Pranav Sankhe

Education

Indian Institute of Technology Bombay, Mumbai, India — *July 2015 – Aug 2020*

Bachelor of Technology & **Master of Technology**
Department of Electrical Engineering, IIT Bombay
Specialization: *Signal Processing & Communication*

Publications & Patents

- **Pranav Sankhe**, Ritik Madan, *Cortical Representations of Auditory Perception using Graph Independent Component Analysis on EEG*. To appear in Proceedings of Future Directions of Music Cognition 2021. Pre-Print
- **Pranav Sankhe**, P.Chaporkar, *An Information Theoretical Approach Towards the Reconstruction of Tempo from EEG Responses*. Accepted at CogMIR 2019. Abstract
- **Pranav Sankhe**, P.Chaporkar, *Efficient Coding Approach Towards Non-Linear Spectro-Temporal Receptive Fields*. Submitted to Journal of Computational Neuroscience. Pre-Print
- **Pranav Sankhe**, Azim, S., Goyal, S., Et al., *Indoor Positioning System using LSTMs over WLAN Network*. Accepted at the 16th IEEE Workshop on Positioning Navigation and Communication 2019. Paper
- Filed a patent, *"Indoor Positioning System using LSTMs over WLAN Network"*, December 2018, **Indian Patent Office**, Mumbai.

Work Experience

Computational Social Neuroscience Group, Centre for Information and Neural Networks
Researcher — *June 2021 - Present*
Guide: Dr. Masahiko Haruno

Computational Underpinnings and Neural Correlates of Self Focus Theory
We investigated the computational mechanisms and neural correlates of self-focus theory for performance deterioration under anxiety using Drift Diffusion Modelling and brain imaging. For a sequential motor task, we found that under anxiety, the reflective processes causes the reactivation of explicit choice processes reducing the drift rate that results in performance deterioration. In addition to that, we found that the slowing down of participants was accounted for by peripheral processes such as delays in response execution and stimulus encoding. We are preparing to submit our work to *Nature Neuroscience*.
We are currently studying the impact of threat on model-free and model-based learning mechanisms in the view of self-focus theory.

Honda Research Institute
Visiting Student Researcher — *Feb 2020 - Oct 2020*
Guide: Dr. Shigeaki Nishina

Extension of Human Visual Function based on Brain Plasticity
We proposed a computational model for the cross-modal association of the visual perception system with the temperature perception system. In addition to that, we designed a perceptual learning framework for the sensory association and designed behavioural experiments to verify the predictions of our model. Unfortunately, because of the pandemic, we couldn't conduct experiments, but we established theoretical bounds on SNR levels of visual and thermal signal estimation for the learning of the cross-modal association to converge.

Rakuten Instiute of Technology
Research Scientist — *Nov 2020 - Apr 2021*

I worked at the Research & Development centre of Rakuten (An IT Company in Japan) for a period of half-year. During my time there, I worked on migrating Rakuten projects to new

Hadoop and Spark systems. I also worked on the integration of Rakuten's digital payment data with the existing user understanding framework and improvised Rakuten's user understanding models by Multitask Task Learning.

Other Research Work

Efficient Coding Approach Towards Non-Linear Spectro-Temporal Receptive Fields
Guide: Prof. Prasanna Chaporkar, Electrical Engineering, IIT Bombay

Linear Non-Linear(LN) models are widely used to characterize the receptive fields of early-stage auditory processing. We apply the principle of efficient coding to the LN model of the Spectro-Temporal Receptive Fields(STRFs) of neurons in the primary auditory cortex. Efficient coding is realized by jointly optimizing the mutual information between stimuli and neural responses subjected to the metabolic cost of firing spikes. We compare the predictions of the efficient coding principle with the physiological observations, which match qualitatively under realistic conditions of noise in stimuli and the spike generation process. We have submitted our work at the *Journal of Computational Neuroscience*, and it is currently under review.

Cortical Representations of Auditory Perception using Graph Independent Component Analysis on EEG
Guide: Prof. Animesh Kumar, Electrical Engineering, IIT Bombay *Jan'19 - May'19*

We identified intrinsic cognitive subnetworks corresponding to music perception by decomposing the whole brain graph-network by performing Graph-Independent Component Analysis. Graph-ICA is a variant of ICA that decomposes the measured graph into independent source graphs. We observed that the computed electrodes' location corresponds to the temporal lobes and the Broca's area, which have been found to be involved in auditory perception. Additionally, we found that the weight of auditory subnetworks is positively correlated with the tempo of the stimulus.

An Information Theoretical Approach Towards the Reconstruction of Tempo from EEG Responses
Guide: Prof. Prasanna Chaporkar, Electrical Engineering, IIT Bombay *Jan'19 - Oct'19*

We proposed an information theoretical model to analyze the reconstruction of the tempo of music stimuli from EEG responses. Our focus was on the question of computationally quantifying the amount of information shared between the response of neuronal populations and the stimulus input they receive. We computed the mutual information, which we then used to establish bounds on tempo change for the reconstruction from EEG response data. Our results established bounds within which the reconstruction of the music stimulus from EEG responses is possible. We presented our work at CogMIR 2019 and received the *Best Paper Award*.

Achievements and Awards

Undergraduate Research Award

- Awarded Undergraduate Research Award for exceptional research work done in senior year of my undergraduate studies. We developed a novel and highly accurate indoor localization system and filled a patent for the same.

Best Paper Award

- Received the Best Paper Award at CogMIR 2019 for our work on *"An Information Theoretical Approach Towards the Reconstruction of Tempo from EEG Responses"*

Scientific Outreach

I conducted a six-month-long science workshop in IIT Bombay for kids of age 12-16 from the underprivileged slums of Mumbai. The workshop included learning about electronic sensors, microprocessors like Arduino, and basic C programming. Interacting with these lovely kids and helping them build exciting projects was one of the most fulfilling experiences I have ever had and made me realize the importance of scientific outreach.