Hans Kumar

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EXPERIENCE

CMU BIOROBOTICS LAB | PITTSBURGH, PA
Graduate Researcher, Summer 2019 - Current
- Implementing robust state estimation algorithms onboard a hexapod robot for traversal of challenging terrain
- Exploiting periodicity of legged robot motion within a visual SLAM pipeline to avoid algorithm divergence
- Researching reinforcement learning as a method to actively select legged robot gaits that maximize localization performance

CATERPILLAR | RALEIGH, NC
Robotics Intern, Summer 2018
- Integrated and calibrated robotics sensor hardware onto a multiple degree of freedom mini-excavator for autonomous demolition
- Implemented a ROS centric interface to process sensor information, plan a control strategy, and actuate the machine

HEBI ROBOTICS | PITTSBURGH, PA
Mechanical/Controls Intern, Summer 2017
- Designed and optimized a high-speed, compliant delta parallel robot using industrial series elastic actuators
- Demonstrated modularity of system by adding camera, gripper, and moving base plate in a high-speed pick-and-place demo

PROJECTS

REINFORCEMENT LEARNING GAIT ADAPTATION
Deep Reinforcement Learning for Robotics, Spring 2020
- Applied policy gradient methods to optimize gait parameters for a legged robot walking over obstacles in a simulated environment
- Learned representation of terrain using a Variational Autoencoder

PERIODIC GRAPH SLAM
Robot Localization and Mapping, Fall 2019
- Used multiple factor graphs to track individual sections of periodically pitching camera's phase
- Increased tracking accuracy of shaky camera motion in simulation

WASHBOT
Robotics Capstone, Spring 2019
- Designed and built a mobile robot capable of autonomously driving around a prescribed area and power-washing it
- Integrated visual estimation and coverage planning software modules onto the robot's onboard computer

ROBOTIC FEEDER
Robot Kinematics and Dynamics, Fall 2017
- Derived and implemented the low-level kinematics, dynamics, and trajectory planning necessary to control a robotic feeding arm

EDUCATION

CARNEGIE MELLON UNIVERSITY
PITTSBURGH, PA
MS in Robotics, Expected Fall 2020
QPA = 4.08/4.00
B.S. in Mechanical Engineering, May 2019
Additional Major in Robotics
QPA: 3.75/4.0

SKILLS

Programming: Python, C++/C, Matlab ROS, Linux, GIT
CAD: Solidworks, Creo Pro/E
Machines: Mill, Lathe, 3D Printer, Laser Cutter
Other: Computer Vision, SLAM, Manipulator Controls

COURSEWORK

- Robot Localization and Mapping
- Intro to Machine Learning
- Deep Reinforcement Learning for Robotics
- Computer Vision
- Kinematics, Dynamics and Control
- Electromechanical Systems Design
- Feedback Control Systems
- Mobile Robots
- Numerical Methods
- Artificial Intelligence
- Principles of Imperative Computing

PUBLICATIONS

Shuo Yang, Hans Kumar, Zhaoyuan Gu, Xiangyuan Zhang, Matthew Travers, and Howie Choset (2019). *State Estimation for Legged Robots Using Contact-Centric Leg Odometry.* Preprint: arXiv:1911.05176 [eess.SY].