APURBA DEBNATH

apurba.debnath@ucsf.edu | linkedin.com/in/apurba-debnath | apurba.github | apurba.github.io

EDUCATION

University of California, San Francisco — San Francisco, CA
Master of Science in Biomedical Imaging | GPA: 3.9/4.0 — SEP 2025 – SEP 2026
Thesis: *Spectral Graph modeling of abnormal neural synchronizations in Alzheimer's disease.*

National Institute of Technology Durgapur — Durgapur, India
Bachelor of Technology in Biotechnology | Major GPA: 3.78/4.00, CS GPA: 4.0/4.0. — DEC 2020 – MAY 2024
Thesis: *Machine learning-based approach for the design and release kinetics prediction of the PLGA-based drug delivery systems.*

PEER-REVIEWED PUBLICATIONS

1. **Debnath, A.,** Venot, T., Corsi, M-C. & Verma, P., ***"Neural mechanisms of training in Brain-Computer Interface: A Biophysical modeling approach,"****(under review)* *(https://doi.org/10.1101/2025.06.21.660834)*
2. **Debnath, A.,** Barron, N., Prabhu, P., Ranasinghe, K., Nagarajan, S., S., & Raj, A., ***"Altered frequency-dependent neural driving signals significantly impair E/I dynamics in Alzheimer's disease."*** *(in-prep)*

RESEARCH EXPERIENCE

University of California, San Francisco, San Francisco, CA, USA — JAN 2026 – Present
Graduate Student Researcher, Brain Networks Laboratory, UCSF
Co-Advisors: Prof. Ashish Raj & Prof. Srikantan Nagarajan

- Conducted signal processing and spectral analysis of MEG recordings from cohorts of 77 healthy controls and Alzheimer's disease (AD) patients, where AD was accompanied by significant increase in δ–θ (1–7 Hz) and reduction in α–β–γ (8–51 Hz) power, consistent with the previous studies.
- Developed a graph-theoretic biophysical neural mass model to deconvolve aperiodic neural driving signals and model oscillatory brain activity, and achieved a Pearson correlation of > 0.90 and an RMSE < 0.5 between modeled and empirical spectra across 246 cortical/subcortical brain regions, with successful recovery of aperiodic neural driving signals.
- Quantified the deconvolved neural driving signals and demonstrated that AD pathology ($A\beta$ and tau accumulation) is accompanied by significant alterations in the underlying aperiodic, scale-free neural drving signals.
- Showed that altered neural driving signals disrupt excitation–inhibition (E/I) dynamics, reflected by significant increase in excitatory time constants in AD and showed that disease severity is associated with impaired inter-regional connectivity, reflected by increased long-range excitatory time constants.

Indian Institute of Technology Madras, Chennai, India — JUL 2024 – JUL 2025
Post-Baccalaureate Researcher, Centre for Integrative Biology and Systems Medicine (IBSE)
Co-Advisors: Dr. Parul Verma (IIT Madras) & Dr. Marie-Constance Corsi (Paris Brain Institute)

- Analyzed EEG/MEG recordings and did signal processing from a longitudinal cohort of 19 healthy participants across four motor imagery (MI)-based BCI training sessions, along with an independent EEG dataset of 16 participants trained on a separate BCI paradigm.
- Developed a biophysically informed neural mass model to investigate the neural mechanisms underlying MI-BCI learning, achieving Pearson correlation > 0.90 and RMSE < 0.3 between modeled and empirical power spectra across most brain regions, subjects, and sessions in both MI and resting-state (RS) conditions for EEG and MEG data.
- Demonstrated that the regional activation accompanied by significantly reduced excitatory time constant during MI compared to RS, and revealed that BCI training drives a shift from diffuse to targeted sensorimotor activation. Additionally, identified that the excitatory time constant strongly associated with event-related desynchronization/synchronization (ERD/ERS), providing a mechanistic interpretation of BCI learning dynamics.

National Institute of Technology Durgapur, India — AUG 2023 – MAY 2024
Undergraduate Researcher, Department of Biotechnology
Advisor: Prof. Dalia Dasgupta Mandal

- Developed and benchmarked 8 ML regression models to predict drug release kinetics in PLGA-based drug delivery systems using a dataset of 1,914 experimental drug release profiles across 20 drug–polymer formulations having cancerous and non-cancerous drugs.
- Designed an end-to-end predictive modeling pipeline, achieving testing R^2 of 0.71, MSE of 0.0264 and MAE of 0.1169 with the optimized Random Forest (best model), while reducing the feature space from 17 to 7 key physicochemical features, and identified molecular weight, drug loading capacity, surface area-to-volume ratio, and time as the key determinant of drug release kinetics.

SKILLS

- **Programming:** Python, MATLAB, C/C++, SQL, LaTeX
- **Frameworks/Softwares:** NumPy, Pandas, SciPy, Matplotlib, Scikit-Learn, PyTorch, TensorFlow, Nilearn, fMRIPrep
- **Neuroimaging/Reserch:** EEG, MEG, f-MRI, d-MRI; Neuroscience, BCI, Drug Delivery Systems.

- **Others:** Machine Learning, Deep Learning, Git/Github, Linux, CoreHPC

SELECTED CONFERENCE POSTERS

1. **Debnath, A.**, Raj, A. (2026). **Spectral Graph modeling of abnormal neural synchronizations in Alzheimer's disease.** *2026 UCSF Annual Radiology Research Conference, Santa Cruz, CA. Poster: March 30, 2026.*
2. **Debnath, A.,** Verma, P., Corsi, M-C. (2025). **A biophysical model to infer neural mechanisms of motor imagery in brain-computer interface training.** *OHBM 2025 Annual Meeting, Brisbane, Australia. Poster: June 27-28, 2025.*
3. **Debnath, A.,** Corsi, M-C., Verma, P. (2025). **A Neural mass modeling approach for uncovering neural mechanisms in motor imagery-based brain-computer interface.** *Wadhwani School of Data Science and Artificial Intelligence (WSAI) Annual Research Showcase 2025, IIT Madras, India. Poster: May 17, 2025.*
4. **Debnath, A.,** Corsi, M-C., Verma, P. (2025). **Biophysical modeling to elucidate the underlying neural mechanisms in EEG-based brain-computer interface.** *Physics of Cells & Tissues (PoCT) 3.0 Symposium, Indian Institute of Science (IISc), Bengaluru, India. Poster: February 21, 2025.*

SELECTED PROJECTS

Decoding Cognitive tasks from functional-MRI using machine learning UCSF | 2026

- Designed ML pipelines to preprocess/process voxel-level task-based fMRI data of two sessions from 10 healthy subjects using fMRIPrep.
- Trained a Support Vector Machine (SVM) classifier on these voxel-level preprocessed BOLD signals to decode and classify different language and motor tasks across 10 healthy subjects. Trained SVM achieved an overall accuracy of 86.1% across tasks and subjects, with a strong performance in decoding language tasks, achieving an F1-score of 0.95, and moderate performance in classifying motor tasks, with an F1-score of 0.77. Notably, 21% of motor task instances were misclassified as language tasks.

Deep learning models for brain MRI denoising: A comparative benchmark study UCSF | 2026

- Designed and implemented deep learning pipelines to train and benchmark denoising autoencoders (CAE, VAE, ResNet, and UNet) using 7000 T1 MRI slices from 128 subjects, under both fixed and variable noise conditions.
- ResNet and UNet consistently achieved strong performance, with SSIM values reaching $\sim$ 0.92–0.96, PSNR $\sim$ 30–34 dB, and EPI $\sim$ 0.85–0.92 across noise levels. In contrast, CAE demonstrated moderate performance (SSIM $\sim$ 0.85–0.91, PSNR $\sim$ 27–31 dB, EPI $\sim$ 0.78–0.88), while VAE showed the lowest scores (SSIM $\sim$ 0.75–0.88, PSNR $\sim$ 25–29 dB, EPI $\sim$ 0.70–0.82) with higher variability.

AWARDS AND HONORS

- MS Thesis Research Grant ($11000 in total) Summer 2026
- IBSE Post-Baccalaureate Fellowship ($6000 in total) 2024–2025
- Paris Brain Institute Travel Award for OHBM 2025 Annual Meeting at Brisbane 2025
- IBSE Travel Award for Physics of Cells & Tissues 3.0 Symposium at IISc 2025
- NEC Merit Scholarship to pursure Bachelor's degree ($1140 in total) 2020–2024

RELEVANT COURSES TAKEN

Graduate Courses:

- **Biomedical Imaging/Bioengineering & Neuroscience:** Principles of MRI – MRI Physics, Systems and Behavioural Neuroscience, Advanced Neurological Imaging, Machine Learning Algorithms for Medical Imaging, Image Processing and Analysis-I & II, Physical Principles of CT, PET and SPECT Imaging, MR Spectroscopy, Imaging Probes for Nuclear and Optical Imaging, Imaging Study Design.

UG Courses:

- **Biotechnology:** Cell Biology and Genetics, Molecular Biology and rDNA Technology, Biochemistry and Enzyme Technology, Human Genomics, Bioinformatics, Cancer Biology and Cell Signaling.
- **Mathematics:** Linear Algebra, Calculus, Ordinary Differential Equations, Probability, Partial Differential Equations.
- **Computer Science:** Introduction to Computing, Programming and Data Structures, Compiler Design, Database Management Systems.
- **Others:** Electrical Eng.– Control Systems.