

CHAITANYA KAPOOR

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(Nationality: Citizen of the United States of America)

Research Interests

My research interests lie at the intersection of Deep Learning and Neuroscience, aiming to understand and reverse engineer neural computation. I aim to develop computational models of cognitive neural circuits, with an overarching goal of designing efficient, biologically-constrained learning algorithms.

Education

University of California, San Diego
Incoming PhD Student (Cognitive Science)

Sep. 2024 – Present
La Jolla, CA

University of California, San Diego
Post-Baccalaureate Student ([NeuroML Group](#))
Advisor: [Meenakshi Khosla](#)

Aug. 2024 – Present
La Jolla, CA

Massachusetts Institute of Technology
Visiting Student ([Senseable Intelligence Group](#))

Jan. 2024 – July 2024
Cambridge, MA

***Thesis:** LUMIN: Light-sheet Microscopy Analysis Unified with Distributed and Domain-Randomized Generative Models*

Advisor: [Satrajit Ghosh](#)

Birla Institute of Technology and Science, Pilani
B.E. (Hons.) in Electrical and Electronics engineering

Nov. 2020 – July 2024
Pilani, India

Honors & Awards

04/24 **NeuroMatch Academy:** Computational Neuroscience Summer School

02/24 **COSYNE 2024:** Undergraduate Travel Grant Award

04/23 **OxML 2023:** ML × Health Summer School, Oxford Mathematical Institute

Publications

Bridging Critical Gaps in Convergent Learning: How Representational Alignment Evolves Across Layers, Training, and Distribution Shifts

C. Kapoor, S. Srivastava, M. Khosla
(Under review) - [preprint](#)

Multiplexed Expansion Revealing for Imaging Multiprotein Nanostructures in Healthy and Diseased Brain

J. Kang, M. Schroeder, Y. Lee, C. Kapoor, E. Yu, T. B. Tarr, K. Titterton, M. Zeng, D. Park, E. Niederst, D. Wei, E. S. Boyden
Nature Communications, 2024 - [paper](#), [code](#), [news story](#)

RnR-ExM: Robust Non-Rigid Registration Challenge for Expansion Microscopy Volumes

E. Besier, R. Zhang, Y. Bando, Y. Quémener, C. Kapoor, M. Alawi, M. Hoffman, A. Dalca, A. Casamitjana, I. Arganda-Carreras, E. S. Boyden, H. Pfister, D. Wei
IEEE International Symposium on Biomedical Imaging (IEEE ISBI), 2023 - [code](#), [website](#)

Attention-enabled Deep Neural Network for Enhancing UAV-Captured Pavement Imagery in Poor Visibility

C. Kapoor, A. Warriar, M. Singh, P. Narang, H. Puppala, R. Srinivas, A. P. Singh
IEEE Multimedia Information Processing and Retrieval (IEEE MIPR), 2023 - [paper](#)

Fast and Lightweight UAV-based Road Image Enhancement Under Multiple Low-Visibility Conditions

C. Kapoor, A. Warriar, M. Singh, P. Narang, H. Puppala, R. Srinivas, A. P. Singh
PerCom Workshops (PerSASN 2023) - [paper](#)

Dense Residual Networks for Gaze Mapping on Indian Roads

C. Kapoor, K. Kumar, S. Vishnoi, S. Ramanathan

[preprint](#)

Research Experience

NeuroML Lab

Supervisor: Prof. Meenakshi Khosla

Aug. 2024 – Present

La Jolla, CA

- Leading the investigation in convergence of learnt representations of artificial and biological neural networks.
- Exploring network invariances across network layers and training, by identifying the *minimal* set of transformations to align representations.
- Examining responses of networks to out-of-distribution stimulus to uncover shared learning principles between systems.

Talmo Lab

Supervisor: Dr. Talmo Pereira

May 2023 – Aug. 2024

Salk Institute, La Jolla, CA

- Worked on the development of methods for pose estimation and tracking to quantify animal behavior through robust tracking of anatomical landmarks in 3D.
- Designed algorithms utilizing projective geometry to create inputs for a CNN that leverages geometric reasoning.

Senseable Intelligence Group

Supervisor: Prof. Satrajit Ghosh

Jan. 2024 – July 2024

Massachusetts Institute of Technology, MA

- Developed a distributed framework for large-scale ($\approx 1\text{TiB}$) image segmentation for light-sheet microscopy images.
- Designed a domain-randomized generative model, using spherical harmonics to synthesize cortical sections of *ex-vivo* human brains to enable zero-shot segmentation.
- Worked on designing few-shot, *spatially* guided semantic segmentation algorithms for MRI segmentation.
- Proposed the use of a topologically aware Graph Neural Network which is capable of encoding spatial and anatomical constraints.

Synthetic Neurobiology Group

Supervisors: Prof. Ed Boyden, Prof. Donglai Wei

Feb. 2022 – Jan. 2024

Massachusetts Institute of Technology, MA

- Worked on the development of a *generalist* 3D segmentation model for Expansion Microscopy (ExM) volumes for various animal species.
- Proposed a human-in-the-loop feedback learning mechanism, built on top of an existing deep learning framework, NucMM.
- Worked on developing a new joint-intensity and point-based, high throughput image registration algorithms having nanoscale precision ($10 - 40$ nm) for Multiplexed Expansion Revealing (**multiExR**). This work has been published at Nature Communications.

Invited Talks and Tutorials

02/24 Automating behavior quantification using deep learning, COSYNE 2024

06/23 SIS Symposium, Harvard SEAS, *Seeing Beyond the Camera*

Teaching Experience

Department of Mathematics, BITS Pilani

Teaching Assistant

August 2023 – Dec. 2023

Pilani, India

- **Undergraduate TA:** assisted with the course Combinatorial Mathematics (MATH F421)

Students Mentored

- **Pratham Yashwante:** Masters Student at UC San Diego
- **Chanyoung Park:** Undergraduate Student at UC San Diego

Technical Skills

Languages: Python, C, MATLAB, Unix Shell Scripting, \LaTeX

Technologies/Frameworks: Keras, Tensorflow, Numpy, PyTorch, Git, OpenCV