Education

Carnegie Mellon University

Ph.D. in Software Engineering, Advisors: Dr. Eunsuk Kang and Dr. Sebastian Scherer TA: Designing Large Scale Software Systems (S3D S24)

Carnegie Mellon University

Masters in Software Engineering GPA: 4.03/4.00 | Selected Courses: Deep Learning Systems, Artificial Intelligence for Social Good, Advanced Formal Methods, Provably Safe Robotics, Human-Robot Interaction

Manipal Institute of Technology

B.Tech. in Computer Science Engineering

GPA: 8.59/10 | Minor: Intelligent Systems

Research Experience

Scaled Foundations

Research Intern | PIs: Dr. Sai Vemprala and Dr. Ashish Kapoor

- Developing a foundation model deployment pipeline for domain adaption to diverse physical form factors
- Building novel alignment strategies for robotics foundation models using constrained decoding in transformers

Verimag, Université Grenoble Alpes

Research Engineer | PI: Dr. Thao Dang

- Developed input stimulus generation theory using timed automata for autonomous system validation
- Evaluated these techniques within the SUMO simulation environment for applications in autonomous vehicles

Cyber Physical Systems Lab, University of Southern California

Research Intern | PI: Dr. Jyotirmoy Vinay Deshmukh

- Developed novel model-based reinforcement learning algorithms for safe policy training from signal temporal logic specifications
- Implemented efficient model-free algorithms (TRPO, A3C, PPO) in PyTorch with unique STL-based reward design
- · Achieved 82 percent higher specification satisfaction compared to baseline RL policies
- Engineered in-house simulation environments for algorithm benchmarking employing CARLA, AirSim, and Gazebo

Visual Computing Group, Cardiff University

Research Intern | PI: Dr. David Marshall

- · Constructed a safe trajectory prediction system for visually impaired individuals using ZED stereo camera
- Implemented and trained a 2-stream CNN in TensorFlow on human walking data for forecasting ego agent camera movement
- Improved CNN accuracy in low-data regimes through neuro-inspired data augmentation

RapidQube Digital solutions Pvt. Ltd.

Research Intern

- Created an accident prediction system leveraging convolutional neural networks and object tracking algorithms (YOLOV3)
- Implemented depth prediction Residual CNNs alongside YOLO v3 in Tensorflow to classify nearby drivers' speed profiles with 300 ms latency

Academic Research

AirLab, Carnegie Mellon University

Graduate Research Assistant | PI: Sebastian Scherer

- Enhanced Learning from Demonstration (LfD) policy constraint satisfaction via Monte Carlo Tree Search refinement
- Attained a 60 % improvement in real-world trajectory planning leveraging human demonstration data over baseline LfD methods
- Designed an angular rate-based control barrier function for autonomous aircraft collision avoidance using only vision-based sensing
- Analyzed the enforcing reactive controller in a digital twin environment within Nvidia Isaac Sim and conducted over 70 hours of in-field testing on Aurelia X6 drones
- Achieved a 71 % improvement over baseline system with high-speed closure rates (92 mph)

Software Design and Analysis Lab, Carnegie Mellon University

Graduate Research Assistant | PI: Eunsuk Kang

- Defined a new tolerance notion for safe reinforcement learning policies and created a simulation-based framework to identify unsafe operating conditions.
- Proposed a novel inverse learning problem leveraging positive and negative behavior traces, through translation into maximal satisfiability (MaxSAT) problems.
- · Devised a requirement decomposition theory for incremental Task and Motion Planning and Safe Reinforcement Learning
- Achieved a 65% reduction in solving time and a 51% performance improvement over state-of-the-art optimization-based planners

Parv Kapoor · Résumé

Pittsburgh, U.S.A. August 2021 - August 2025 (expected)

Pittsburgh, U.S.A. August 2021 - August 2024 (expected)

> Manipal, India August 2016 - August 2020

> > Los Angeles, U.S.A.

Seattle, WA

May 2024 - Ongoing

January 2020 - January 2021

Grenoble, France (Remote)

January 2021 - August 2021

Cardiff, U.K.

May 2019 - July 2019

Mumbai, India

May 2018 - July 2018

Pittsburgh, U.S.A.

August 2021 - Ongoing

Pittsburgh, U.S.A.

August 2021 - Ongoing

Skills

Programming Python, C/C++, JAVA, MATLAB, Alloy, TLA+, MySQL, CUDA programming, OpenCL **Tools and Libs** PyTorch, TensorFlow, ROS, Issac sim, AirSim, CARLA

Projects_

Safeguards for Large Language Models (with Microsoft Research NYC)

Collaborators: Hosein Hasanbeig, Siddhartha Sen

- Worked with AI for Systems Group to develop iterative, feedback-guided in context learning
- · Analysed Embedding Spaces to improve alignment of LLMs.

Differential Programming in custom Deep Learning libraries

Deep Learning Systems Course Project

- Built a comprehensive deep learning library from scratch, enabling GPU acceleration, automatic differentiation, and customizable layers, loss functions, and optimizers.
- Deployed Implicit Layers, convolutional networks, recurrent networks, self-attention models, and generative models using the library.

Predicting Food Insecurity in Somalia using Machine Learning

Collaborators: Michael Feffer, Sebastian Dodt and Fei Fang

- Collaborated with United Nations OCHA for food insecurity predictions in Somalia.
- Employed random forests, gradient-boosted trees, and gaussian processes for accurate real-time forecasting of hunger levels.

Trust elicitation and restoration in assistive robots

Collaborators: Angela Chen, Simon Chu, Henny Admoni

- Investigated the impact of customization and perspective on perceived trust in dexterous manipulation of assitive robotics.
- Conducted a pilot user study that showed higher trust and comfort measures with increased customization.

Preprints and Publications

Logically Constrained Robotics Transformers for Enhanced Perception Action Planning

P. Kapoor, Sai Vemprala, Ashish Kapoor

• Robotics Science and Systems (RSS): Towards Safe Autonomy 2024

Example-based Constrained LTL specification learning using MaxSAT

C. Zhang*, P. Kapoor*, I. Dardik, A. Cui, R.M. Goes, D. Garlan, E. Kang

• IEEE International Conference on Software Engineering (ICSE) 2025 (Under Revision)

Analyzing Tolerance of Reinforcement Learning Controllers against Deviations in

Cyber Physical Systems

C. Zhang*, P. Kapoor*, R.M. Goes, D. Garlan, E. Kang, A. Ganlath, S. Mishra, N. Ammar

Formal Methods (FM) 2024 [arxiv]

Safe Planning through Incremental Decomposition of Signal Temporal Logic

P. Kapoor, R.M. Goes and E. Kang

• Nasa Formal Methods (NFM) 2024 [arxiv]

ViSafe: Vision-enabled Safety for High-speed Detection and Avoidance

P. Kapoor, I. Higgins, N. V. Keetha, J. Patrikar I. Cisneros, Z. Ye, Y. He, Y. Hu, S. Scherer

• Under Review

FoundLoc: Vision-based Onboard Aerial Localization in the Wild

Y. He, I. Cisneros, N. V. Keetha, J. Patrikar, Z. Ye, I. Higgins, Y. Hu, P. Kapoor, S. Scherer

• Under Review [arxiv]

Follow The Rules: Online Signal Temporal Logic Tree Search for Guided Imitation Learning in Stochastic Domains

- J. Patrikar, J. Aloor, **P. Kapoor**, S. Scherer and J. Oh
- IEEE International Conference on Robotics and Automation (ICRA) 2023 [arxiv]

Challenges in Close-Proximity Safe and Seamless Operation of Manned and

Unmanned Aircraft in Shared Airspace

J. Patrikar, J. Dantas, S. Ghosh, **P. Kapoor** et al

• IEEE International Conference on Robotics and Automation (ICRA) 2022 [arxiv]

Model-based Reinforcement Learning from Signal Temporal Logic Specifications

- P. Kapoor, A. Balakrishnan, J. V. Deshmukh
- 2020 [arxiv]

Predicting Time to Contact Across the Visual Image

D. Marshall, S.K. Rushton, J. Redfern, **P. Kapoor**, R.J. Moran

• In PERCEPTION (Vol. 49, No. 6, pp. 714-714) SAGE PUBLICATIONS LTD. 2020

Fall 2022

Spring 2022

Fall 2023