**Jaskaran Singh Grover**

Phone: +1-310-903-0487

E-mail: [jaskarag@andrew.cmu.edu](mailto:jaskarag@andrew.cmu.edu)

**Research Interests**

Optimization, Nonlinear Control, System Identification, Learning, Multirobot Systems, Motion Planning, Soft Robots

**Education**

2018-Current **Carnegie Mellon University**

PhD. Student in Robotics. GPA 4.00 (Advisors: Prof. Katia Sycara and Prof. Changliu Liu)

2016-2018 **Carnegie Mellon University**

Master of Science in Robotics. GPA 4.00 (Advisors: Prof. Howie Choset and Dr. Matthew Travers)

2015-2016 **University of California, Los Angeles**

Master of Science in Electrical Engineering. GPA 3.97

2010-2014 **Birla Institute of Technology and Science, Pilani, India**

Bachelor of Engineering in Electronics and Instrumentation (Distinction) GPA 9.00/10

**Skills**

Python, C, C++, TensorFlow, Keras

MATLAB, Simulink, Mathematica, Solidworks, Open-CV, COMSOL Multiphysics, NI LabVIEW

**Relevant Coursework**

Convex Optimization, Robust and Optimal Control, Kinematics and Dynamics, Linear Systems, Underactuated Robotics, Deep Learning, Machine Learning, Linear Systems, Adaptive Filtering, Real Analysis, Measure and Integration, Math for Robotics

**Papers**

* **Jaskaran Grover**, Changliu Liu, Katia Sycara,“Parameter Identification for Multirobot Systems” (Submitted to ACC 2020)
* **Jaskaran Grover**, Changliu Liu, Katia Sycara, “Why Does Symmetry Cause Deadlocks?” (IFAC World Congress 2020)
* **Jaskaran Grover**, Changliu Liu, Katia Sycara, “Deadlock Analysis and Resolution in Multirobot Systems” (WAFR 2020)
* K. Shih, C. Ho, **Jaskaran Grover**, C. Liu, S. Scherer, “Provably Safe in the Wild: Testing Control Barrier Functions on a Vision Based Quadrotor in Outdoor Environments” (RSS 2020 Workshop on Robust Autonomy)
* **Jaskaran Grover**, Daniel Vedova, Nalini Jain, Howie Choset, Matthew Travers, “Motion Planning, Design Optimization and Fabrication of Ferromagnetic Swimmers”, (RSS 2019)
* Scott Kelly, Rodrigo Abrajan, **Jaskaran Grover**, Howie Choset, Matthew Travers, “Planar Motion Control, Coordination and Dynamic Entrainment in Chaplygin Beanies”, (DSCC 2018)
* Chaohui Gong, Julian Whitman, **Jaskaran Grover**, Baxi Zhong, Howie Choset, “Geometric Mechanics and Gait Design on Cylindrical and Toroidal Shape spaces”, (DSCC 2018)
* **Jaskaran Grover**, Jake Zimmer, Tony Dear, Matt Travers, Howie Choset, Scott Kelly, “Geometric Motion Planning for a Three-Link Swimmer in a Three-Dimensional Low Reynolds-Number Regime”, (ACC 2018)
* **Jaskaran Grover**, Venkat Natarajan “Estimation and Tracking of Knee Angle Trajectory using Inertial Sensors and a Smartphone Application”, (BodyNets 2015)
* **Jaskaran Grover**, Anu Gupta, “Studying Crosstalk Trends for Signal Integrity on Interconnects using Finite Element Modeling”, (COMSOL Conference 2013)

**Work Experience**

**Systems Engineer, Biosignals and Systems Research Group, Intel Labs (07.2014 – 07.2015)**

**Pedestrian position tracking and gait analysis using inertial sensors**

* Developed extended Kalman filtering algorithms for measuring foot trajectory using inertial sensors
* Developed quaternion based orientation estimation algorithm for tracking 3D orientation from IMUs

**Intern, Biosignals and Systems Research Group, Intel Labs (01.2014 – 07.2014)**

**Smart knee motion tracking Solution using wearable bands and mobile phone**

* Created a smart-fabric knee band instrumented with a WSN, IMU and stretch sensors.
* Integrated sensor measurements to track the ‘flexion’ angle of knee joint on a BLE android-tablet.

**Research Experience**

**Graduate Research Assistant, Intelligent Control Lab and Advanced-Agent Robotics Technology Lab**

**Development of an Integrated Prediction, Estimation, Planning and Control Framework**

* Working in a collaboration with team from Intelligent Control Lab to develop a Python based software package for doing prediction, estimation, planning and control for model free and model based control tasks

**Multirobot exploration, path planning and room clearing with mixed integer linear programming**

* Working on exploration of rooms in unknown nonconvex environments to search for friendly/hostile robots
* Integrated PRM based path planning and barrier certificate controllers for collision avoidance and room clearing

**Adversarial Robustness, Multirobot and Swarm System Identification**

* Derived parameter estimation algorithms for identifying controller and model parameters of multirobot systems and swarms using their position information with theoretical guarantees
* Exploring human intent estimation using inverse optimization and system identification

**Multirobot Experiments Arena Development**

* Designed and constructed a multirobot motion experiments arena for benchmarking swarm algorithms on Khepera robots
* Integrated Vicon motion tracking and projector for virtual environments with ROS for feedback control

**Graduate Research Assistant, Biorobotics Lab**

**Geometric gait design for a novel 3D low-Reynolds swimmer with yaw-pitch inputs**

* Derived a dynamics model for a novel three-dimensional swimmer in a viscous regime
* Validated gaits derived from simulations on a physical robot in corn syrup

**Dynamics modeling, design optimization and planning for elastomagnetic swimmers**

* Developed a geometric framework for locomotion control of ferromagnetic swimmers
* Fabricated elastomagnetic swimmers, designed and programmed a Helmholtz coil setup for locomotion using magnetic fields

**Course Projects**

**Model free control using deep reinforcement learning**

* Derived robustly stabilizing controllers using off-policy reinforcement learning in TensorFlow
* Benchmarked neural network based controllers against basis-function based controllers on prototype systems

**Fault tolerant control of a quadrotor**

* Investigated the problem of controlling a quadrotor experiencing propeller failure
* Demonstrated how feedback linearization can be used to control attitude and altitude

**Achievements**

* Recipient of Uber Presidential Fellowship (2019)
* Distinction Divsion, BITS Pilani (2014)
* All India Rank 8 in Graduate Aptitude Test in Engineering, GATE 2014, Instrumentation Engineering (2014)

**Teaching Experience**

Provably Safe Robotics (Fall 2019), Underactuated Robotics (Fall 2018), Robot Kinematics and Dynamics (Fall 2017)

**Mentoring Activities**

Michael Cheng (CMU), Kenneth Shaw (Georgia Tech), Raghavv Goel (IIIT Delhi), Daniel Vedova (CMU), Nalini Jain (CMU)