# Jaskaran Grover

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I am a PhD. student in the Robotics Institute at Carnegie Mellon University. I work at the intersection of system identification, optimization and control theory, and use these for analyzing closed-loop behavior of multirobot systems. I also take interest in analyzing mechanical systems that exhibit complex nonlinear dynamics, especially using tools from geometric mechanics, nonlinear control and differential geometry.

## Education

**Doctor of Philosophy in Robotics**                                     **Ongoing**
*Carnegie Mellon University*                                          *Pittsburgh, PA*
Advisors: Changliu Liu and Katia Sycara
GPA: 4.00

**Masters of Science in Robotics**                                    **August 2018**
*Carnegie Mellon University*                                          *Pittsburgh, PA*
Advisors: Howie Choset and Matthew Travers
GPA: 4.00

**Masters of Science in Electrical Engineering**                         **July 2016**
*University of California, Los Angeles*                               *Los Angeles, CA*
GPA: 3.97

**Bachelor of Engineering Electronics & Instrumentation**                **July 2014**
*Birla Institute of Technology and Science, Pilani*                      *Pilani, India*
Distinction, GPA: 9.00/10.0

## Skills

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

## Relevant Coursework

Convex Optimization, Robust Control, Optimal Control, Robot Kinematics and Dynamics, Linear Systems, Underactuated Robotics, Deep Learning, Machine Learning, Adaptive Filtering, Real Analysis, Math for Robotics, Differential Geometry, Calculus of Variations, Reinforcement Learning

## Patents and Publications

- **J. Grover**, V Natarajan, K Ranganathan, "Motion Tracking Using Electronic Devices", US Patent 10,799,118 Application Granted 2020-10-13

- **J. Grover**, C. Liu, K. Sycara, "Feasible Region-Based Identification Using Duality", Submitted to ECC 2021

- **J. Grover**, C. Liu, K. Sycara, "Parameter Identification for Multirobot Systems Using Optimization-Based Controllers", Submitted to ACC 2021

- **J. Grover**, C. Liu, K. Sycara, "Why Does Symmetry Cause Deadlocks?", IFAC World Congress 2020

- **J. Grover**, C. Liu, K. Sycara, "Deadlock Analysis and Resolution in Multirobot Systems", WAFR 2020

- K. Shih, C. Ho, **J. 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

- **J. Grover**, D. Vedova, N. Jain, H. Choset, M. Travers, "Motion Planning, Design Optimization and Fabrication of Ferromagnetic Swimmers", RSS 2019

- S. Kelly, R. Abrajan, **J. Grover**, H. Choset, M. Travers, "Planar Motion Control, Coordination and Dynamic Entrainment in Chaplygin Beanies", DSCC 2018
- C.Gong, J. Whitman, **J. Grover**, B. Zhong, H. Choset, "Geometric Mechanics and Gait Design on Cylindrical and Toroidal Shape spaces", DSCC 2018
- **J. Grover**, J. Zimmer, T. Dear, M.Travers, H. Choset, S. Kelly, "Geometric Motion Planning for a Three-Link Swimmer in a Three-Dimensional Low Reynolds-Number Regime", ACC 2018
- **J. Grover**, V. Natarajan, "Estimation and Tracking of Knee Angle Trajectory using Inertial Sensors and a Smartphone Application", Bodynets 2015
- **J. Grover**, A. Gupta, "Studying Crosstalk Trends for Signal Integrity on Interconnects using Finite Element Modeling", COMSOL Conference 2013

## Work Experience

**Intel Labs**        **July 2014**-**June 2014**
*Systems Engineer, Biosignals and Systems Research Group*        *Bangalore, India*
**Pedestrian position tracking and gait analysis using inertial sensors**
Developed EKF based algorithms for measuring foot trajectory using inertial sensors
Developed quaternion based orientation estimation algorithm for tracking 3D orientation from IMUs

**Intel Labs**        **January 2013**-**June 2013**
*Intern, Biosignals and Systems Research Group*        *Bangalore, India*
**Smart knee motion tracking 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

## Research Experience

- **Intelligent Control Lab, Advanced-Agent Robotics Technology Lab**
  *Development of Composable Agent Toolbox:* Worked in a collaboration with team from Intelligent Control Lab to develop a software package for prediction, estimation, planning and control for model-free and model-based control tasks.

- *Multirobot exploration and path planning with mixed integer linear programming:*
  Developed algorithms for exploration of rooms in unknown environments to search for friendly/hostile robots. Integrated PRM based path planning and barrier certificate controllers for collision avoidance and room clearing.

- *Multirobot System Identification:*
  Derived parameter estimation algorithms for identifying task parameters of multirobot systems and swarms using their position information with theoretical guarantees. Exploring human intent estimation using inverse optimization and system identification

**Biorobotics Lab, CMU**
- *Motion planning for a 3D low-Reynolds swimmer with yaw-pitch inputs:*
  Dynamics analysis for a novel three-dimensional swimmer in a viscous regime Validated gaits and motion plans derived from simulations on a physical prototype

- *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

## Awards

- (2019) Recipient of Uber Presidential Fellowship
- (2015) All India Rank 8 in Graduate Aptitude Test in Engineering (GATE) in Instrumentation
- (2014) Distinction Division for undergraduate studies, BITS Pilani

## Teaching Experience

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

## Mentoring Activities

- (Fall 2020) Shreya Manjunath (CMU Freshman), Ruohai Ge (CMU Masters), Jeff Hu (CMU Masters)
- (Fall 2019) Michael Cheng (CMU Masters), Kenneth Shaw (Intern), Raghavv Goel (Intern)
- (2018-2019) Danny Vedova (CMU Undergrad)