

# Bharath Raj Nagoor Kani

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## EDUCATION

### Carnegie Mellon University

*M.S. in Robotics (MSR) – CGPA: 4.25/4.0*

*Relevant Courses: Learning for 3D Vision, Physics-based Rendering*

Advisor: **Dr. Shubham Tulsiani**

*Aug 2022 – Present*

### Sri Sivasubramaniya Nadar College of Engineering

*B.E. in Electronics and Communication Engineering (ECE) – CGPA: 8.4/10.0*

Affiliated to **Anna University**

*June 2015 – Apr 2019*

## EXPERIENCE

### Carnegie Mellon University

*Graduate Research Assistant*

*Oct 2022 – Present*

- Exploring techniques in the intersection of diffusion models and neural fields for generating 3D representations from partial observations. Advised by [Dr. Shubham Tulsiani](#).

### Siemens Digital Industries Software

*Engineering Services Engineer*

*Jan 2022 – July 2022*

*Associate Engineering Services Engineer*

*May 2019 – Jan 2022*

Built models, algorithms and systems for myriad autonomous driving and general machine learning applications as part of the Intelligent Control Systems team. A few highlights are elaborated below:

- **Generative Models for Vehicle Trajectory Prediction:**
  - Researched and experimented with creating generative adversarial networks with a structured latent space for predicting the future trajectory for a given ego-vehicle.
- **Ego-Lane Estimation and Tracking; ROS based Perception Toolchain:**
  - Leveraged concepts from 3D geometry, machine learning, state estimation and more to create a fast and robust ego-lane estimation and tracking system that can effectively handle many challenging scenarios.
  - Designed and implemented integral parts of a ROS based toolchain which contains several nodes that can perform various tasks related to perception for autonomous driving.
- **Maximum Entropy Inverse Reinforcement Learning:**
  - Researched and implemented algorithms based on maximum entropy inverse reinforcement learning to model highway driving styles given expert demonstrations.
- **Unsupervised Variable Length Multivariate Time Series Data Clustering:**
  - Researched and implemented feature extraction techniques and experimented with dimensionality reduction techniques and clustering algorithms to cluster together driver types given multivariate time series data.

## PUBLICATIONS

### UpFusion: Novel View Diffusion from Unposed Sparse View Observations

*Bharath Raj Nagoor Kani, Hsin-Ying Lee, Sergey Tulyakov, Shubham Tulsiani*

- UpFusion is a system that can perform novel view synthesis and infer the 3D representation of an object given a sparse set of reference images *without* corresponding pose information.
- Currently under review. [[project-page](#)] [[paper](#)] [[code](#)]

### Exploring Techniques to Improve Activity Recognition using Human Pose Skeletons

*Bharath Raj N., Anand Subramanian, Kashyap Ravichandran, Venkateswaran N.*

- Explored the efficacy of using hand crafted feature extraction techniques and some train-time techniques such as keypoint dropout on improving human pose skeleton based activity recognition performance.
- Paper was published at the 2020 IEEE Winter Applications of Computer Vision Workshops (WACVW). Poster was presented at the HADCV'20 workshop at WACV 2020. [[paper](#)]

### Single Image Haze Removal Using a Generative Adversarial Network

*Bharath Raj N., Venkateswaran N.*

- Created a conditional GAN based architecture to remove haze from images.
- Code and first version of the preprint were launched in 2018. Project currently has more than 100 stars on GitHub.
- Paper was published at the 2020 International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET). [[paper](#)] [[code](#)]

## PROJECTS

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### Progressive Photon Mapping

- Created an implementation of the Progressive Photon Mapping algorithm in C++ as a project for the Physics-based Rendering course (15-668) in CMU.
- This enhanced the ability of an internal graphics renderer used in the course to handle light paths of type  $L(S^+)D(S^+)$  and faithfully render caustic effects. [[🔗 report](#)]

### Open Source Contributions to Kornia

- Contributed enhancements and fixes to Kornia, an open source differentiable computer vision library for PyTorch.
- One of my significant contributions to Kornia was the implementation of a Direct Linear Transform (DLT) based Perspective-n-Point (PnP) solver using PyTorch.

### Deploying Tiny YOLOv2 on Jetson Nano using DeepStream

- Deployed a Tiny YOLOv2 ONNX model on NVIDIA Jetson Nano using the DeepStream SDK.
- Extended C++ code to enable it to parse the output of the TinyYOLOv2 model.
- Created a technical article about the project. The article is featured in the Jetson Community Resources page in the Deep Learning section. [[🔗 link](#)]

### Activity Recognition System based on Human Pose Estimation

- Created a system to recognize the activity performed by humans in a given video. The system used an activity recognition algorithm that depended on human poses estimated by OpenPose.
- A custom BRIEF based multi-object tracker was used to track human poses across frames obtained from the given video.
- Custom feature extraction techniques were used to extract features from the tracked human poses. An LSTM was trained and used to recognize the activity from the extracted features.
- Multiprocessing and pipelining concepts were used to enhance the inference speed of the system. Of note, copies of a trained LSTM were used in multiple CPU processes to perform activity recognition of multiple humans in parallel.

### Technical Articles

- Authored technical articles on various topics in machine learning and computer vision. Some selected articles:
  - *Advances in Generative Adversarial Networks*. (Jan 2019, [[🔗 link](#)])
  - *An Overview of Human Pose Estimation with Deep Learning*. (Apr 2019, [[🔗 link](#)])

## TECHNICAL SKILLS

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**Languages:** Python, C++, C, JavaScript, MATLAB

**Frameworks & Libraries:** PyTorch, PyTorch3D, TensorFlow, PCL, OpenCV, NumPy, SciPy, Shapely, ROS, RViz

**Developer Tools:** Git, Docker, GCP, AWS

## COMMUNITY EXPERIENCES

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### Undergraduate AI Mentoring Program | Carnegie Mellon University

Oct 2023 – Present

- Mentoring a student by conducting regular 1:1 meetings to help them get acquainted with relevant AI research and tools that can be applied to their fields of interest.

### Google Code-In Mentor | CloudCV

Oct 2018 – Dec 2018

- Mentored students of the age group 13-17 to contribute to the open source project Fabrik by providing extensive code reviews and feedback.

### Machine Learning Domain Head | Tech Club SSN

Jun 2018 – Apr 2019

- Conducted technical classes, and organized events and hackathons as the machine learning domain head of Tech Club SSN, a student run organization of the ECE department of my undergraduate institution.
- Created a website for Tech Club SSN to display information about events and announcements.

## ACHIEVEMENTS

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### People's Choice Award | Yet Another Hackathon (SVCE)

August 2018

- Presented a simple carry-on device created using a Raspberry Pi and an accelerometer sensor that can detect if a person has been assaulted and if so sends SMS alerts.

### Runner Up | Data Science Challenge (Exebit, IIT Madras)

April 2018

- Runner up in a 10 day online contest involving a highly skewed dataset to detect debit card fraud.

### Runner Up | AWS Deep Learning Hackathon (Shaastra, IIT Madras)

January 2018

- Trained an object detection algorithm that could detect a few hand signs.

### First Place | Project Presentation (SSN)

August 2017

- Presented a live demonstration of a convolutional neural network that could decode some simple captcha.