Rana Mozumder

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Education

Vanderbilt University (VU) *USA*

Ph.D. in Biomedical Engineering *Aug 22- Present*

- **Research:** Cognitive neuroscience, Neuroengineering.
- **Key Courses:** Special topics in Deep Learning, Advanced Quantitative Image Analysis, Analysis of fMRI, Quantitative Methods in BME, Fundamentals of Neuroscience II.

Bangladesh University of Engineering and Technology (BUET) *Bangladesh*

Bachelor of Science, Biomedical Engineering *2016-2021*

- **CGPA:** 3.78/4.00
- **Research:** Biomedical signal processing.
- **Key Courses:** Digital Signal Processing, Random Signal Processing, Medical Imaging, Biomedical Instrumentation, Tissue Engineering.

Research Experiences

Department of Biomedical Engineering, VU *USA*

Graduate Student *Aug 22- Present*

- **Optotagging Somatostating interneurons in macaque prefrontal cortex.** In this ongoing project, I optically tag Somatostatin (SST) interneurons in the prefrontal cortex of macaque brain. My aim is to study their functional roles in local circuit that contorls working memory by both tagging and stimulating them in live monkeys. When completed, this will provide tremondous insights about the cellular-level computations (for the first time in a non-human primate model).
- **Asynchronous firing and off states in working memory maintenance.** In this work we are trying to answer a very important/debated question in the field: Is persistent activity an artifact of averaging? Along with traditional approch like raster plot, peri-stimulus time histogram, and inter-spike interval analysis, we are using machine learning algorithms to decode stimulus from neural activity. Read the paper *here*.
- **Repeatable, low-drift recordings in behaving non-human primates using flexible microelectrodes.** In collaboration with *Gonzales Lab*, we are working on making next generation flexible probes for large animal models (macaque monkeys). Currently we are working on acute recording set up with the aim of creating fully chronic probes in future. Read the preprint *here*.
- **Integration of audiovisual motion in dorsolateral prefrontal cortical neurons.** Our results demonstrate that dorsolateral prefrontal neurons integrate auditory and visual motion signals, extending multisensory computations beyond sensory cortices into prefrontal circuits that support higher-order cognition. Read the paper *here*.
- **Contributions of narrow- and broad-spiking prefrontal and parietal neurons on working memory tasks.** We divided neurons into two groups: narrow and broad-spiking by extracting feature from their waveform and explored how these different cell types contribute to perform cognitive tasks. This work got published in Frontiers in Systems Neuroscience. Paper link
- **Single-neuron and population measures of neuronal activity in working memory tasks.** This work compared traditional single-neuron approaches with population-level analysis and what kind of insights we can get from both kind of approaches. This work is now published in Journal of Neurophysiology. Paper link

Department of Biomedical Engineering, BUET *Bangladesh*

Undergraduate Student *2018 - 2021*

- **Subject Independent Mental Task Classification using Energy based Features from EEG Signal (UG thesis).** In this work two methods were investigated for classification. Firstly, the signal was divided into five different frequency bands and Entropy and Log-variance of signals were calculated to construct the feature vector. And secondly, Variational Mode Decomposition (VMD) analysis was performed and then, same energy related features were extracted from the Intrinsic Mode Functions found after VMD analysis to form the feature vector. In both cases k-Nearest Neighbors was used as the classifier. Thesis report

Work Experiences

Constantinidis Lab *USA*

Graduate Research Assistant *Aug 22- Present*

- Leading optogenetic experiments on NHPs in the lab.
- Designing new experiments, training non-human primates (NHPs) on novel tasks.
- Multimodal recording: electrophysiological recording with various laminar probes, e.g., Plexon, Diagnostic Bio Chips, Neuropixels probes, and behavioral data (eye-tracking).
- Data preprocessing and spike sorting to create datasets
- Analysis of data: Single-neuron, Population-level, and Local Field Potential (LFP) analysis.
- CT and MR image analysis (Registration, Segmentation) for surgery.

Biomedical Engineering Department, VU *USA*

Graduate Teaching Assistant for *Biomedical Instrumentation* course *Fall'23, Fall'24*

- Guided senior-level students in building robust hardware systems for recording biophysical signals such as ECG.
- Assisted in designing and debugging microcontroller codes to collect, preprocess, and visualize physiological data.
- Led hands-on lab sessions, providing one-on-one support to students in troubleshooting and optimizing their systems.
- Evaluated student projects and provided constructive feedback to enhance their technical and analytical skills.

Sanofi Bangladesh *Bangladesh*

Trainee Engineer *2019*

- Worked there as an intern as a part of our academic curriculum.
- Explored their plants, research and development wing, product design, and engineering section to gain insight into the industrial production of drugs.

Publications & Manuscripts

2026	Woods DP, Adams GM, **Mozumder, R.**, Dang W, Chen AY, Constantinidis C, & Gonzales DL., Repeatable, low-drift recordings in behaving non-human primates using flexible microelectrodes. Paper link	*Preprint*
2025	**Mozumder, R., Wang, Z.,Dang, W., Zhu, J., Hammond, B. & Constantinidis, C.**, Asynchronous firing and off states in working memory maintenance. Paper link	*Cell Reports*
2025	Karimi, A.**, Mozumder, R.,** Schoenhaut, A., Rausis, O., Wallace, M., Ramachandran, R. & Constantinidis, C., Integration of audiovisual motion in dorsolateral prefrontal cortical neurons. Paper link	*Journal of Neurophysiology*
2024	**Mozumder, R. ,** Chung, S., Li, S. & Constantinidis, C. Contributions of narrow- and broad-spiking prefrontal and parietal neurons on working memory tasks. Front. Syst. Neurosci. 18, (2024). Paper link	*Frontiers in Systems Neuroscience*
2023	**Mozumder, R.**, & Constantinidis, C. Single-neuron and population measures of neuronal activity in working memory tasks. J. Neurophysiol. 130, 694–705 (2023). Paper link	*Journal of Neurophysiology*

Skills

Programming/Scripting	Python, Matlab, R, C
Softwares/Packages	Jupyter, Matplotlib, Numpy, Scipy, Pandas
Deep Learning	Pytorch, Keras, TensorFlow
Medical Image Analysis	3D Slicer, AFNI, FSL
Data Acquisition	Open Ephys
Simulation & Design	Matlab & Simulink, Proteus, ANSYS, Solidworks, LabVIEW
Miscellaneous	Exploratory Data Analysis, Data Visualization, LaTeX, Microsoft Office, Google Workspace, Adobe Illustrator
Soft Skills	Time Management, Teamwork, Problem-solving, Documentation, Experiment Design, Presentation.

Honors & Awards

Design for Life Competition *Bangladesh*

4th Place *2020*

- A low-cost ventilator was designed during COVID epidemic with readily available products like a one-way valve, removac set, suction air filter, and gearbox motor with Scoth Yoke mechanism to control the speed of ventilation.

Dean's List Honor *Bangladesh*

Three times awardee *2017, 2018, 2021*

- Awarded for CGPA>3.75 during a academic year.

Board Scholarship by Intermediate and Secondary Education Board, Bangladesh *Bangladesh*

Four times Awardee *2008-2020*

- Awarded for excellent academic result.

Leadership & Voluntary Experiences

Aug 23-Present	**Biomedical Engineering Graduate Student Association**, Treasurer	*USA*
2016-21	**Badhan, Ahsanullah Hall Unit, BUET Zone**, Active member	*Bangladesh*
2019	**Ahsanullah Hall Kali Puja Committee**, President	*Bangladesh*
2020	**Ahsanullah Hall Bani Archana Committee**, Secretary	*Bangladesh*