentate gyrus, *Journal of Neurophysiology*, 123(2): 755–772, February 2020.

21. Abha Jain and **Rishikesh Narayanan**, Degeneracy in the emergence of spike-triggered average of hippocampal pyramidal neurons, *Scientific Reports*, 10, 374: 1–14, January 2020.

22. Reshma Basak and **Rishikesh Narayanan**, Robust emergence of sharply tuned place cell responses in hippocampal neurons with structural and biophysical heterogeneities, *Brain Structure and Function*, 225(2), 567–590, March 2020.

23. Poonam Mishra and **Rishikesh Narayanan**, Disparate forms of heterogeneities and interactions among them drive channel decorrelation in the dentate gyrus: Degeneracy and dominance, *Hippocampus*, 29(4): 378–403, March 2019.

24. Reshma Basak and **Rishikesh Narayanan**, Active dendrites regulate the spatiotemporal spread of signaling microdomains, *PLoS Computational Biology*, 14(11): e1006485, November 2018.

25. Reshma Basak and **Rishikesh Narayanan**, Spatially dispersed synapses yield sharply-tuned place cell responses through dendritic spike initiation, *The Journal of Physiology (London)*, 596(17): 4173–4205, September 2018.

    - Highlighted in a perspective on this article by Szabolcs Káli ("Studying the effects of synaptic clustering *in silico*: when the neighbourhood party gets too loud") in the same issue of *The Journal of Physiology*.
    - Highlighted as part of Editor's choice.

26. Divyansh Mittal and **Rishikesh Narayanan**, Degeneracy in the robust expression of spectral selectivity, subthreshold oscillations and intrinsic excitability of entorhinal stellate cells, *Journal of Neurophysiology*, 120(2): 576–600, August 2018.

27. Anindita Das and **Rishikesh Narayanan**, Theta-frequency selectivity in the somatic spike triggered average of rat hippocampal pyramidal neurons is dependent on HCN channels, *Journal of Neurophysiology*, 118(4): 2251–2266, October 2017.

28. Chinmayee L Mukunda and **Rishikesh Narayanan**, Degeneracy in the regulation of short-term plasticity and synaptic filtering by presynaptic mechanisms, *The Journal of Physiology (London)*, 595(8): 2611–2637, April 2017.

    - Highlighted in a perspective on this article by Astrid Prinz ("Degeneracy rules!") in the same issue of *The Journal of Physiology*.

29. Sufyan Ashhad and **Rishikesh Narayanan**, Active dendrites regulate the impact of gliotransmission on rat hippocampal pyramidal neurons, *Proceedings of the National Academy of Sciences (USA)*, 113(23): E3280–E3289, June 2016.

    - Highlighted as part of "In this issue" in PNAS.

30. Rahul Kumar Rathour, Ruchi Malik and **Rishikesh Narayanan**, Transient potassium channels augment degeneracy in hippocampal active dendritic spectral tuning, *Scientific Reports*, 6, 24678: 1–14, April 2016.

31. Sunandha Srikanth and **Rishikesh Narayanan**, Variability in state-dependent plasticity of intrinsic properties during cell-autonomous self-regulation of calcium homeostasis in hippocampal model neurons, *eNeuro*, 2(4), e0053-15.2015: 1–24, August 2015.

32. Anindita Das and **Rishikesh Narayanan**, Active dendrites mediate stratified gamma-range coincidence detection in hippocampal model neurons, *The Journal of Physiology (London)*, 593(16): 3549–3576, August 2015.

33. Manisha Sinha and **Rishikesh Narayanan**, HCN channels enhance spike phase coherence and regulate the phase of spikes and LFPs in the theta-frequency range, *Proceedings of the National Academy of Sciences (USA)*, 112(17): E2207–E2216, April 2015.

34. Sufyan Ashhad, Daniel Johnston and **Rishikesh Narayanan**, Activation of $InsP_3$ receptors is sufficient for inducing graded intrinsic plasticity in rat hippocampal pyramidal neurons, *Journal of Neurophysiology*, 113(7): 2002–2013, April 2015.

35. Arun Anirudhan and **Rishikesh Narayanan**, Analogous synaptic plasticity profiles emerge from disparate channel combinations, *The Journal of Neuroscience*, 35(11): 4691–4705, March 2015.

36. Neha Dhupia, Rahul Kumar Rathour and **Rishikesh Narayanan**, Dendritic atrophy constricts functional maps in resonance and impedance properties of hippocampal model neurons, *Frontiers in Cellular Neuroscience*, 8, 456: 1–17, January 2015.

37. Poonam Mishra and **Rishikesh Narayanan**, High-conductance states and *A*-type K^+ channels are potential regulators of the conductance-current balance triggered by HCN channels, *Journal of Neurophysiology*, 113(1): 23–43, January 2015.

38. Rahul Kumar Rathour and **Rishikesh Narayanan**, Homeostasis of functional maps in active dendrites emerges in the absence of individual channelostasis, *Proceedings of the National Academy of Sciences (USA)*, 111(17): E1787–E1796, April 2014.

    - Highlighted as part of "In this issue" in PNAS.

39. Anindita Das and **Rishikesh Narayanan**, Active dendrites regulate spectral selectivity in location-dependent spike initiation dynamics of hippocampal model neurons, *The Journal of Neuroscience*, 34(4): 1195–1211, January 2014.

40. Mohan Raghavan, Bharadwaj Amrutur, **Rishikesh Narayanan** and Sujit Sikdar, Synconset waves and chains: Spiking onsets in synchronous populations predict and are predicted by network structure, *PLoS ONE*, 8(10), e74910:1–17, October 2013.

41. Sufyan Ashhad and **Rishikesh Narayanan**, Quantitative interactions between the *A*-type K^+ current and inositol trisphosphate receptors regulate intraneuronal Ca^{2+} waves and synaptic plasticity, *The Journal of Physiology (London)*, 591 (7): 1645–1669, April 2013.

    - Highlighted in a virtual issue on "Biophysics and Breakthroughs" in *The Journal of Physiology*, 2014.

42. Suraj Honnuraiah and **Rishikesh Narayanan**, A calcium-dependent plasticity rule for HCN channels maintains activity homeostasis and stable synaptic learning, *PLoS ONE*, 8(2), e55590: 1–17, February 2013.

43. Rahul Kumar Rathour and **Rishikesh Narayanan**, Inactivating ion channels augment robustness of subthreshold intrinsic response dynamics to parametric variability in hippocampal model neurons, *The Journal of Physiology (London)*, 590 (22): 5629–5652, November 2012.

    - Highlighted in a virtual issue on "Biophysics and Discovery 2013" in *The Journal of Physiology*, 2013.

44. Rahul Kumar Rathour and **Rishikesh Narayanan**, Influence fields: A quantitative framework for representation and analysis of active dendrites, *Journal of Neurophysiology*, 107(9): 2313–2334, May 2012.

45. **Rishikesh Narayanan**, Kevin Dougherty and Daniel Johnston, Calcium store depletion induces persistent perisomatic increases in the functional density of *h* channels in hippocampal pyramidal neurons, *Neuron*, 68(5): 921–935, December 2010.

    - Highlighted in a perspective on this article by Stefan Schmidt and Barbara Ehrlich ("Unloading Intracellular Calcium Stores Reveals Regionally Specific Functions") in the same issue of *Neuron*.

- Highlighted as Editor's choice titled "Neuronal ER Stress" in *Science Signaling*, 14 December 2010.

46. **Rishikesh Narayanan** and Daniel Johnston, The *h* current is a candidate mechanism for regulating the sliding modification threshold in a BCM-like synaptic learning rule, *Journal of Neurophysiology*, 104(2): 1020–1033, August 2010.

47. **Rishikesh Narayanan** and Sumantra Chattarji, Computational analysis of the impact of chronic stress on intrinsic and synaptic excitability in the hippocampus, *Journal of Neurophysiology*, 103(6): 3070–3083, June 2010.

48. **Rishikesh Narayanan** and Daniel Johnston, The *h* channel mediates location dependence and plasticity of intrinsic phase response in rat hippocampal neurons, *The Journal of Neuroscience*, 28(22): 5846–5860, May 2008.

49. **Rishikesh Narayanan** and Daniel Johnston, Long-term potentiation in rat hippocampal neurons is accompanied by spatially widespread changes in intrinsic oscillatory dynamics and excitability, *Neuron*, 56(6): 1061–1075, December 2007.

    - Highlighted in a Minireview by Stephen Williams, Christian Wozny and Simon Mitchell ("The back and forth of dendritic plasticity") in the same issue of *Neuron*.

50. **Rishikesh Narayanan**, Anusha Narayan and Sumantra Chattarji, A probabilistic framework for region-specific remodeling of dendrites in three-dimensional neuronal reconstructions, *Neural Computation*, 17(1): 75–96, January 2005.

51. **Rishikesh Narayanan** and Y. V. Venkatesh, A computational model for the development of simple-cell receptive fields spanning the regimes before and after eye-opening, *Neurocomputing*, 50: 125–158, January 2003.

52. **Rishikesh Narayanan** and Y. V. Venkatesh, Shape recognition using an invariant pulse code and a hierarchical competitive neural network, *Pattern Recognition*, 34(4): 841–853, April 2001.

53. Y. V. Venkatesh and **Rishikesh Narayanan**, Self-organizing neural networks based on spatial isomorphism for active contour modeling, *Pattern Recognition*, 33(7): 1239–1250, July 2000.

II. Reviews/Previews/Perspectives

1. David Dahmen, Axel Hutt, Giacomo Indiveri, Ann Kennedy, Jeremie Lefebvre, Luca Mazzucato, Adilson E. Motter, **Rishikesh Narayanan**, Melika Payvand, Henrike Planert, and Richard Gast, How Heterogeneity Shapes Dynamics and Computation in the Brain, *Neuron*, In press, December 2025.

2. Larissa Albantakis, Christophe Bernard, Naama Brenner, Eve Marder, and **Rishikesh Narayanan**, The brain's best kept secret is its degenerate structure, *The Journal of Neuroscience*, 44 (40): e1339242024, October 2024.

3. Divyansh Mittal and **Rishikesh Narayanan**, Network motifs in cellular neurophysiology, *Trends in Neurosciences*, 47(7): 506–521, July 2024.

4. Poonam Mishra and **Rishikesh Narayanan**, The enigmatic HCN channels: A cellular neurophysiology perspective, *Proteins: Structure, Function, and Bioinformatics*, 93 (1): 72–92, January 2025.

5. Tristan Manfred Stöber, Danylo Batulin, Jochen Triesch, **Rishikesh Narayanan**, and Peter Jedlicka, Degeneracy in epilepsy: Multiple Routes to Hyperexcitable Brain Circuits and their Repair, *Communications Biology*, 6, 479, May 2023.

6. Pavithraa Seenivasan and **Rishikesh Narayanan**, Efficient information coding and degeneracy in the nervous system, *Current Opinion in Neurobiology*, 76: 102620, October 2022.

7. Manisha Sinha and **Rishikesh Narayanan**, Active dendrites and local field potentials: Biophysical mechanisms and computational explorations, *Neuroscience*, 489: 111–142, May 2022.

8. Poonam Mishra and **Rishikesh Narayanan**, Stable continual learning through structured multiscale plasticity manifolds, *Current Opinion in Neurobiology*, 70: 51–63, October 2021.

9. Manisha Sinha and **Rishikesh Narayanan**, Unitary sources say: It is inhibition!, *The Journal of Physiology*, 598(18): 3815–3816, September 2020.

10. Rahul Kumar Rathour and **Rishikesh Narayanan**, Degeneracy in hippocampal physiology and plasticity, *Hippocampus*, 29(10): 980–1022, October 2019.

11. Sufyan Ashhad and **Rishikesh Narayanan**, Stores, Channels, Glue and Trees: Active Glial and Active Dendritic Physiology, *Molecular Neurobiology*, 56(3): 2278–2299, March 2019.

12. Anindita Das, Rahul Kumar Rathour and **Rishikesh Narayanan**, Strings on a violin: Location dependence of frequency tuning in active dendrites, *Frontiers in Cellular Neuroscience*, 11, 72: 1–8, March 2017.

13. **Rishikesh Narayanan** and Daniel Johnston, Functional maps within a single neuron, *Journal of Neurophysiology*, 108(9), 2343–2351, November 2012.

14. **Rishikesh Narayanan** and Daniel Johnston, The ascent of channels with memory, *Neuron*, 60(5), 735–738, December 2008.

15. Daniel Johnston and **Rishikesh Narayanan**, Active dendrites: Colorful wings of the mysterious butterflies, *Trends in Neurosciences*, 31(6), 309–316, June 2008.

III. Conference Proceedings

1. **Rishikesh Narayanan** and Y. V. Venkatesh, Experiments on three-dimensional wire-frame object recognition, in Proceedings of the International Conference on Neural Information Processing, Vol. 1, 207–210, 21–23 October 1998, Kitakyushu, Japan.

2. **Rishikesh Narayanan** and Y. V. Venkatesh, An invariant pulse-coder for 2-D shape recognition, in Proceedings of the IEEE International Conference on Information, Communications and Signal Processing, Vol. 3, 1552–1556, 9–12 September 1997, Singapore.

3. Y. V. Venkatesh and **Rishikesh Narayanan**, Some applications of active contours using ANN's isomorphic to boundaries, in Proceedings of the IEEE International Conference on Information, Communications and Signal Processing, Vol. 3, 1547–1551, 9–12 September 1997, Singapore.

4. Y. V. Venkatesh and **Rishikesh Narayanan**, Modelling active contours using neural networks isomorphic to boundaries, in Proceedings of the IEEE International Conference on Neural Networks, Vol. 3, 1669–1672, 9–12 June 1997, Houston, TX, USA.

IV. Conference Abstracts

1. Sanjna Kumari and **Rishikesh Narayanan**, Dorsoventral gradients in intrinsic neuronal excitability of rat hippocampal granule cells and mossy cells, Presented at the Society for Neuroscience Annual Meeting, 15–19 November 2025, San Diego, USA, Program No. PSTR318.06.

2. Anjana Santhosh and **Rishikesh Narayanan**, Task-dependence of network-to-network variability in learning, performance, and dynamics of heterogeneous recurrent networks, Presented at the Society for Neuroscience Annual Meeting, 15–19 November 2025, San Diego, USA, Program No. PSTR039.02.

3. Sarang Saini and **Rishikesh Narayanan**, Dopamine-induced reduction of subthreshold excitability in rat dentate gyrus granule cells contributes to pattern separation, Gordon Research Seminar/Conference on Modulation of Neural Circuits and Behavior, 17–23 May 2025, Les Diablerets, Switzerland.

4. Richa Sirmaur and **Rishikesh Narayanan**, Distinct extracellular signatures of chemical and electrical synapses impinging on active dendrites differentially contribute to ripple-frequency oscillations, Society for Neuroscience Annual Meeting, 5–9 October 2024, Chicago, IL, USA, Program No. PSTR383.16.

5. Richa Sirmaur and **Rishikesh Narayanan**, Impact of afferent and recurrent inputs impinging on hippocampal active basal dendrites in the emergence of ripple-frequency oscillations, Gordon Research Seminar/ Conference on Dendrites: Molecules, structure and function, 25–31 March 2023, Lucca (Barga), Italy.

6. Sanjna Kumari and **Rishikesh Narayanan**, Emergence of spatially selective firing in hippocampal granule cells through conjunctive synaptic and intrinsic plasticity, Gordon Research Seminar/ Conference on Dendrites: Molecules, structure and function, 25–31 March 2023, Lucca (Barga), Italy.

7. Rituparna Roy and **Rishikesh Narayanan**, Synergistic interaction between calcium and calcium-dependent potassium channels in regulating complex spike bursting in CA3 pyramidal neuronal models, EMBO Workshop on Dendrites 2022: Dendritic anatomy, molecules and function, 23–26 May 2022, Heraklion, Greece.

8. Pavithraa Seenivasan, Reshma Basak, and **Rishikesh Narayanan**, Conjunctive theta- and ripple-frequency oscillations across hippocampal strata of foraging rats, Computational and Systems Neuroscience (COSYNE 2022) meeting, 17–20 March 2022, Lisbon, Portugal.

9. Ankit Roy and **Rishikesh Narayanan**, Spatial information transfer in hippocampal place-cell models depends on biophysical heterogeneities, trial-to-trial variability, and symmetry of place-field firing, Society for Neuroscience Annual Meeting, 8–11 November 2021, Program No. P868.07.

10. Divyansh Mittal and **Rishikesh Narayanan**, HCN channels stabilize heterogeneous conductance based continuous attractor networks, Society for Neuroscience Annual Meeting, 8–11 November 2021, Program No. PP863.02.

11. Rituparna Roy and **Rishikesh Narayanan**, Dominant role of calcium and calcium-dependent potassium channels in regulating complex spike bursting in a heterogeneous population of CA3 pyramidal neuron models, Society for Neuroscience Annual Meeting, 8–11 November 2021, Program No. P127.03.

12. Pavithraa Seenivasan, Reshma Basak, and **Rishikesh Narayanan**, Co-occurrence of hippocampal theta- and ripple-frequency rhythms in foraging rats, Society for Neuroscience Annual Meeting, 8–11 November 2021, Program No. P136.05.

13. Sameera Shridhar, Poonam Mishra, and **Rishikesh Narayanan**, Synergistic interactions among intrinsic, synaptic, and structural heterogeneities drive synaptic plasticity profiles in dentate gyrus granule cells, Society for Neuroscience Annual Meeting, 8–11 November 2021, Program No. P121.05.

14. Harshith Nagaraj and **Rishikesh Narayanan**, Ion-channel degeneracy and plasticity manifolds govern the emergence of circadian oscillations of neuronal intrinsic properties in the suprachiasmatic nucleus, Society for Neuroscience Annual Meeting, 8–11 November 2021, Program No. P097.12.

15. Divyansh Mittal and **Rishikesh Narayanan**, Resonating neurons stabilize heterogeneous grid-cell networks, Computational and Systems Neuroscience (COSYNE 2020) meeting, 27 February–3 March 2020, Denver, Colarado, USA.

16. Reshma Basak and **Rishikesh Narayanan**, Robust emergence of sharply tuned place cell responses in hippocampal neurons with structural and biophysical heterogeneities, Society for Neuroscience Annual Meeting, 19–23 October 2019, Chicago, IL, USA, Program No. 789.16.

17. Poonam Mishra and **Rishikesh Narayanan**, Theta burst firing induces intrinsic plasticity in dentate gyrus granule cells. IBRO World Congress, 21–25 September 2019, Daegu, Republic of Korea. Abstract published as IBRO Reports, Volume 6, Supplement, September 2019, Pages S145–S146.

18. Rishikesh Narayanan, Degeneracy in robust spatial encoding. IBRO World Congress, 21-25 September 2019, Daegu, Republic of Korea. Abstract published as IBRO Reports, Volume 6, Supplement, September 2019, Page S40.

19. Pavithraa Seenivasan and **Rishikesh Narayanan**, Efficient phase coding in hippocampal place cells, Computational and Systems Neuroscience (COSYNE 2019) meeting, 28 February–3 March 2019, Lisbon, Portugal.

20. Poonam Mishra and **Rishikesh Narayanan**, Activity-dependent long-term intrinsic plasticity in dentate gyrus granule cells, Society for Neuroscience Annual Meeting, 3–7 November 2018, San Diego, USA, Program No. 203.14.

21. Manisha Sinha and **Rishikesh Narayanan**, An emergent model of hippocampal sharp wave ripple complexes reveals sublayer-specific stratified disparities, EMBO Workshop on Dendrites 2018: Dendritic anatomy, molecules and function, 17–20 June 2018, Heraklion, Greece.

22. Manisha Sinha and **Rishikesh Narayanan**, An emergent model of hippocampal sharp wave ripple complexes reveals sublayer-specific stratified disparities, Society for Neuroscience Annual Meeting, 11–15 November 2017, Washington D.C., USA, Program No. 615.18.

23. Anindita Das and **Rishikesh Narayanan**, Location-dependence of spike triggered average and gamma-range coincidence detection in rat hippocampal pyramidal neuronal dendrites, Gordon Research Seminar/ Conference on Dendrites: Molecules, structure and function, 25–31 March 2017, Lucca (Barga), Italy.

24. Sufyan Ashhad and **Rishikesh Narayanan**, Active dendritic conductances regulate the impact of gliotransmission on rat hippocampal pyramidal neurons, Society for Neuroscience Annual Meeting, 12–16 November 2016, San Diego, USA, Program No. 211.28.

25. Poonam Mishra and **Rishikesh Narayanan**, Degenerate mechanisms mediate decorrelation and pattern separation in the dentate gyrus, Society for Neuroscience Annual Meeting, 12–16 November 2016, San Diego, USA, Program No. 263.08.

26. Sunandha Srikanth and **Rishikesh Narayanan**, Intrinsic plasticity during state-dependent calcium homeostasis in hippocampal model neurons, Society for Neuroscience Annual Meeting, 17–21 October 2015, Chicago, IL, USA, Program No. 672.19.

27. Rahul Kumar Rathour and **Rishikesh Narayanan**, Modulation of intrinsic response dynamics by subthreshold inactivating conductances in rat hippocampal pyramidal neurons, Society for Neuroscience Annual Meeting, 15–19 November 2014, Washington, D.C., USA, Program No. 299.24.

28. Manisha Sinha and **Rishikesh Narayanan**, Subthreshold conductances regulate local field potentials and theta-frequency spike phase preference of hippocampal model neurons, Society for Neuroscience Annual Meeting, 15–19 November 2014, Washington, D.C., USA, Program No. 686.07.

29. Sufyan Ashhad, Daniel Johnston and **Rishikesh Narayanan**, Activation of inositol trisphosphate receptors is sufficient for inducing graded intrinsic plasticity in hippocampal pyramidal neurons, Society for Neuroscience Annual Meeting, 15–19 November 2014, Washington, D.C., USA, Program No. 686.10.

30. Manisha Sinha and **Rishikesh Narayanan**, HCN channels regulate theta-frequency spike phase preference of hippocampal model neurons, Gordon Research Seminar / Conference on Dendrites: Molecules, structure and function, 18–24 May 2013, Les Diablerets, Switzerland.

31. Anindita Das and **Rishikesh Narayanan**, Dendritic voltage-gated ion channels regulate feature selectivity in spiking dynamics of hippocampal model neurons, Gordon Research Seminar / Conference on Dendrites: Molecules, structure and function, 18–24 May 2013, Les Diablerets, Switzerland.

32. Sufyan Ashhad and **Rishikesh Narayanan**, The *A*-type potassium current regulates ER calcium release through inositol trisphosphate receptors in a hippocampal pyramidal cell model, Society for Neuroscience Annual Meeting, 13–17 October 2012, New Orleans, LA, USA, Program No. 340.05.

33. Rahul Rathour and **Rishikesh Narayanan**, Influence fields: A quantitative framework for the representation and analysis of functional maps within a single neuron, Gordon research conference on Dendrites: Molecules, structure and function, 13–18 March 2011, Ventura, CA, USA.

34. **Rishikesh Narayanan** and Daniel Johnston, Intracellular calcium store depletion in rat hippocampal neurons induces long-term increases in the *h* current, Society for Neuroscience Annual Meeting, 15–19 November 2008, Washington, DC, USA, Program No. 240.20.

35. Clifton Rumsey, **Rishikesh Narayanan** and Daniel Johnston, Intraneuronal resonance and frequency response properties of CA1 pyramidal neuron models, Society for Neuroscience Annual Meeting, 3–7 November 2007, San Diego, CA, USA, Program No. 587.12.

36. **Rishikesh Narayanan** and Daniel Johnston, Activity regulates location-dependent oscillatory dynamics in rat hippocampal neurons, Gordon Research Seminar / Conference on Dendrites: Molecules, structure and function, 18–23 March, 2007, Ventura, CA, USA.

37. **Rishikesh Narayanan** and Daniel Johnston, Activity-dependent increase of intrinsic oscillatory frequency in rat hippocampal neurons, Society for Neuroscience Annual Meeting, 14–18 October 2006, Atlanta, GA, USA, Program No. 42.6.

38. **Rishikesh Narayanan**, Darrin H. Brager, Yuan Fan and Daniel Johnston, I_{h} as a candidate mechanism for sliding the BCM modification threshold, Society for Neuroscience Annual Meeting, 12–16 November 2005, Washington, DC, USA, Program No. 737.5.

39. **Rishikesh Narayanan**, Luke R. Johnson, Hannah H. Alphs, Joseph E. LeDoux and Sumantra Chattarji, Biophysical correlates of intrinsic and stress-induced morphological variability in lateral amygdaloid neurons: A computational study, Society for Neuroscience Annual Meeting, 23–27 October 2004, San Diego, CA, USA, Program No. 517.7.

40. **Rishikesh Narayanan**, Anusha Narayan and Sumantra Chattarji, Computational analysis of the effects of chronic stress on hippocampal excitability: From neurons to network, Society for Neuroscience Annual Meeting, 8–12 November 2003, New Orleans, LA, USA, Program No. 192.5.

ORGANIZING ROLE IN CONFERENCES/WORKSHOPS

- Co-organizer of summer school on Computational Approaches to Memory and Plasticity, Indian Institute of Science Education and Research, Pune, 3–17 July 2025.
- Co-organizer of summer school on Computational Approaches to Memory and Plasticity, Indian Institute of Science Education and Research, Pune, 1–17 July 2024.
- Co-organizer of summer school on Computational Approaches to Memory and Plasticity, Indian Institute of Science Education and Research, Pune, 11–25 July 2023.
- Member, organizing committee, MBU50: Golden Jubilee Celebrations of the Molecular Biophysics Unit, Indian Institute of Science, Bangalore, 23–25 January 2023.
- Co-organizer of summer school on Computational Approaches to Memory and Plasticity, National Centre for Biological Sciences, Bangalore, 23 July–7 August 2022.
- Co-organizer of summer school on Computational Approaches to Memory and Plasticity, National Centre for Biological Sciences, Bangalore, 27 June–12 July 2019.
- Member, organizing committee, Third Workshop on Brain, Computation And Learning, Indian Institute of Science, Bangalore, 24–29 June 2019.
- Co-organizer of summer school on Computational Approaches to Memory and Plasticity, National Centre for Biological Sciences, Bangalore, 1–16 July 2018.
- Member, organizing committee, Second Workshop on Brain, Computation And Learning, Indian Institute of Science, Bangalore, 8–12 January 2018.
- Co-organizer of summer school on Computational Approaches to Memory and Plasticity, National Centre for Biological Sciences, Bangalore, 19 July–3 August 2017.
- Member, organizing committee, First Workshop on Brain, Computation And Learning, Indian Institute of Science, Bangalore, 9–13 January 2017.
- Co-organizer of summer school on Computational Approaches to Memory and Plasticity, National Centre for Biological Sciences, Bangalore, 1–16 July 2016.
- Member, organizing committee, Annual meeting of the Indian Biophysical Society on *Molecules in Living Cells: Mechanistic Basis of Function*, Indian Institute of Science, Bangalore, 8–10 February 2016.
- Co-organizer of summer school on Computational Approaches to Memory and Plasticity, National Centre for Biological Sciences, Bangalore, 27 June–12 July 2015.

INVITED RESEARCH TALKS

- Talk on "Diverse roles of heterogeneities in neural circuits" as part of the *Bangalore Neuromorphic Engineering Workshop*, Indian Institute of Science, Bengaluru, 10 January 2026.

- Talk on "Neuroscience for AI for neuroscience" in the workshop *AI for Life Sciences* held at Maharaja Sayajirao University of Baroda, Vadodara, 27 September 2025.
- Talk on "A cascade of degeneracy in encoding neural systems" in the satellite meeting of *Gutenberg Workshop on Flexibility and Robustness of Nervous System Function* held at Ingelheim, Germany, 2–4 September 2025.
- Talk on "Degeneracy in neural circuits as a substrate for resilience" in the satellite meeting of *XVIII Workshop on Neurobiology of Epilepsy (WONOEP 2025) on "The resilient brain"* organized by the International League Against Epilepsy (ILAE), held at Cascais, Portugal, 25–29 August 2025.
- Talk on "Diverse roles of heterogeneities in neural circuits" at *Computational Approaches to Memory and Plasticity*, Indian Institute of Science Education and Research, Pune, 3–17 July 2025.
- Talk on "Complexity and degeneracy in single-neuron oscillations" in the satellite meeting of *India EMBO lecture course on Understanding biological clocks: Theoretical framework to cellular basis* held at the Jawaharal Nehru Centre for Advanced Scientific Research, Bengaluru, 8–9 March 2025.
- Talk on "Membrane molecules and neuronal function: A complex systems framework" as part of the *43rd Mahabaleshwar Seminar Series on Molecules, Membranes and Organelles*, Alibaug, 26 February–1 March 2025.
- Talk on "The four generations of single-neuron models: From the perceptron to the complex adaptive system" as part of the *Bangalore Neuromorphic Engineering Workshop*, Indian Institute of Science, Bengaluru, 10 January 2025.
- Talk on "The brain is a complex adaptive system: Implications for function and dysfunction" as part of the *SCAN Annual Symposium 2025*, Indian Institute of Technology Bombay, Mumbai, 9 January 2025.
- Talk on "The brain is a complex adaptive system" as part of the *90th Anniversary General Meeting of the Indian National Science Academy*, SRM Institute, Chennai, India, 9–10 December 2024.
- Talk on "A single neuron is a complex adaptive system" as part of the *Center for Learning and Memory Seminar Series*, The University of Texas at Austin, Austin, USA, 11 October 2024.
- Talk on "A cascade of degeneracy in encoding neural systems" at the Symposium on *The brain's best kept secret is its degenerate structure*, Society for Neuroscience Annual Meeting, Chicago, USA, 5–9 October 2024.
- Talk on "Diverse roles of heterogeneities in neural circuits" at the Workshop on *Neural Diversity and Computation – Towards a Mathematical Account of Tissue Heterogeneity in the Brain*, Bernstein Network Computational Conference, Frankfurt, Germany, 29–30 September 2024.

- Talk on "Network motifs in cellular neurophysiology" at the Theoretical Sciences Visiting Program on *Neuromodulation of adaptive learning: Theoretical lessons learned from invertebrate and vertebrate brains*, Okinawa Institute of Science and Technology, Okinawa, Japan, 29 July 2024.

- Talk on "Network motifs in cellular neurophysiology" at *Computational Approaches to Memory and Plasticity*, Indian Institute of Science Education and Research, Pune, 1–17 July 2024.

- Talk on "Plasticity manifolds in the brain" at the symposium on *Brain, Behaviour and Society*, National Brain Research Centre, Manesar, India, 13–15 December 2023.

- Talk on "Efficient information coding and degeneracy in the nervous system" at the workshop on *Optimality, evolutionary trade-offs, Pareto theory and degeneracy in neuronal modeling*, CNS*2023, Leipzig, 18–19 July 2023.

- Talk on "Computation and plasticity in the brain: Towards remedying the oversimplifications" at *Computational Approaches to Memory and Plasticity (CAMP)*, Indian Institute of Science Education and Research, Pune, 11–25 July 2023.

- Talk on "From Electronics Engineering to Electrophysiology: An Acknowledgment of HFSP Support to Basic Research" in Symposium on *Opportunities for frontier research collaborations by the Human Frontier Science Program (HFSP)*, National Institute of Immunology, New Delhi, 10 February 2023.

- Talk on "Plasticity and computing in the brain: Towards remedying the oversimplifications" at the *KCN Hub, Krembil Computational Neuroscience*, University of Toronto, Canada, 17 January 2023.

- Talk on "Efficient information coding and degeneracy in the nervous system" at the *MAIN meeting 2022: Maths, AI, and Neuroscience*, KTH Royal Institute of Technology, Stockholm, Sweden, 15–17 December 2022.

- Talk on "Information processing and plasticity in the brain" at *iGEM, Indian Institute of Science Education and Research, Mohali*, 8 August 2022.

- Talk on "Computation and plasticity in the brain: Towards remedying the oversimplifications" at the *International Institute of Information Technology, Bangalore*, 7 March 2022.

- Talk on "Computing and plasticity in the brain: Towards remedying the oversimplifications" at the National Science Day symposium on *Biology is Fascinating*, Tezpur University, Tezpur, 1 March 2022.

- Talk on "Information processing and plasticity in the brain: Towards remedying the oversimplifications" at the *Indian Institute of Science Education and Research, Bhopal*, 8th Annual Meeting, 7–8 January 2022.

- Talk on "Plasticity and computing in the brain: Oversimplifications" at the *MAIN meeting 2021: Maths, AI, and Neuroscience*, KTH Royal Institute of Technology, Stockholm, Sweden, 13–15 December 2021.

- Talk on "Heterogeneities in neural circuits: Origins and implications" at *Synapse 2021* organized by IISER Tirupati and IISER Thiruvananthapuram, 3–4 December 2021.
- Talk on "Heterogeneities in neural circuits: Origins and implications" at the *32nd mid year meeting of the Indian Academy of Sciences, Bangalore*, 11 June 2021.
- Talk on "The changes within: Intrinsic plasticity in hippocampal neurons" at the *National Centre for Biological Sciences*, Bangalore, NCBS Annual Talks 2020, 16 January 2020.
- Talk on "The changes within: Intrinsic plasticity in hippocampal neurons" at the *Jawaharlal Nehru Centre for Advanced Scientific Research*, Bangalore, 23 October 2019.
- Talk on "Degeneracy in robust spatial encoding" at *IBRO World Congress*, Daegu, Republic of Korea, 21–25 September 2019.
- Opening keynote talk on "Degeneracy in the brain" at *NeuroAI symposium*, Bangalore, 3–4 August 2019.
- Talk on "Degeneracy in robust spatial encoding" in the *Indo-French scientific and training workshop* organized by and held at Université Côte d'Azur, Nice, France, 4–8 February 2019.
- Talk on "Degeneracy in robust place field encoding" in the *IISc-UCL symposium on neuroscience, machine learning and artificial intelligence*, University College of London, London, U.K., 8–10 July 2018.
- Talk on "Degeneracy in robust spatial encoding" in the *IBRO-APRC school on cognitive neuroscience: The 5th Bangalore Cognition Workshop*, Indian Institute of Science, Bangalore, June 17–19, 2018.
- Talk on "Degeneracy in the hippocampal formation" in the *One-Day Satellite Symposium on Neuroscience, IBRO-APRC-Associate School of Neuroscience*, Savitribai Phule Pune University, Pune, 26 March 2018.
- Talk on "Degeneracy in the hippocampal formation" in the *No Garland Neuroscience* symposium, Indian Institute of Science Education and Research, Pune, October 13–15, 2017.
- Talk on "Active Dendrites: Implications for local field potentials and neuron-glia interactions" in the *Meeting on Neuroscience Across Scales*, National Centre for Biological Sciences, Bangalore, July 17–19, 2017.
- Talk on "Stores, Channels, Glue and Trees" in the *Third Mini Symposium on Cell Biology*, National Centre for Cell Sciences, Pune, May 23, 2017.
- Talk on "Degeneracy in hippocampal physiology and plasticity" in the *ICTS Summer Program on Dynamics of Complex Systems*, International Centre for Theoretical Sciences (ICTS), Bangalore, May 13, 2017.
- Talk on "Active dendrites and rhythms in the hippocampus" in the *International Symposium on Biological Timing and Health Issues in the 21st Century*, University of Delhi, Delhi, February 21–24, 2017.

- Talk on "Active Dendrites: Implications for neuronal physiology and neuron-glia interactions" in the *The 25th ISFN Annual Meeting and the joint Israel-India Neuroscience symposium*, Eilat, Israel, December 4–6, 2016.

- Talk on "Functional maps within a single neuron: Emergence, homeostasis and implications" in the *EMBO Workshop on Dendritic Anatomy, Molecules and Function*, Foundation for Research and Technology, Hellas, Crete, Greece, June 18–21, 2016.

- Talk on "Degeneracy in hippocampal physiology and plasticity" in the Annual meeting of the Indian Biophysical Society on *Molecules in Living Cells: Mechanistic Basis of Function*, Indian Institute of Science, Bangalore, 8–10 February 2016.

- Talk on "Mapping the resonating wings before the stores were depleted", *The colorful wings of Johnston's butterflies: A symposium to honor Prof. Daniel Johnston*, Northwestern medical school, Chicago, USA, 17 October 2015.

- Talk on "HCN channels, LFPs and STA" as part of a KITP Program on *Neurophysics of Space, Time and Learning*, Kavli Institute for Theoretical Physics, University of California, Santa Barbara, USA, Jan 27–Mar 7, 2014.

- Talk on "Reification of the role of ion channel interactions in neuronal physiology" as part of the *Bangalore-Zurich Workshop on Frontiers in Biology and Medicine*, held at the Indian Institute of Science and the National Centre for Biological Sciences, Bangalore, 3–5 February 2014.

- Talk on "Active dendrites regulate spectral selectivity in spike initiation dynamics of hippocampal model neurons" as part of the *INNNI workshop on Hippocampus: From Synapses to Behaviour*, under the aegis of the International Neuroinformatics Coordinating Facility (INCF), held at Indian Institute of Science Education and Research, Pune, 1–2 December 2013.

- Talk on "Reification of Non-Synaptic Changes in Neuronal Networks" as part of the *International conference on Pattern Recognition Applications and Techniques* held at the Meenakshi College for Women, Chennai, 1–2 March 2013.

- Talk on "Two tales of two active membranes: Influences and interactions" as part of the *International Conference on Recent Advances in Molecular Mechanisms of Neurological Disorders*, under the aegis of the Society for Neurochemistry, India, at the All India Institute of Medical Sciences, New Delhi, 21–23 February, 2013.

- Talk on "Functional maps within a single neuron" as part of the *Winter Conference on Computational Aspects of Neural Engineering* held at the Indian Institute of Science, Bangalore, 20–21 December 2012.

- Talk on "Functional maps within a single neuron" as part of the *International Neuroinformatics Coordinating Facility (INCF) workshop* held at The Institute of Mathematical Sciences, Chennai, 5–7 November 2012.

- Talk on "Two tales of two active membranes: Influences and interactions" as part of the *Edinburgh - Bangalore symposium* held at the Indian Institute of Science, Bangalore, 16–17 January 2012.

INVITED PEDAGOGIAL LECTURES

- Lectures on "The four generations of single-neuron models: From the perceptron to the complex adaptive system" and "A single neuron is a complex adaptive system" in summer school on *Computational Approaches to Memory and Plasticity*, Indian Institute of Science Education and Research, Pune, 3–17 July 2025.
- Lectures on "Dendritic ion channels and intrinsic plasticity" and "Theta oscillations in the hippocampal formation: Origins, implications, and interactions" in summer school on *Computational Approaches to Memory and Plasticity*, Indian Institute of Science Education and Research, Pune, 1–17 July 2024.
- Lecture on "Brain oscillations: Origins, implications, and interactions" in *NIMHANS Electrophysiology Workshop (NEP)-2024*, National Institute of Mental Health and Neurosciences (NIMHANS), Bangalore, 25 November 2024.
- Master class on "Plasticity and computing in the brain: Towards remedying the oversimplifications" at the Theoretical Sciences Visiting Program on *Neuromodulation of adaptive learning: Theoretical lessons learned from invertebrate and vertebrate brains*, Okinawa Institute of Science and Technology, Okinawa, Japan, 29 July 2024.
- Lectures on "Morphology and Cable Theory" and "Ion channels" in summer school on *Computational Approaches to Memory and Plasticity*, Indian Institute of Science Education and Research, Pune, 11–25 July 2023.
- Lectures on "Morphology and Cable Theory", "Ion channels", "Synaptic plasticity", and "Degeneracy in detailed neuronal models" in summer school on *Computational Approaches to Memory and Plasticity*, National Centre for Biological Sciences, Bangalore, 23 July–7 August 2022.
- Lectures on "Morphology and Cable Theory", "Ion channels", "Synaptic plasticity", "Dendritic ion channels and intrinsic plasticity" and "Degeneracy in detailed neuronal models" in summer school on *Computational Approaches to Memory and Plasticity*, National Centre for Biological Sciences, Bangalore, 27 June–12 July 2019.
- Lecture on "Electrophysiological methods" in *Monsoon Workshop on Experimental Neuroscience (MonsoonWEN)*, Indian Institute of Science, Bangalore, 21–25 July 2019.
- Lectures on "Dendritic computation" and "Degeneracy in neural systems" in the *IFCAM Summer School on Mathematical and Computational Biology*, Indo-French Centre for Applied Mathematics, Indian Institute of Science, Bangalore, July 16–31, 2018.
- Lectures on "Cable Theory", "Ion channels and active dendrites", and "Synaptic plasticity" in summer school on *Computational Approaches to Memory and Plasticity*, National Centre for Biological Sciences, Bangalore, July 1–16, 2018.

- Lecture on "In vitro electrophysiology: Active dendrites and their plasticity" in the *IBRO-APRC-Associate School of Neuroscience*, Savitribai Phule Pune University, Pune, 27–31 March 2018

- General lecture on "Multidisciplinary neuroscience" as part of the *Bio-REAP program* for college students, Planetarium, Bangalore, 24 February 2018.

- Lectures on "Cable Theory", "Dendritic ion channels and intrinsic plasticity", "Single-neuron plasticity models" and "Degeneracy in detailed neuronal models" in summer school on *Computational Approaches to Memory and Plasticity*, National Centre for Biological Sciences, Bangalore, July 19–August 3, 2017.

- Lecture on "Holistic Learning in Biological Neurons" in the *Workshop on Brain, Computation And Learning*, Indian Institute of Science, Bangalore, 9–13 January 2017.

- Lectures on "Passive dendritic computation" and "Active dendritic computation" in the *Second Instructional School on Mathematical and Computational Biology*, National Network for Mathematical and Computational Biology (NNMCB), Indian Institute of Science, Bangalore, 23–31 May 2016.

- Lectures on "Synaptic plasticity", "Dendritic ion channels and intrinsic plasticity", "Single-neuron plasticity models" and "Degeneracy in detailed neuronal models" in summer school on *Computational Approaches to Memory and Plasticity*, National Centre for Biological Sciences, Bangalore, 1–16 July 2016.

- Lectures on "Cable theory" and "Single-neuron plasticity models", *Computational Approaches to Memory and Plasticity*, National Centre for Biological Sciences, Bangalore, 27 June–12 July 2015.

- Lecture on "Functional maps within a single neuron: Homeostasis and plasticity" *Annual BSBE Winter Workshop 2014*, Indian Institute of Technology, Kanpur, 18–20 December, 2014.

- Lectures on "Introduction to dendritic physiology" and "NEURON: Tutorial" as part of the *8th SERB School in Neuroscience* with a focus on brain circuits, Indian Institute of Science Education and Research, Pune, 8–21 December 2014.

- Lecture on "Single-neuron plasticity", *Computational Approaches to Memory and Plasticity*, National Centre for Biological Sciences, Bangalore, 28 June–12 July 2014.

- Lectures on "Functional maps within a single neuron: Principles and plasticity" and "Functional maps within a single neuron: Origins and homeostasis", *First Instructional School on Mathematical and Computational Biology*, Indian Institute of Science Education and Research Mohali (IISERM), Punjab, 15–29 May 2014.

- Lecture on "Neuroscience and engineering techniques: Independent or interdependent?", *National Conference on Computers, Communication and Signal Processing*, Department of Information Technology, SSN College of Engineering, Chennai, 3–5 April 2014.

- Lecture on "Patch-clamp electrophysiology: A biophysical technique with utilities ranging from assessing molecular function to understanding behavioral correlates" as part of a symposium on *Relevance of Physical Science in Biological Research*, Maharani Lakshmi Ammanni College for Women, Bangalore, 18 Feb 2014.
- Lectures on "Dendritic physiology, plasticity and computation" as part of the *7th SERB School in Neuroscience* with a focus on electrophysiology, University of Hyderabad, 9–21 December 2013.
- Lecture on "Patch-clamp electrophysiology: A historical account of utilities ranging from assessing molecular function to understanding behavioral correlates" as part of the *MCB technique symposium 2013* held at the Department of Microbiology and Cell Biology, Indian Institute of Science, Bangalore, 27 April 2013.
- Lectures on "Cellular Neuroscience: Neurons, spikes, synapses and plasticity" as part of the *Winter School on Computational Aspects of Neural Engineering* held at the Indian Institute of Science, Bangalore, 12–19 December 2012.
- Lecture on "The changes within: Intrinsic plasticity and learning theory" as part of the Indo-US Science and Technology Forum's Workshop on *Modeling electrical activity in physiological systems*, held in Agra, 5–9 March 2012.
- Lecture on "The changes within: Intrinsic plasticity, learning and memory" as part of the *5th DST-SERC School in Neuroscience on Learning and Memory*, National Institute of Mental Health and Neurosciences (NIMHANS), 16–29 February 2012.
- Tutorial on "Computational Neuroscience" as part of the *Centenary Conference of the Electrical Engineering department* at the Indian Institute of Science, Bangalore, 14 December 2011.
- Lecture on "The ascent of channels with memory" as part of the Indian Academy Lecture workshop on *Nanotechnology and biosensors: Present and future perspectives* at Dayananda Sagar Institutions, Bangalore, 30 November 2011.
- Lecture on "The ascent of channels with memory", at the Department of Chemical Engineering, Indian Institute of Science, Bangalore, 11 August 2011.
- Lecture on "What is computational neuroscience?" at the Vidya Vikas Institute of Engineering and Technology, Mysore, 18 September 2010.
- Lecture on "Signal processing and the brain's efforts to understand itself: Independent or interdependent?" in a workshop on signal and image processing, at the M.S. Ramaiah Institute of Technology, Bangalore, 19–20 February 2010.
- Lecture on "Hippocampal learning and ion channels" under the aegis of the Association of Physiologists and Pharmacologists of India, at the Kempegowda Institute of Medical Sciences, Bangalore, 29 January 2010.
- Lectures on "Dendritic computation: Introduction and basic principles" and on "Dendritic computation: Plasticity" in *Computational Neuroscience 2009*, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram, 14–18 November 2009.