CHAITANYA KAPOOR

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(Nationality: Citizen of the United States of America)

Research Interests

My research interests lie at the intersection of 3D vision and cognition, aiming to understand learning principles of animals under the influence of various stimuli. I aim to develop efficient computational models offering insights into the mechanisms governing learning processes in animals.

Education

Massachusetts Institute of Technology   **Jan. 2024 – Present**
Visiting Student (Senseable Intelligence Group)   *Cambridge, MA*
Faculty Host: Satrajit Ghosh

Birla Institute of Technology and Science, Pilani   **Nov. 2020 – Present**
B.E. (Hons.) in Electrical and Electronics engineering   *Pilani, India*

Honors & Awards

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

Publications

SLEAP-Anipose Toolkit
*S. Afshar, E. J. Leonardis, D. Tsin, **C. Kapoor**, L. Maree, S. Oline, T. D. Pereira, A. Falkner*
[manuscript in preparation]

ORCa In The Wild
*T. Zhang, **C. Kapoor**, W. Jiang, A. Dave, K. Tiwary, R. Raskar, A. Veeraraghavan*
[manuscript in preparation]

Large-Scale 3D ExM Registration: A Comparison of Methods
*A. Casamitjana, G. Fleishman, E. Besier, R. Zhang, M. Alawi, **C. Kapoor**, H. Pfister, E. S. Boyden, D. Wei*
[manuscript in preparation]

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*
[Under review - Nature Communications]

RnR-ExM: Robust Non-Rigid Registration Challenge for Expansion Microscopy Volumes
*E. Besier, R. Zhang, Y. Bando, Y. Quéméner, **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 - website

Attention-enabled Deep Neural Network for Enhancing UAV-Captured Pavement Imagery in Poor Visibility
***C. Kapoor**, A. Warrier, 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. Warrier, 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

Talmo Lab   **May 2023 − Present**
Supervisor: Dr. Talmo Pereira   *Salk Institute, La Jolla, CA*

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

Synthetic Neurobiology Group   **Feb. 2022 − Jan. 2024**
Supervisors: Prof. Ed Boyden, Prof. Donglai Wei   *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 is currently under review at Nature Communications.

Camera Culture Group   **August 2022 − Dec. 2023**
Supervisor: Dr. Ramesh Raskar   *Massachusetts Institute of Technology, MA*

- Working on extracting environments from surfaces of glossy objects from sparse, and unstructured views.
- Exploring methods that incorporate shape priors, which enable us to turn everyday objects having unknown geometry into radiance-field camera to image the world from an objects perspective.

Multimodal Cognition Research Group   **Jan. 2022 − Feb. 2023**
Supervisor: Dr. Pratik Narang   *BITS Pilani, India*

- Worked on image-to-image translation from RGB to hyperspectral color space by making use of an ACL-GAN.
- Worked on enhancing drone Based Surveillance in Low-Visibility Conditions by using YOLOv8 and canonical image processing techniques to build a toolbox for civil engineers to conduct pavement health monitoring.

Sally Robotics   **August 2021 − June 2023**
Supervisor: Prof. Bijay Kumar Rout   *BITS Pilani, India*

- Lead of the Computer Vision subsystem.
- Worked on designing lightweight Real time Semantic Segmentation algorithms for deployment on autonomous vehicles
- Proposed using a dense residual network architecture for monitoring a car driver's *gaze* to assess attentiveness.
- Using the proposed method, we surpassed SOTA accuracies by **1.5**% without prior conditioning.

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   **August 2023 − Dec. 2023**
Teaching Assistant   *Pilani, India*

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

Technical Skills

Languages: Python, C, MATLAB, Unix Shell Scripting , LaTeX
Technologies/Frameworks: Keras, Tensorflow, Numpy, PyTorch, Git, OpenCV