Asit **Pal**

Graduate Student at New York University

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Summary

Graduate student with a strong background in neuroscience and advanced data analysis, specializing in hierarchical recurrent neural networks, divisive normalization, and inter-areal communication in the cortex. Strong technical proficiency in Python, PyTorch, and deep learning frameworks. Proven skills in presenting findings at international conferences and mentoring undergrad researchers. Enthusiastic about advancing innovative AI research by integrating neuroscience insights and engaging in collaborative projects.

Education

New York University — *New York, USA*
Ph.D. Candidate in Chemistry (GPA: 3.8/4.0) — *Aug. 2021 - Present*

Indian Institute of Technology Kanpur — *Kanpur, India*
M.S. in Chemistry (GPA: 9.0/10.0) — *May 2018 - May 2020*

Calcutta University — *Kolkata, India*
B.S. in Chemistry — *May 2015 - Apr. 2018*

Research Projects

Graduate Research Associate

New York University, USA
Advisor: Prof. Stefano Martiniani — *Aug. 2021 - Present*

A Recurrent Neural Circuit Theory of Normalization and Inter-area Communication

- Designed and implemented a multi-stage **neural recurrent circuit** performing normalization dynamically at each hierarchical stage.
- Introduced feedback connections to extend the **ORGaNICs** (Oscillatory Recurrent Gated Neural Integrator Circuits) framework, enabling hierarchical information processing.
- Formulated and tested dynamical equations for excitatory and inhibitory neuron populations to achieve divisive normalization at each hierarchical stage.
- Investigated the impact of **feedback-mediated attention** on responses in different brain areas.

Inter-areal communication through Coherence (CTC) and Communication Subspace (CS).

- Analyzed distinct frequency channels for feedforward and feedback signals, corroborating empirical evidence.
- Identified that enhancing feedback strengthens inter-areal communication without altering the subspace dimensionality.
- Proposed a potential mechanism for dynamic control of functional connectivity by changing the gain in higher cortical areas.

A novel method to identify differentially expressed genes (DEGs) implicated in long-term memory formation in mice

- Quantified non-linear relationships between behavioral and transcriptomic data by estimating mutual information.
- Introduced a novel method utilizing Kullback-Leibler divergence to identify the DEG genes in mice trained on active place avoidance tasks.

Research Associate

Tata Institute of Fundamental Research Hyderabad, India
Advisor: Prof. Jagannath Mondal — *Aug. 2020 - Aug. 2021*

Discovering Slow Collective Variables Utilizing Modified Time-Lagged Autoencoders and Deep Generative Models

- Utilized time-lagged autoencoders to identify slow fluctuation modes governing protein-ligand interaction.
- Employed deep generative models to learn Boltzmann distributions of input trajectories and generate novel samples from the learned distributions.

Masters Thesis

Indian Institute of Technology Kanpur, India
Advisor: Prof. Nisanth N. Nair — *Dec. 2019 - July 2020*

Mean Force based Temperature Accelerated Sliced Sampling Method

- Developed a novel mean-force-based reweighting method for enhanced sampling method TASS, eliminating the need for the computationally intensive Weighted Histogram Analysis Method (WHAM)

Summer Internship

Indian Institute of Technology Kanpur, India
Advisor: Prof. Nisanth N. Nair — *Summer 2019*

A Generalised Mean-force based approach for reweighing and estimating statistical error in Metadynamics (MTD), Umbrella Sampling (US) and Temperature Accelerated Molecular Dynamics (TAMD)

- Developed general mean-force-based reweighting methods applicable to enhanced sampling techniques.
- Quantified statistical error in reweighting processes.

Publications

Mean force based temperature accelerated sliced sampling: Efficient reconstruction of high dimensional free energy landscapes — *Journal of Computational Chemistry*

***Asit Pal**, Subhendu Pal, Shivani Verma, Motoyuki Shiga, Nisanth N. Nair* — *2021*

Multi-stage cortical recurrent circuit implementing normalization — *Bulletin of the American Physical Society*

***Asit Pal**, Shivang Rawat, David J. Heeger, Stefano Martiniani* — *2024*

Honors & Awards

2024	Selected for the prestigious **Analytical Connectionism Summer School 2024** at the Flatiron Institute.
2024	Recipient of the **Dean's Conference Fund** from NYU Graduate School of Arts and Science (GSAS).
2021	Awarded the **Henry M. MacCracken** Doctoral Fellowship from NYU GSAS.
2018	Qualified and secured an **All India Rank 61** in the Junior Research Fellowship: funding for graduate studies in India.
2018	Achieved an **All India Rank 43** in the Joint Admission Test (JAM) for M.S.
2015	Recipient of the **INSPIRE** fellowship for being in the top 1% of the state board, awarded by the Department of Science & Technology.

Talks and Presentations

From Neuroscience to Artificially Intelligent Systems Conference — *Cold Spring Harbor, New York*

Poster Presentation: *"Multi-stage Cortical Recurrent Circuit Implementing Normalization"* — *2024*

Cognitive Computational Neuroscience conference — *Boston, Massachusetts*

Poster Presentation: *"Multi-stage Cortical Recurrent Circuit Implementing Normalization"* — *2024*

American Physical Society March Meeting — *Minneapolis, Minnesota*

Contributed Talk: *"Multi-stage Cortical Recurrent Circuit Implementing Normalization"* — *2024*

Minds, Brains, and Machines Conference — *Center for Data Science, NYU*

Poster Presentation: *"A Recurrent Neural Circuit Theory of Normalization and Inter-area Communication"* — *2024*

Soft Condensed Matter Seminars — *Center for Soft Matter Research, NYU*

Contributed Talk: *"A Recurrent Neural Circuit Theory of Normalization and Inter-area Communication"* — *2024*

Mathematics of Neuroscience and AI — *Rhodes, Greece*

Poster Presentation: *"Feedback-Dependent Communication Subspace in a Multistage Recurrent Circuit Model Implementing Normalization"* — *2023*

Technical Skills

Programming Languages	Python, Fortran, Shell scripting
Libraries	PyTorch, Pandas, Scikit, NumPy, Matplotlib
Mathematical Tool	Mathematica, MATLAB, Octave
Developer Tools	Git, VS Code, Cursor, PyCharm
Molecular Dynamics	AMBER, PLUMED, LAMMPS
Visualization & Plotting	VMD, Avogadro, Ovito, Gnuplot, Illustrator

Teaching and Mentoring Experience

- Graduate Teaching Assistant for '**Modern Chemistry**' and '**Energy and the Environment**' undergraduate course for three semesters
- Mentored two undergraduate summer research interns on **transcriptomic data analysis** project.

Online ML Courses

Machine Learning, Neural Networks and Deep Learning, Dimensionality Reduction using Autoencoder, Generative Adversarial Networks (GANs)