K. Niranjan Kumar

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Summary

Researcher with **7+ years** of experience in **Reinforcement Learning**, **Robotics** and **Computer Vision**. Extensive experience in designing and training control policies for whole-body control, locomotion, navigation, manipulation.

Education

Georgia Institute of Technology — Atlanta, GA
PhD in Electrical and Computer Engineering, GPA 4.0/4.0 — *Jan. 2017 – May 2024*

Georgia Institute of Technology — Atlanta, GA
Master of Science in Electrical and Computer Engineering, GPA 4.0/4.0 — *Aug. 2015 – Dec. 2016*

National Institute of Technology — Trichy, India
Bachelor of Technology in Electrical and Electronics Engineering, GPA 8.3/10 — *July. 2011 – May 2015*

Publications

1. N. Sontakke, **K. N. Kumar**, and S. Ha. RoboDesignGPT: Design Optimization using LLMs. *Workshop on Co-design in Robotics, ICRA*, May 2024

2. T. Huang, N. Sontakke, **K. N. Kumar**, I. Essa, S. Nikolaidis, D. W. Hong, and S. Ha. Bayrntune: Adaptive bayesian domain randomization via strategic fine-tuning. *IROS*, October 2024

3. **K. N. Kumar**, I. Essa, and S. Ha. Words into action: Learning diverse humanoid robot behaviors using language guided iterative motion refinement. *LangRob workshop, CoRL*, 2023

4. **K. N. Kumar**, I. Essa, and S. Ha. Cascaded compositional residual learning for complex interactive behaviors. *IEEE Robotics and Automation Letters*, 8(8):4601–4608, 2023

5. **K. N. Kumar**, I. Essa, and S. Ha. Graph-based Cluttered Scene Generation and Interactive Exploration using Reinforcement Learning. *ICRA*, May 2022

6. **K. N. Kumar**, I. Essa, S. Ha, and C. K. Liu. Estimating Mass Distribution of Articulated Objects using Non-prehensile Manipulation. *NeurIPS ORLR Workshop (Oral)*, Dec 2020

Experience

Applied Researcher - Robotic Controls — Feb 2024 – Present
Sanctuary AI — *Lynnwood, WA*

- Created a framework to train **human-like walking policies on H1 humanoid robot**, combining motion imitation and reward-engineering based RL.
- Developed **data-driven techniques for actuator modeling** in humanoid robots.
- Formulated and developed **collision avoidance using barrier-constraints** to ensure safety.

Research Intern — May 2019 – July 2019
Samsung Research America — *Mountain View, CA*

- Worked at the AI center on **long-range video understanding** using neural networks.

- Built graphical representations of video to tackle **few shot video classification** built on top of I3D architecture.

Research Intern June 2018 – August 2018
Nokia Bell Labs *New Providence, NJ*

- Interned with the Mathematics and Algorithms group at Bell labs and worked on **training procedures that make neural networks robust to adversarial attacks**.
- Studied the effect of weight normalization techniques on the loss landscape of neural networks.

Research Intern Aug 2016 – Dec 2016
Emory University School of Medicine *Atlanta, GA*

- **Designed and developed a smart head-mounted eye dropper device** with a built-in camera to track the drop's trajectory using a machine learning model.

Technical Skills

Languages: Python, C++
Libraries/Packages: NumPy, Scipy, Matplotlib, Pandas, Jupyter, OpenCV, ROS, MATLAB
Machine Learning Libraries: Tensorflow, Pytorch
Physics Libraries: Pybullet, Pydart, Issac Gym
Robots: TurtleBot, UR10, Unitree A1,H1, Agility Robotics Digit, FPV Quadcopters

Academic Projects

Learning dynamic and agile skills for a humanoid robot from language commands Feb 2023 – Dec 2023

- Built a framework that utilizes **Large Language Models (LLMs) to control and direct training of RL control policies for Digit** humanoid robot from language instructions.
- Developed **cross-morphological motion re-targeting** to map trajectories from human to digit skeleton.

Interactive navigation with a quadruped robot Dec 2021 – Dec 2022

- Developed learning based **control policies for a quadruped robot to interactively navigate** an indoor environment.
- The approach incrementally develops complex skills by learning **residuals on top of a library of pre-learned policies** using Deep Reinforcement Learning. The robot dynamically navigates through a house, opening doors, manipulating objects, and crawling through tight spaces to reach its goal, achieving state-of-the-art performance.

Object search in clutter using physical plausibility priors Aug 2020 – Aug 2021

- Developed a robotic system to efficiently **discover hidden objects in cluttered environments.**
- Built a **scene grammar to represent structured clutter** and used it as a unifying representation to generate and rearrange structured clutter. Developed a pair of **RL agents that generate and explore complex cluttered scenes** by interactively rearranging and discovering hidden objects. Both these agents use Graph Neural network architectures, and generalize to an arbitrary number of objects.
- Deployed the policies trained in simulation on real cluttered scenes with a **UR10 robot** (sim2real) and an **e-pick vacuum suction gripper**.

Mass estimation of articulated objects Aug 2018 – Feb 2020

- Built **RL policies to efficiently interact with articulated objects** and estimate their mass distribution.
- Developed a **dual-network approach** to interactive perception, where a Predictor neural network minimizes estimation error and a Policy neural network selects optimal actions that reveal the maximum information.
- Deployed the learned policy on UR10 robot (sim2real), developed **dynamic pushing strategies** for manipulating 3D printed articulated toys and demonstrated state-of-the-art results on estimation of mass distribution.

Volunteering/ Leadership

Web Chair, CoRL 2023
Reviewer, TRO, THRI, IROS, CoRL, ICRA
Head of Spider Electronics, R&D club, NITT
Overall Coordinator, EEE Association NITT