# Chaitanya Kapoor

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## Research Interests

I am passionate about **Machine Learning** in general, and **Computer Vision** in particular. The sheer fun of grokking an amalgamation of myriad mathematical techniques in service of the discipline, and seeing them all come alive on a computer (through various tools and techniques), is a perennial source of joy and wonder to me!

## Education

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

**CBSE 2020** – 94.5% (honors in **Physics**)

**ICSE 2018** – 94.25% (100% in **Mathematics**)

## Publications

**Multiplexed Expansion Revealing (multiExR) for Imaging of Many-Component Nanostructures in Healthy and Diseased Brain**
*J. Kang, M. Schroeder, Y. Lee,* ***C. Kapoor****, T. B. Tarr, K. Titterton, M. Zeng, D. Wei, L. H. Tsai, G. Feng, E. S. Boyden*
Nature Methods - [under submission]

**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*
ISBI 2023 - [website]

**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) - [to appear]

**Dense Residual Networks for Gaze Mapping on Indian Roads**
***C. Kapoor****, K. Kumar, S. Vishnoi, S. Ramanathan*
[preprint]

## Research Experience

**Camera Culture Group** **August 2022 – Present**
*Guide: Dr. Ramesh Raskar* *Massachusetts Institute of Technology, Boston*

- Glossy object reflections can reveal hidden information about the surrounding environment. By turning them into cameras, we can access unique views beyond a cameras field-of-view. Our method turns such objects with **unknown geometry** into radiance-field cameras to image the world from the objects perspective, and synthesize **novel views** which are visible only to the object.

**Department of Brain and Cognitive Sciences** **Feb. 2022 – Present**
*Guide: Dr. Donglai Wei* *Massachusetts Institute of Technology, Boston*

- Our group explores building computational models for brain image analysis derived from **Expansion Microscopy** (ExM) and **multiplexed Expansion Revealing** (multiExR). As part of this, we are developing novel algorithms to perform **joint-intensity based** and **point-based** image registration.

**Multimodal Cognition Research Group** **Jan. 2022 – Present**
*Guide: Dr. Pratik Narang* *BITS Pilani, India*

- Our present research focuses on unpaired image to image translation from the RGB domain to the **Hyperspectral** domain with the help of an **ACL-GAN**.
- Working on enhancing **Drone Based Surveillance in Low-Visibility Conditions**, a project funded by ARTPARK, under the aegis of IISc Bengaluru. This is primarily an object detection problem, for which I am trying to bring to bear the power of **Vision Transformers** to gain more insights into it.

**Computer Vision Research Society** **August 2021 – Present**
*Guide: Dr. Pratik Narang* *BITS Pilani, India*

- At present, I am working on **self-supervised image super resolution** with a special focus towards medical imaging.
- I have also actively worked on **video super resolution** using **deformable convolutions** with a **TDAN** baseline.

**Sally Robotics** **August 2021 – Present**
*Guide: Prof. Bijay Kumar Rout* *BITS Pilani, India*

- I am working on designing novel (and lightweight) algorithms for **Real-time Semantic Segmentation** which can be deployed in the context of autonomous vehicles.

## Projects

**Irodov solutions** | LaTeX **Ongoing**

- Problems In General Physics is a quintessential problem set for cementing fundamental concepts in an advanced high-school and undergraduate Physics curriculum. This is my rendition of solutions to these. It is my labor of love! My love of Mathematics & Physics and a passion for typesetting beautiful documents in LaTeX.

**Expression Recognition using Deep CNNs** | *Python* **August 2021**

- Facial expression recognition seeks to classify facial expressions into various categories such as **anger, fear, surprise** etc. Using the network model from DeXpression, and enhancing it with **5-fold** cross validation on the canonical Extended Cohn-Kanade (CKP+48) dataset, I was able to achieve a mean training set accuracy of **99.47%** and a mean testing accuracy of **98.98%**.

**Generative Adversarial Network (GAN)** | *Python* **April 2021**

- This introductory project uses a GAN to generate numeric digits from its corresponding Devanagari equivalent. I used `scikit-learn` to implement the digit classifier, and wrote the GAN implementation (from scratch using `numpy`!), which using output from the digit classifier, generates digits in the $MNIST$ dataset.

## Technical Skills

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