Raghavv Goel

raghavvg@cs.cmu.edu | (412)-519-8580 |

EDUCATION

CARNEGIE MELLON UNIVERSITY Pittsburgh, PA
School of Computer Science, The Robotics Institute Dec 2022
Master of Science in Robotics (MSR) **(GPA: 3.95/4.0)**
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) New Delhi, India
Bachelor of Technology in Electronics & Communication **(Dept. Rank 1/70) (CGPA: 9.18/10)** 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

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)