

BIJURIKA NANDI

bijurika.nandi@gmail.com; <https://www.linkedin.com/in/bijurikanandi>

SUMMARY

I am a cognitive and computational neuroscientist with experience in collecting multi-modal biosignal time series data and analyzing them by applying various univariate and multivariate signal processing techniques, statistical methods and machine learning algorithms.

WORK EXPERIENCE

- **Postdoctoral Scholar** **March 2020 –Present**
Neuroscape, UCSF
 - Leading the data collection and data analysis team (N = 41) of a music and meditation study which is a multi-modal biosignal project (simultaneous recording of about 150 sensors). Aim of the study is to understand and analyze how music may evoke an emotional response while attending to either the music itself or on breath and how all the different neuro and biosignals can predict these different emotional signatures.
 - As a part of a cognitive intervention study, analyzed EEG data (N = 37) and published manuscript on how rhythm training improves temporal attention in older adults, that in turn improves their cognitive abilities which decline with age.
 - Worked with neurodegenerative population in a sleep study and developed and optimized spindle detection algorithm in polysomnography data (N = 10). Spindle detection is of utmost importance in understanding quality of sleep and cognitive health of an individual.
- **Research Assistant** **September 2019 – March 2020**
Neuroinformatics Laboratory, UF, Gainesville
 - Analyzed fMRI BOLD data and pupillometry data in human subjects (N = 20) and applied ML algorithms to classify between different attentional states.

EDUCATION

- **PhD in Biomedical Engineering** GPA: 3.64/4.0
University of Florida, Gainesville Aug 2014 – Aug 2019
- **MS in Electrical and Computer Engineering** GPA: 3.67/4.0
University of Florida, Gainesville Aug 2013 - July 2015
- **B.Tech in Electronics and Communications Engineering** GPA: 8.64/10
West Bengal University of Technology, Kolkata, India May 2008 - Apr 2012

RESEARCH EXPERIENCE

Data modalities recorded and/or analyzed:

- Experienced in recording and analyzing the following physiological data from human subjects: - Electroencephalogram(**EEG**), Electrocardiogram(**ECG**), Electrogastrogram(**EGG**), Trans-Radial Electrical

Bioimpedance Velocimetry(**TREV**), Electrodermal Activity(**EDA**), facial Electromyography(**EMG**), Electrooculogram(**EOG**).

- Gained experience in analyzing Electrocorticography(**ECoG**), **pupillometry**, **fMRI BOLD** and **polysomnography** data in human subjects.
- Analyzed Local Field Potential (**LFP**) data in animals (rats and monkeys).

Computational experience:

- Extensively applied various univariate and multivariate **advanced signal processing techniques** (**Granger Causality** (GC), **phase amplitude coupling** (PAC), **current source density** (CSD) analysis, **coherence**, **cross-correlation**, **auto-correlation**, **power spectrum density** (PSD) measure, **time-frequency** analysis, and **source localization**) and **statistical methods** (**linear regression analysis**, **ANOVA**, **t-tests**, **permutation** and **bootstrapping** methods).
- Studied **autoregressive** (AR) processes and how to effectively characterize neural time series data based on AR models.
- Applied **Machine Learning** (ML) techniques on neural data.

PROGRAMMING EXPERIENCE

MATLAB, Python.

RESEARCH PROJECTS

Music and meditation study: a multimodal biosensing study (ongoing)

- Aim is to understand and analyze how music may evoke an emotional response and how that may affect one's ability to focus on either on the audio itself or on the breath.
- Multi-modal signals including EEG, fMRI, GSR, TREV, EGG, facial EMG, EOG and ECG are recorded during task.

Musical (rhythm) training enhances cognitive function in older adults

- Temporal orienting of attention plays an important role in our day-to-day lives, which gets impaired with age and negatively affects cognitive abilities.
- In this study, aim was to understand if rhythm training is able to improve temporal attention in older adults and the neuroplastic changes of such improvements. Randomized study was done over a period of 8 weeks where participants were divided into rhythm training and control groups. Pre and post training, participants were assessed on temporal attention based outcome measures and EEG signal was recorded during the assessments.
- Rhythm training was found to improve performance on temporal attention tasks which was associated with increased inter-trial coherence (ITC) within the delta (1-4 Hz) band as assessed by EEG recordings.

Left visual field bias in spatial attention: cue evoked pupillometry– fMRI study

- Targets are more effectively processed in the left visual field, also known as the left visual field bias, due to the right hemisphere dominance in spatial cognition.
- To understand whether such bias exists in covert visual attention where subjects voluntarily direct their attention to left or right visual field in anticipation of target processing, pupillometry study was done for cued visual attention task. Pupil dilation has been proven to be a physiological index of effort.
- Parietal activity patterns from fMRI using SVM predicted increased pupil dilation while attending to leftward targets.

Inferring the direction of rhythmic neural transmission via inter-regional phase-amplitude coupling (ir-PAC)

- Cross Frequency Coupling (CFC) technique has emerged in recent years as a major technique to understand the spatial and temporal organization of neural dynamics in both humans and animals.
- Phase-Amplitude Coupling (PAC), a type of CFC, estimates the statistical dependence between the phase of a low-frequency and the amplitude of a high-frequency component of local field potentials (LFP).
- Extended application of PAC to two signals and established the direction and strength of rhythmic neural transmission between different brain networks.

Decomposing neural interaction in 3-node neural network

- Pairwise connectivity measures are incapable of decomposing functional interactions when more than 2 time-series are involved in a neural interaction. Such measures cannot distinguish between direct and mediated information transfer.
- Applied conditional Granger causality and linear regression based ir-PAC approach to disambiguate conditional dependencies in multi-node networks: (1) hippocampal tri-synaptic circuit and (2) CA1→PFC→RE→PFC loop.

Estimation of autoregressive model order

- Stochastic time series data forms a very important aspect of neuroscience, especially in cognitive and behavioral neuroscience experiments.
- Autoregressive (AR) models can be used to represent these real world data and hence it is important to understand the characteristics and estimation of AR models from experimental data.
- Designed novel techniques to characterize these autoregressive time series data and how to effectively use them in the neuroinformatics domain.

Large scale gamma responses to emotional scene: SVM based ECoG study

- Visual analysis of emotionally engaging scenes may be facilitated by deep structures such as the amygdaloid complex and re-entrant projections from temporal, orbital frontal and parietal cortices.
- Changes in high gamma frequency oscillations, a neurophysiologically specific index, have been found in response to emotional pictures.
- Performed a time course decoding using SVM to classify between pleasant and unpleasant emotional states using the gamma power obtained from time-frequency analysis.

Assessing Granger causality in electrophysiology

- Multielectrode signals are typically recorded against a common reference electrode.
- In practice, the reference electrode is not electrically silent, creating a confounding influence on connectivity measures such as Granger causality and leads to erroneous results. Volume conduction presents a further complicating factor.
- Established that bipolar derivations of signals yield the correct connectivity patterns whereas unipolar signals generally do not.

Characterizing the interactions between hippocampal theta generators

- Hippocampal theta oscillations are generated by multiple generators acting on the pyramidal cells of the Ammon's horn (CA) and the granule cells of the dentate gyrus (DG).

- This theta rhythm is associated with various behaviors and sleep stages, and behavioral tasks can effectively modify the layer-specific activation pattern of theta generators.
- After locating the theta generators established the characteristics and directional interactions between them.

RELEVANT RESEARCH PUBLICATIONS

- **Nandi, B.**, Ostrand, A., Johnson, V., Ford, T., Gazzaley, A., Zanto, T (2023). Musical Training Facilitates Exogenous Temporal Attention via Delta Phase Entrainment within a Sensorimotor Network. *The Journal of Neuroscience*, 43(18), 3365.
- Rajan, A., Meyyappan, S., Liu, Y., Samuel, I. B. H., **Nandi, B.**, Mangun, G. R., & Ding, M. (2021). The Microstructure of Attentional Control in the Dorsal Attention Network. *Journal of Cognitive Neuroscience*, 33(6), 965–983.
- **Nandi, B.**, Swiatek, P., Kocsis, B., & Ding, M. (2019). Inferring the Direction of Rhythmic Neural Transmission via Inter-Regional Phase-Amplitude Coupling (Ir-PAC). *Scientific Reports* 9(1), 6933.
- Trongnetrpunya, A., **Nandi, B.**, Kang, D., Kocsis, B., Schroeder, C.E. and Ding, M. (2015). Assessing Granger Causality in Electrophysiological Data: Removing the Adverse Effects of Common Signals via Bipolar Derivations. *Frontiers in Systems Neuroscience*, 9,189.

JOURNAL REVIEW SERVICE

- Aging Clinical and Experimental Research (ACER)
- Frontiers in Human Neuroscience
- Neurobiology of Aging
- Memory & Cognition

MENTORING EXPERIENCE

- As a postdoctoral scholar, trained undergraduate and volunteers and research associates to conduct human subject experiments, pre-process and analyze neurophysiological data.
- Mentored undergraduate and graduate students during my PhD years, teaching them advanced signal processing techniques and writing software modules to apply on neural data.
- Mentored a group of undergrad students working on neural data information processing in collaboration with a research company based in Boston.

LEADERSHIP SKILLS

- *Vice President* of Indian Graduate Student Association (IGSA), UF. **Jan 2018 – March 2019**

AWARDS

- Office of Research Travel Grant Award, University of Florida **2018, 2017,2016, 2015**
- Achievement Award, University of Florida **2013**
- Awarded Scholarship by Ministry of Human Resource Dept., Govt. of India. **2008, 2006**