CV

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2023-2024	Postdoctoral associate, Department of Speech, language and Hearing Science, Purdue University Advisor: Prof. Michael G. Heinz, Purdue University
2018-2023	Ph.D. (Computational Neuroscience), **Prime Minister's Research Fellow**, IIT Kharagpur
2017-2018	Master of Technology (Dual degree), Biotechnology and Biochemical Engineering, IIT Kharagpur.
2013-2017	Bachelor of Technology (Dual degree), Biotechnology and Biochemical Engineering, IIT Kharagpur PhD, Master's and bachelor's thesis advisor: Prof. Sharba Bandyopadhyay, IIT Kharagpur

Research:

Postdoctoral work:

- *Cross-species harmonization of EEG data for predicting similar and dissimilar patterns between them.*
  - Information theoretic approach to understand the encoding of spectro-temporally varying stimuli in hearing impaired chinchilla animal model.
  - CNN based modelling of auditory signals to identify relevant patterns required for speech identification and reconstruction in hearing impaired condition.

Doctoral Thesis: **Recurrent micro-scale sub-networks of excitatory and specific inhibitory neuron types differentially process spectral and temporal structures in sound streams**

- *Processing of spectral features in complex sounds*
  - Worked on timeseries data and developed novel orthogonal metrics to show selectivity to the contrast and context features of different sounds.
  - Used methods like bootstrapped correlations and weighted graphs to find the coding properties of special types of neurons neurons in the brain which encode contrasting features of sound.
- *Selectivity for regularity and randomness in sound streams*
  - Studied varying temporal statistics of randomised sound streams and their proceeding by the brain using large scale group comparisons and weighted graphs.
  - Performed bootstrapped estimation of correlation values to find out local subnetworks of neurons in the brain which code for the temporal features of the sound streams.
  - Used Gini index as a measure of sparsity in weighted graphs to study connectivity within the local networks of the brain and found separate sub-networks which code for temporal features of the sound.
- *Information theoretic approach to explain and simulations to demonstrate the impact of rare sound events*
  - Constructed a binary network feed-forward model based on temporal learning algorithms to demonstrate the preference to rare sound objects shown by the brain.
  - Performed a mutual information based theoretical optimization subject to sparse coding constraints to mathematically prove the selectivity to rare sound objects found in experimental data.
  - Preference the optimisation in two different temporal regimes to study the relative weightage of sparsity on maximising mutual information.

Undergraduate research:

- A network model incorporating the known cellular architecture from a developing brain to demonstrate the role of rare sound objects in the maturation of the brain circuits. (Bachelor's and Masters' thesis)
- Computational investigation of interaction between various protein subunits in macro-molecular protein assemblies. (Summer Internship in National Center for Biological Sciences, Bangalore, India)

Skills:

- Fluent in quantitative statistical analysis, network modelling and image analysis.
- In-depth experience with statistics, hypothesis testing, Bayesian decision theory, Markov models, clustering methods, time series forecasting and knowledge of wide range of modern statistical tools
- Languages: MATLAB, Python, C

Awards and Achievements:

- '*Recommended with commendation*' in the annual PMRF review held in July 2022
- Selected for National Symposium of Prime Minister's Research Fellowship (2022).
- Awarded the Prime Minister's Research Fellowship (PMRF) in the first attempt to pursue PhD in IIT Kharagpur
- Member of the Bronze winning team in International Genetically Engineered Machines (iGEM) in 2016. Engineered a bacterial strain to produce spider silk protein Masp-2 and a mechanism to monitor the production.
- 2nd place in Biotechnology Entrepreneurship Students' Team (BEST) – 2015 conducted by the Dept. of Biotechnology, Govt. of India. Won a cash prize of INR 300,000 along with 4 other team-mates.

Publications:

- Muneshwar Mehra, **Adarsh Mukesh**, Sharba Bandyopadhyay. Earliest experience of rare but not frequent sounds causes long term changes in the adult auditory cortex, **Journal of Neuroscience**, 23 February 2022, 42 (8) 1454-1476 - link
- *Muneshwar Mehra, ***Adarsh Mukesh** and Sharba Bandyopadhyay. Separate functional subnetworks of excitatory neurons show preference to periodic and random structures. **Journal of Neuroscience**. 13 April 2022, 42 (15) 3165-3183 (*equal contribution) - link
- **Adarsh Mukesh,** Muneshwar Mehra, and Sharba Bandyopadhyay. Spectral Contrast selectivity in Excitatory and Inhibitory neurons of mouse auditory cortex. (Submitted).

Conference Presentations:

- **Mukesh A.**, Athreya V.M., Patra M., Heinz M.G. Information theoretical analysis on cross-species EEG signals reveals consistent features within neural oscillations in response to temporally varying sounds. **Society for Neuroscience, 2024**, Chicago, IL. link
- Patra M., **Mukesh A**., Heinz M.G. Characterizing inner-hair-cell specific dysfunction from spike train derived transduction functions using a phenomenological auditory -nerve model. **Acoustic Society of America, 2024**, Ottawa, Canada. link
- Kaushik, A.R., **Mukesh, A.**, Bandyopadhyay, S. Recurrent networks of neurons can produce selectivity to temporally separated sound as a whole. **Association for Research in Otolaryngology, 2023**, Orlando, FL. link
- Muneshwar*, **Mukesh, A***. and Bandyopadhyay, S. Separate functional subnetworks encode regularity and irregularity of sound sequences within auditory cortex. **Society for Neuroscience, 2022**, San Diego, CA. (* equal contribution). link
- **Mukesh, A**., Muneshwar and Bandyopadhyay, S. Deviant selectivity in auditory cortical neurons for stimuli with varying contrast, **Association for Research in Otolaryngology, 2022**, San Jose, CA. link
- Muneshwar, Parashar, M., Srivastava, H.K., **Mukesh, A**. and Bandyopadhyay, S. Role of inhibitory interneurons in long time scale adaptation-based changes in coding of sound sequences in the mouse auditory cortex (ACX), **Society for Neuroscience, 2018**, San Diego, CA. link
- Mukherjee, A., Patel, P., **Mukesh, A**., Muneshwar and Bandyopadhyay, S. Spectral shape-based adaptation unravels mechanisms underlying spectral contrast coding in the mouse auditory cortex (ACX), **Society for Neuroscience, 2018**, San Diego, CA. link
- **Mukesh, A.,** Muneshwar and Bandyopadhyay, S. Model of developing auditory cortex shows low probability stimuli as drivers of cortical organization, **Association for Research in Otolaryngology, 2018**, San Diego, CA. link