Jaskaran Singh Grover

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Research Interests

Optimization, Nonlinear Control, System Identification, Geometric Mechanics, Multirobot Systems, Motion Planning

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, 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, Differential Geometry, Calculus of Variations

Papers

- **Jaskaran Grover**, Changliu Liu, Katia Sycara,"Parameter Identification for Multirobot Systems" (Submitted to ACC 2021)
- **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, 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

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)