Niranjan Kumar

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RESEARCH STATEMENT

The goal of my research is to build embodied agents that interactively explore and improve their understanding of objects around them. My current research focuses on teaching quadruped robots explore cluttered indoor scenes. More broadly, I am interested in applying machine learning techniques to tackle problems in computer vision, robotic manipulation and quadruped locomotion.

EDUCATION

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

Georgia Institute of Technology   Atlanta, GA
Master of Science in Electrical and Computer Engineering, GPA 4.0/4.0   *Aug. 2015 – Aug.2017*

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

PUBLICATIONS

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

2. K. N. Kumar, I. Essa, S. Ha, and C. K. Liu. Estimating Mass Distribution of Articulated Objects using Non-prehensile Manipulation. *NeurIPS Workshop on Object Representations for Learning and Reasoning (Oral)*, Dec 2020

EXPERIENCE

Graduate Teaching/Research Assistant   Jan 2017 – Present
Georgia Institute of Technology   *Atlanta, GA*
- GTA for 6475 Graduate Computational Photography course
- Responsibilities: Designing assignments, grading, discussions on Piazza

Research Intern   May 2019 – July 2019
Samsung Research America   *Mountain View, CA*
- Interned at the AI center and worked on long-range video understanding using neural networks
- Investigated the applicability of graphical representations of video to tackle few shot video classification

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 that automatically administers eye drops into the user's eyes.
- The device has a built-in camera that tracks the drop as it falls into the user's eye with an ML model, and re-administers it in-case of failure.

Academic Projects

Object search in cluttered indoor environments   Aug 2021 – present
- Training control policies for a quadruped robot to interactively search for objects in an indoor scene.

Object search in clutter   Aug 2020 – Aug 2021
- Built a scene grammar to represent structured clutter and used it as a unifying representation to generate and rearrange structured clutter.
- Developed a framework to train RL agents that generate complex cluttered scenes and rearrange them to discover hidden objects.
- Tested the policies trained in simulation by deploying them on a real cluttered scene with a UR10 robot (sim2real).

Mass estimation of articulated objects   Aug 2018 – Feb 2020
- Designed RL policies to efficiently interact with articulated objects and estimate their mass distribution.
- Developed a two-network approach to interactive perception, where a Predictor network minimizes estimation error and a Policy network selects optimal actions that reveal the most information.
- Tested the approach with a real UR10 robot (sim2real) and 3D printed articulated toys that can have an arbitrary mass distribution.

Realistic video generation of hand-object interactions   Aug 2018 – May 2019
- Trained an Image2Image Generative Adversarial Network (GAN) that generates realistic videos of hands manipulating objects from motion capture data.

Eye-dropper device   Jan 2016 – Dec 2016
- Designed and built an intelligent eye-dropper that automatically administers eye drops to a patient's eye.
- Developed and implemented a machine learning based approach to classify an image of the eye as open or closed. The algorithm is light-weight and can run on a Raspberry Pi mounted within the device.
- Designed and fabricated an electro-mechanical system that administers medication when the eye is open and tracks the drop to ensure that it enters the eye.

Selecting real world objects with eye gaze   Jan 2016 – May 2016
- Built a system that helps paralyzed patients select objects of interest from a scene with an eye-gaze tracker. The objects of interest are detected and tracked by using image features captured at keypoints.

Graduate Coursework

Interactive Robot Learning	Computer Vision
Statistical Techniques for Robotics	Advanced Computer Vision
Mathematical Foundations for ML	Computational Photography
Statistical Machine Learning	PDEs for Image Processing and CV
Control of Robotic Systems	Digital Image Processing
Intro to Graduate Algorithms	Linear Systems and Control

Technical Skills

Languages: Python
Developer Tools: Git, Docker, VS Code, Visual Studio, PyCharm
Libraries/Packages: NumPy, Scipy, Matplotlib, Pandas, Jupyter, OpenCV, ROS, MATLAB
Neural Network Libraries: Tensorflow, Pytorch
Physics Libraries: Pybullet, Pydart, Issac Gym
Robots: UR10, TurtleBot, Unitree A1