

## EDUCATION

### CARNEGIE MELLON UNIVERSITY

School of Computer Science, The Robotics Institute

Master of Science in Robotics (MSR) (GPA: 3.95/4.0)

Pittsburgh, PA

Dec 2022

**Coursework:** Optimal Control and Reinforcement Learning, Kinematics Dynamics and Controls, Machine Learning (PhD), Advance Dynamics and Simulator Design, Convex Optimization, Visual Learning and Recognition

### INDRAPRASTHA INSTITUTE of INFORMATION TECHNOLOGY DELHI (IIITD)

Bachelor of Technology in Electronics & Communication (Dept. Rank 1/70) (CGPA: 9.18/10)

New Delhi, India

May 2020

**Relevant Coursework:** Machine Learning in Real Time Control, Nonlinear Control in Robotics, Adaptive Control in Robotics, Linear Optimization, Computer Vision, Statistical Signal Processing, Dynamical Systems, VLSI Design Flow, Embedded Logic Design


## EXPERIENCE

### BIOROBOTICS LAB, CMU (PI: Professor [Howie Choset](#))

Pittsburgh, PA

Research Assistant

Jan 2021-Dec 2022

- Student Lead for Robo-TRACIR: surgical robotics project for saving lives of in trauma patients via autonomous needle insertion using robotic ultrasound system (RUS).
- Developed **multi-encoder UNET** for improving segmentation in ultrasound images by late fusion of images and flow (ongoing)
- Designed algorithm for autonomously finding venous regions using Bayesian Optimization & force feedback on RUS (ICRA) [1] 

### Model Based Reinforcement Learning with Image Observations in Presence of Distractors (PI: [Jeff Schneider](#))

Pittsburgh, PA

Research Assistant

May 2021-Present





- Extended SOTA **model-based reinforcement learning** algorithm Dream to Control which learns RL policy using images even in presence of distractors
- Novel idea of increasing representational power of variational autoencoder by fusing autoregressive video prediction network and dream to control architecture to handle distractors

### ROBOTICS INSTITUTE SUMMER SCHOLAR (RISS) PROGRAM, CMU (PI: Professor [Katia Sycara](#))

Pittsburgh, PA

Undergraduate Student Intern

May 2019-Aug 2019




- Selected amongst 40 students worldwide [2] 
- Designed **heterogeneous multi-agent** task allocation algorithm via mixed integer optimization with collision avoidance 
- Scaled multi-agent deep reinforcement learning algorithm for predator prey formation control to more agents via transfer learning  

### IIIT DELHI (PI: Professor [Sayan Basu Roy](#) and Professor [P. B. Sujit](#))

New Delhi, India

Student Researcher

May 2018-Dec 2020

- Proposed swarm robotics algorithm to split swarm using leader/predator agents for parallel tasks completion (SMC 2019) [3] 
- Designed **first-ever** closed-loop reference model for **distributed systems** (CRM-DMRAC) framework, converges faster to desired trajectory than SOTA; **adaptive controller** & parameter estimation designed based on Lyapunov analysis (L-CSS, ACC 2021) [4] 
- Improved CRM-DMRAC to tackle limited bandwidth multi-agent setting via a novel external input estimation using Dynamic Surface Control and Cooperative Initial Excitation (TCNS 2022) [5] 


## PROJECTS

### Novel Parameter Estimation Algorithm for Time-varying Systems (PI: Professor [Sayan Basu Roy](#))

Pittsburgh, PA

Independent Researcher

Jun 2020-May 2022

- Provable novel time-varying system parameter estimation and tracking using adaptive control and Lyapunov analysis
- First unified algorithm to work for both unknown time-varying parameters and unknown constant parameters (under review [TAC](#)) [6] 

### Robotic On-Orbit Satellite Servicing (Northrop Grumman)

Pittsburgh, PA

Graduate Researcher

Feb 2021-May 2021


- Designed inverse dynamics and force based non-linear controller for 7-DOF robotic arm to enable minimal disturbance docking
- Computed Basin of Attraction to determine the convergence bounds for the operational space controller using Mujoco simulator

### Trajectory Optimization for Spacecraft Rendezvous (PI: Professor [Zac Manchester](#))

Pittsburgh, PA

Graduate Researcher (Course Project)

Feb 2021-May 2021

- Designed an MPC based trajectory optimization algorithm with sequential quadratic programming for docking in SE(3) space 
- Utilized Robotics Dynamics Package from Julia to model satellite dynamics based on Clohessy-Wiltshire equations

## SKILLS

- Languages & Tools: MATLAB, Simulink, ROS, Gazebo, Mujoco, Python, Pytorch, Julia (intermediate), C++

## PUBLICATIONS

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1. **Raghavv Goel\***, Abhimanyu\*, Kirtan Patel, John Galeotti, Howie Choset, “Autonomous Ultrasound Scanning with Hybrid Force Controller” International Conference on Robotics and Automation, (ICRA 2022)
2. **Raghavv Goel**, Jaskaran Singh Grover, Sumit Yi Sha, Katia Sycara “Dynamic Task Allocation Using Multi-Agent Mobile Robots”, Robotics Institute Summer Scholars Journal (RISS 2019 Journal)
3. **Raghavv Goel**, John Lewis, Michael A. Goodrich, P. B. Sujit, “Predator & Leader Based Swarm Steering for Multiple Tasks”, International Conference on System, Man, and Cybernetics (SMC 2019)
4. **Raghavv Goel**, Sayan Basu Roy, “Closed-loop Reference Model based Distributed MRAC for Multi-agent Systems”, IEEE Control Systems Letters (L-CSS 2021) and American Control Conference (ACC 2021)
5. **Raghavv Goel**, Tushar Garg, Sayan Basu Roy, “Closed-loop Reference Model based Distributed MRAC using Cooperative Initial Excitation and Distributed Input Estimation”, IEEE Transactions on Control of Network Systems (TCNS 2022)
6. **Raghavv Goel**, Sayan Basu Roy, “Adaptive Control for Time-varying Systems using Dual Adaptation”, Transaction of Automatic Control (TAC 2022)