Rupesh Kumar Chillale, Ph.D.

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Employment History

2021 – Present **Assistant Research Scientist,** University of Maryland Collge Park, MD, USA.
Mentor: Prof. Shihab Shamma

2019 – 2021 **Senior Postdoc,** École Normale Supérieure, Paris, France.
Mentor: Dr. Yves Boubenec, Prof. Shihab Shamma

2015 – 2019 **Postdoctoral Fellow,** École Normale Supérieure, Paris, France.
Mentor: Dr. Srdjan Ostojic, Prof. Shihab Shamma

2009 – 2011 **Senior Research Fellow,** Jawaharlal Nehru University, New Delhi.
Title: Center for Sleep Studies.
Mentor: Prof. Birendranath Mallick, School of Life Sciences, JNU, New Delhi.

2007 – 2009 **Junior Research Fellow,** Jawaharlal Nehru University, New Delhi.
Title: To Investigate Neurochemical basis of pedenculopontine nucleus mediated generation of rapid eye movement sleep in rats.
Mentor: Prof. Birendranath Mallick, School of Life Sciences, JNU, New Delhi.

Education

2010 – 2015 **Ph.D., Jawaharlal Nehru University, New Delhi** Computational Neuroscience.
Thesis title: *Collective Dynamics and Emergent Properties of Neuronal Systems.*
Supervisor: Prof. Ramakrishna Ramaswamy, School of Computational and Integrative Sciences, JNU, New Delhi.

2005 – 2007 **M.Sc., Jawaharlal Nehru University, New Delhi** in Physics.
Thesis title: *Nano-Particle based detection of Bio-molecules*.

2001 – 2004 **B.Sc. Sri Krishna Devraya University** in Mathematics, Physics and Chemistry.

Research Publications

Journal Articles

1. **Rupesh Kumar Chillale**, S. Shamma, S. Ostojic, and Y. Boubenec, "Dynamics and maintenance of categorical responses in primary auditory cortex during task engagement," **eLife**, vol. 16, no. 12, Nov. 2023. DOI: 10.1101/2022.12.19.521141.

2. M. Shoaib, R. C. Choudhary, **Rupesh K. Chillale, *et al.***, "Metformin-mediated mitochondrial protection post-cardiac arrest improves EEG activity and confers neuroprotection and survival benefit," **The FASEB Journal**, vol. 36, no. 5, Apr. 2022. DOI: 10.1096/fj.202200121r.

3. K. V. Kuchibhotla, T. H. Sten, E. S. Papadoyannis, *et al.*, "Dissociating task acquisition from expression during learning reveals latent knowledge," **Nature Communications**, vol. 10, no. 1, May 2019. DOI: 10.1038/s41467-019-10089-0.

4. **Rupesh Kumar**, S. Bilal, and R. Ramaswamy, "Synchronization properties of coupled chaotic neurons: The role of random shared input," **Chaos: An Interdisciplinary Journal of Nonlinear Science**, vol. 26, no. 6, Jun. 2016. DOI: 10.1063/1.4954377.

5. **Rupesh Kumar**, R. Ramaswamy, and B. N. Mallick, "Local properties of vigilance states: EMD analysis of EEG signals during sleep-waking states of freely moving rats," **PLoS ONE**, vol. 8, no. 10, Y. Abreu-Villaça, Ed., e78174, Oct. 2013. DOI: 10.1371/journal.pone.0078174.

6. **Rupesh Kumar**, A. Bose, and B. N. Mallick, "A mathematical model towards understanding the mechanism of neuronal regulation of wake-NREMS-REMS states," **PLoS ONE**, vol. 7, no. 8, G. Cymbalyuk, Ed., e42059, Aug. 2012. DOI: 10.1371/journal.pone.0042059.

Conference Proceedings

1. B. N. Mallick, A. Singh, M. Khanday, and **Rupesh Kumar**, "Neural mechanism of rem sleep regulation," in *Proceeding of Ranbaxy Science Foundation, XXVIth Round Table Conference on Sleep Disorder: A Wake UP Call)*, New Delhi, India, 2011.

2. **Rupesh Kumar**, R. Ramaswamy, and B. N. Mallick, "Analysis of rat eeg during vigilance states using empirical mode decomposition," in *Front. Comput. Neurosci. Conference Abstract, Cape Town School on Advance Theoretical and Computational Neuroscience*, New Delhi, India, 2011.

In Preparation

1. **Rupesh Kumar Chillale**, M. S. Ali Mohammad, and S. Shamma, *Decoding of imagined speech using human EEG*, 2023.

2. **Rupesh Kumar Chillale**, G. Maron, C. Pleofi, and S. Shamma, *Implicit learning of statistical structure of music in ferret auditory cortex*, 2023.

3. **Rupesh Kumar Chillale**, S. Ostojic, S. Shamma, and Y. Boubenec, *Task related modulation of phase locking in primary auditory cortex*, 2023.

Miscellaneous Experience

Awards and Achievements

1998	**Second Prize**, 10th Standard.
2006	**GATE**, Qualified with 85% percentile.
2010	**NET**, Qualified lectureship.
2011	**Blue Brain Project**, Invited for 6 moths intern participation at Lausanne, Switzerland.
2013	**SRF**, Direct SRF from CSIR.

Certification

2022	**Certified Mental Health First Aider**. Awarded by University of Maryland, College Park.
2023	**RMP** Completed certificate on SfN Reviewer Mentor Program.

Organizational

Workshop	Co-organised Workshop on *ABC of population decoding* in **Q-life Winter School: Neural Networks**, Département de Biologie, **École Normale Supérieure, Paris** on 4th February,2020

Resarch Interest

A pivotal inquiry in human existence pertains to the profound comprehension of how the human brain learns

speech, processes its comprehension, and swiftly makes decisions grounded in speech recognition. This cognitive processing exhibits remarkable capabilities, at times surpassing the most advanced artificial intelligence systems. My research is dedicated to delving into various facets of how the human brain processes speech and auditory perception, with a focus on the following distinctive domains:

1. **Neurocognitive Underpinnings of Speech Comprehension**:

   Within this sphere, I aim to unravel the intricacies of how the auditory cortex contributes to the comprehension of speech using non-invasive techniques such as EEG. Recent studies have shown speech components can be decoded from EEG/MEG while humans are listening to the speech and have more focused on either imagery or only listened tasks and the mapping between them. I would like to unravel both the temporal and spatial relation between speaking, listening and imagery. My proposed approach would be to record EEG while human subjects speak, listen and imagine the same stimuli and decode the relation between them using nonlinear (Deep Neural Networks) mapping. My proposal has four trusts:

   (a) Contrasting the dynamic relation between speaking, listening and imagining EEG
   (b) Decoding the auditory imagery using the listened EEG and vice versa
   (c) Separating movement related components from speaking EEG

2. **Neural Representation of Auditory Perception**:

   A fundamental question in the realm of systems neuroscience revolves around comprehending how the brain rapidly adapts to the demands imposed by task-specific objectives. Information relevant to sensory inputs, task requirements, and decision-making processes is distributed across distinct cortical regions, constituting a hierarchical framework. However, elucidating how recurrent interactions between these regions govern the dynamic evolution of these task-related variables remains an intriguing challenge.

3. **Music Representation within the Brain**:

   Grounded in the predictive coding framework, our research postulates that continuous prediction during music listening is pivotal to the perception of music. In this line of investigation, we examine music enculturation by exposing ferrets to classical compositions by Bach and observe its impact on the predictive signals within the brain, utilizing microelectrocorticography (μECoG) as a monitoring tool.

To address these multifaceted research inquiries, I employ a diverse array of methodologies ranging from animal behavior studies to human recordings, analytical data analysis from machine learning & computational and mathematical modeling.

Academic Engagement

Talks & Posters

1. **Podium talk**: *Implicit Learning of Statistical Structure of Music in Ferret Auditory Cortex* in Annual ARO Mid Winter meeting, **Anaheim, Los Angeles, USA** on February 05, 2024.

2. **Invited talk**: *Role of Primary Auditory Cortex in Encoding Sensory vs Categorical Perception* in International Symposium on "Trends in Computational and System Biology", Mahila Vidhyalaya, **Banaras Hindu University** on April 28, 2023.

3. **Poster**: *Emergence and maintenance of categorical representations in primary auditory cortex* in Advances and Perspectives in Auditory Neuroscience (APAN), **University of Pennsylvania** on November 4, 2021.

4. **Talk**: *Temporal Discrimination in Auditory cortex* at Journèe d'accueil, Departement d'Etudes Cognitives, **Ecole Normalè Superièure**, Paris on February 18, 2016.

5. **Talk**: *Response of coupled Hindmarsh-Rose neurons to shared random inputs* in Dynamics Day Rajasthan-2014 at **Central University of Rajasthan**, Rajasthan on November 10, 2014.

6. **Talk** *Neuronal mechanism of sleep-wakefulness* during 6th Dynamics Day Delhi 2010 at Sri Venkateshwara College, **Delhi University** South Campus on November 27 2010.

7. **Poster**: *Dynamic the encoding of stimuli features, perceptual category and behavioural choice in ferret A1* Annual ARO Mid Winter meeting, **San Jose, USA**, January 25-29, 2020

8. **Poster**: *Disentangling the encoding of stimuli features, perceptual category and behavioural choice in ferret A1 population activity* Neural Coding, Computation and Dynamics (NCCD), **Capbreton, France** on September 22-25, 2019

9. **Poster**: *Persistent Activity of Sound Categories in Primary Auditory Cortex* at 41st Annual ARO Mid Winter meeting, **San Dieago, USA** on February, 10-14, 2018.

10. **Poster**: *Response of coupled bursting neurons to shared random inputs* in Dynamics Days Asia Pacific-08 at **IIT-M & IMSc, Chennai** from July 21- July 24, 2014.

Workshops/Schools

1. *CogHear* from June 12-16, 2023, **University of Maryland, College Park** USA.

2. *Optical Control of Brain functioning with optogenetics and wavefront shaping* from October 7-11, 2019, **Institute de la Vision, Paris**

3. *GDR mini school on spike sorting, calcium imaging and multineuronal data analysis* from December 3-5, Département de Biologie **École Normale Supérieure, Paris**

4. *Neural Networks – From Brains to machines and vice-versa* on October 11-12, 2018, **Institute Pasteur, Paris**

5. *Modeling the auditory system: Theory and Experiments* on May 29-30, 2017, **European Institute for Theoretical Neuroscience, Paris**

6. *Berkeley summer course in mining and modeling of neuroscience data* on July 11-22, Redwood Centre for Theoretical Neuroscience,**University of Berkeley, Berkeley**, USA.

7. *ENP-Universite Paris Descarte-ENS course on Optical Imaging and Electrophysiological Recording in Neuroscience* on May 9-20, 2016 at **Universite Paris Descarte, Paris**

8. *New Concepts in Neural Pattern Encoding* on January 28-29, 2016 at **Gif-Sur-Yvette, France**

9. *Sensory Encoding by Neural Systems* on December 14-15, 2016 at **École Normale Supérieure, Paris**

10. *IBRO-UNESCO Cape Town school on Advance theoretical and computational neuroscience* on December 12-23, 2011 at **Cape Town, South Africa**

11. *Cold Spring Harbor Asia Summer School on Computational & Cognitive Neurobiology* on July 11-23, 2010 at **Suzhou, China**

12. *SERC Winter School on Nonlinear Dynamics* on February 1-13, 2009 at **IISC, Bangalore**

13. • *Indo-US workshop on Science and Technology* in February, 2008 at **IOP, Bhubaneshwar**

Conferences

1. *Computational and System Neuroscience (COSYNE),* 28 Feb- 03 Mar, 2019, **Lisbon, Portugal**

2. *GDR Conference NeuralNet: Understanding Neural Networks from Dynamics to Functions* from December 5-7, 2018, IBENS, **École Normale Supérieure, Paris**

3. *Dynamics Day Aligarh* on November 28, 2015, Department of Physics, **Aligargh Muslim University, Aligarh**

4. *Symposium on Complex Systems: From Physics to Biology* on October15-16, 2013, **Jawaharlal Nehru University, New Delhi**
5. *Conference on Perspectives in Nonlinear Dynamics PNLD* on July 15-18, 2013, **University of Hyderabad, Hyderabad**
6. *8th Dynamics Day Delhi* at Center for Interdisciplinary Research in Basic Sciences, **Jamia Millia Islamia, New Delhi**
7. *Conference on Perspectives in Nonlinear Dynamics PNLD* on July 26-29, 2010 at **IISc, Bangalore**