

Parul Jain

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Education

Ph.D. Candidate

Physiology, Biophysics, and Systems Biology
Weill Cornell Medical College (WCMC), New York, NY

Aug 2017 - Present

Bachelor of Technology

Computer Science and Engineering, with minor in Computational Biology
Indian Institute of Technology Delhi

8.26/10.0 (3.9/4)
Jul 2012 - May 2016

Research Projects

Detecting language processing in severely brain-injured patients

Drs. Jonathan D. Victor and Nicholas D. Schiff, WCMC

Apr 2018 - Present

The project is aimed at the development of an EEG based analysis for identifying language processing markers in severely brain-injured patients. Current methods include bedside tests, which require motor function, and correlates of neural response such as fMRI, EEG, which require sustained attention. In addition, both methods require language processing at the highest level of comprehension, missing to identify subjects with partial language processing. Taking advantage of hierarchy of language, the proposed method assesses processing of language at lower levels, starting with phonemes, the building blocks of language. This does not require motor function or sustained attention. The project has the potential to aid prognostication and rehabilitation in these patients. The analysis involved:

- Identification of patients with covert cognition using fMRI and EEG response to motor commands.
- Analysis of time-locked EEG responses to phoneme classes, during passive listening to speech.
- Analysis of natural speech envelope tracking to assess its contribution in the observed responses to phonemes.

Application of Hermite-based measure of non-Gaussianity to normality tests and ICA

Dr. Jonathan D. Victor, WCMC, and Bruce W. Knight Jr., The Rockefeller University

Aug 2018 - Present

Measures of deviation from Gaussian distribution have dual role in data analysis: as tests of normality for validating model assumptions and as contrast functions of Independent Component Analysis (ICA). The project explores the use of Hermite functions, a family of functions which form an orthonormal basis set, as a measure of non-Gaussianity. Following steps were undertaken to establish the viability of the method:

- Formulation of a new measure of non-Gaussianity using Hermite functions.
- Applicability as a normality test was assessed using distributions with different shapes and the sensitivity was compared to standard normality tests. The measure is more sensitive to certain distribution shapes and is found to be more robust than many common normality tests.
- Applicability as an ICA contrast function was assessed using simple multidimensional datasets and simulated EEG datasets. The measure was incorporated in a common ICA package and its performance was benchmarked against the contrast functions native to the package. The method has advantages for smaller datasets which diminish as sample size increases.

Network inferencing in neuronal circuits

Dr. Mark Goldman, UC Davis, and Dr. Emre Aksay, WCMC

Aug 2016 - Dec 2017

Modeling neural integrators to describe the working of short term memory. The project involved developing new online tools for recording and stimulation of oculomotor system in larval zebrafish.

- Compared the performance of negative derivative feedback models over the conventional positive feedback models for short term memory.
- Implemented image recognition for automated identification of neurons in two-photon imaging data.
- Devised real-time image analysis from two-photon microscopy to study neuronal activity in oculomotor integrator of zebrafish, by integrating MATLAB based image acquisition to python based analysis pipeline.

Causality in gene regulatory networks

Dr. Sumeet Agarwal, Dr. Parag Singla, and Sahil Loomba, IIT Delhi

Jul 2015 - May 2016

Understanding the dynamics of gene regulatory networks using simulated mRNA concentrations in multiple subject data and time series data.

- Analyzed standard information theory techniques such as Granger causality and transfer entropy for causality detection in nonlinear dynamical systems.
- Applied novel methods of convergent cross maps and manifold learning for network inference under biological constraints, using high performance computing.

Quantum mechanical simulations

Dr. Kushal Shah, IIT Delhi

May 2014 - Jul 2014

The project investigated the asymptotic bounds of energy of a second order Fermi accelerator, using a simple kinetic model of a trapped particle in a box with externally controlled oscillating wall.

- Implemented various models of Fermi accelerator in C++ .
- Performed Monte-Carlo simulations to compute the bounds on energy, on high performance GPU clusters.

Publications

Low-level language processing in severely brain-injured patients

Under review

P. Jain, M. M. Conte, H. U. Voss, J. D. Victor, N. D. Schiff.

Application of Hermite-based measure of non-Gaussianity to normality tests and ICA

Under prep.

P. Jain, J. D. Victor, B. W. Knight.

Presentations

Society for Neuroscience Conference, Chicago, Nov 2019

Poster

P. Jain, M. M. Conte, J. D. Victor, N. D. Schiff. EEG evidence of phonemic processing in severely brain-injured patients.

Vincent du Vigneaud Research Symposium, WCMC, Apr 2022

Talk

P. Jain, M. M. Conte, H. U. Voss, J. D. Victor, N. D. Schiff. EEG evidence of phoneme processing in severely brain-injured patients.

Society for the Neurobiology of Language, Philadelphia, Oct 2022

Poster

P. Jain, M. M. Conte, H. U. Voss, J. D. Victor, N. D. Schiff. EEG evidence of phoneme processing in severely brain-injured patients.

Teaching Experience

- Teaching Assistant, Applied Quantitative Techniques for the Biological Sciences, headed by Dr. Diane Lane, WCMC, Sep - Oct 2021
- Teaching Assistant, Dynamic Models in Biology, taught by Dr. Trine Krogh-Madsen, WCMC, Sep - Dec 2018 and 2019

Work Experience

Zolve

Educational platform for student query redressal

Oct 2015 - May 2016

- Responsible for user and information database management, server maintenance, and web product design.
- Developed string algorithms, machine learning based performance evaluations, and web security methods.
- Trained optical character reader for automated recognition of mathematical expressions in student queries.

Microsoft, India

Software Development Intern

May 2015 - Jul 2015

- Developed a prototype software development kit (SDK) for OneNote Services for further app development.
- The SDK facilitates development by handling the back-end of data transfer, representation, and storage.

Technical Skills

MATLAB, python, L^AT_EX

Awards and Honors

- Kishore Vaigyanik Protsahan Yojana Fellow, 2010
- National Talent Search Scheme Scholar, 2008