Ji Hwang "Henry" Kim

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Research Interests

Teaching robots complex user-specific goals through programming by demonstration and optimizing human-robot interaction via embedding semantic meanings to robots' learning algorithms or object detection

Education

University of Michigan, Ann Arbor — *Ann Arbor, MI*

Master of Science in Robotics — *Sep. 2018 - Exp. May. 2020*

GPA: 4.0 / 4.0

Rice University — *Houston, TX*

Bachelor of Science in Mechanical Engineering — *Sep. 2014 - May. 2018*

GPA: 4.03 / 4.33

Research Experience

Laboratory for Progress — *University of Michigan, Ann Arbor, MI*

Research Assistant — *Jun. 2019 - PRESENT*

- Introduce a new learning algorithm that utilizes factor graph to learn complex user-specific goals from demonstrated scenes and transfer the knowledge to new target environment with similar feature space
- Develop a new docker image configured to run essential libraries for this project, such as DOPE, ROS, Pyperplan, libDAI, etc.
- Integrate factor graphs as scene graphs from YCB dataset objects detected from Fetch robot using DOPE
- Make a PyQt GUI interface to enable user to intuitively communicate with Fetch robot via ROS and visualize the learned goal
- Implement evaluation method for the new learning algorithm introduced and write a paper on the methodology with results to RA-L

BIRDS Laboratory — *University of Michigan, Ann Arbor, MI*

Research Assistant — *Sep. 2018 - May. 2019*

- Optimize existing model predictive control algorithm on dynamics of multi-legged robots through computation time reduction
- Develop mathematical equations of motion of the multi-legged robots given each leg's world coordinates and constraints on body
- Solve the equations efficiently by rewriting current stochastic gradient descent architecture in Python to pure C with CUDA implementation

BioRobotics Lab — *Texas A&M University, College Station, TX*

Research Assistant — *Jun. 2017 - Aug. 2017*

- Designed 3D printable test bed in SolidWorks for force-sensing steerable needle with articulated tip and sensorized tendons
- Architected actuation platform to mount the newly designed needle to preexisting da Vinci Endowrist
- Developed C++ code to calculate temperature and force matrices obtained from the needle to be presented in GUI

Marquez Lab — *Rice University, Houston, TX*

Research Assistant — *Sep. 2016 - Jan. 2017*

- Developed a base mathematical model for the stress and strain behavior of a prototyped drill pipe for oil industry
- Designed the model in MATALB to compute stress and strain at each point in drill shaft in cylindrical coordinates
- Implemented finite element method to enhance the simulated model of the prototype and analyzed advantages of the new data set

Work Experience

Sep. 2019 - Jan. 2020	**Graduate Student Instructor** *ROB 550: Robotics Systems Laboratory*	*University of Michigan, Ann Arbor, MI*
Jan. 2018 - May. 2018	**Grader** *MECH 200: Classical Thermodynamics*	*Rice University, Houston, TX*

Projects

Self-Driving Car — *University of Michigan, Ann Arbor, MI*

Project Member — *Sep. 2018 - Jan. 2019*

- Designed a controller for bicycle model to complete the pre-defined track, Circuit of the Americas in Austin, as rapidly as possible
- Modeled a car with a non-linear bicycle model with Pacejka "Magic Formula", and compute forward integration control with MPC
- Wrote algorithms in MATLAB to generate random obstacles in the course and to generate a trajectory to avoid obstacle collision
- Optimized the hyperparameters of the algorithm to achieve faster track completion time

Robotics Systems Laboratory *University of Michigan, Ann Arbor, MI*

Project Member *Sep. 2018 - Jan. 2019*

- Completed three different robot projects and wrote IEEE-styled reports in LaTeX

ArmLab

- Implemented block detector in OpenCV that is capable of distinguishing 7 general colors from the spectrum
- Designed a gripper for RexArm using SolidWorks and Zortax 3D printer to achieve 6 DOF
- Mapped blocks in real-time video taken by Kinect to workspace coordinates, using intrinsic matrix and depth calibration function
- Computed forward / inverse kinematics of the RexArm and programmed the arm to pick and place blocks in desired orientations

BalanceBot

- Used MEMS IMU sensors and wheel encoders to determine orientation of segway robot
- Constructed nonlinear feedback controller using candidate Lyapunov function and Sontag's formula to balance the robot while traversing
- Installed Beaglebone on the robot with Robot Control Library in C for soft real-time control

BotLab

- Read-in LCM Logs from 2D LiDAR while driving around the workspace and compute occupancy grid
- Implemented SLAM with Monte-Carlo Localization, which sensor model is computed based on the laser scans and action model on odometry
- Implemented A* path planner to the goal position, from current position given by OptiTrack motion capture system

Robot Design Project: Am I Being Detained? *Rice University, Houston, TX*

Project Member *Jan. 2018 - May. 2018*

- Designed and evaluate a wall-building robot that can create temporary walls for enhanced experience for users in virtual reality
- Conducted system identification on a double pendulum robot with plate as end-effector to model its kinematics and dynamics
- Simulated the wall-making algorithm in MATLAB using inverse kinematics and dynamics
- Fabricated 3D CAD model of the robot in SolidWorks and made a poster for project presentation

Capstone Design Project *Rice University, Houston, TX*

Project Member *Sep. 2017 - May. 2018*

- Collaborated as a machining specialist and a programmer in a project to build an escape room, sponsored by Houston Escape Room
- Devised design foundation, mission statement, and Gantt chart to pitch our team's approach in building the escape room
- Fabricated room layouts, puzzle designs and storyline, supported with market analysis
- Designed and manufactured Arduino controllable puzzle devices with laser cutting or 3D printing
- Tested the puzzle devices with volunteers under IRB standards and modulated puzzle difficulties to accommodate the time limit

Leadership Roles & Activities

2014 - 2018 **Rice Korean International Student Association** Member & Vice President at 2017 *Houston, TX*

2014 - 2018 **Rice Woori Samulnori** Member & Leader at 2018 *Houston, TX*

Honors

2016 - 2018 **L. J. Walsh Scholarship** *Houston, TX*

2016 - 2018 **President's Honor Roll** *Houston, TX*

Skills

Libraries Tensorflow, PyTorch, ROS, Docker, DOPE, PoseCNN, Pyperplan, PyCUDA, add more

Languages Python, C/C++, Javascript, HTML/CSS, LaTeX, MATLAB/Simulink, Julia

Programs Git, SolidWorks, Jupyter, Unreal Engine, Unity

Hardware 3D Printing, Laser Cutting, Machining/Welding (MIG/Gas Metal Arc)