

# Richard (Han) Hu

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## Experiences

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### XPENG Robotics

Jan. 2022 - Present

Machine Learning Engineer, Motion Control Center

- **Deep Learning** Developing and deploying a locomotion controller for legged robots that combines reinforcement learning and traditional model-based control to increase robot stability
- **Infrastructure** Building a containerized, distributed and scalable reinforcement learning pipeline using IsaacGym and Pytorch.

### Autonomous System and Biomechatronics Lab

Sep. 2018 - Aug. 2021

Developer, Master Thesis

- **Deep Learning** Led the development and **published** a novel sim-to-real transfer pipeline for rough terrain navigation in Pytorch
- **Sim-to-Real** Researched, designed, and implemented a high fidelity Gazebo simulator and domain randomization
- **Development** Developed a decentralized software and hardware robot architecture using ROS, C++, and Python
- **Localization** Implemented LiDAR and visual SLAM on a mobile robot for real time pose estimation
- **Control** Designed and optimized a cascade PID controller for global position and wheel control in rough terrain
- **Analysis** Led real-world navigation, comparison, and ablation experiments to demonstrate that the pipeline achieved 87% real world success rate given a 90% simulation success rate; up to 72% increase against existing methods
- **Hardware** Enhanced a robot with auxilliary computing units and sensors with components designed using SolidWorks
- **Publication** Published in 1) IEEE Robotics and Automation Letters and 2) International Conference on Intelligent Robots and Systems

### Huawei Noah's Ark Lab

May. 2020 - Jan 2021

Developer, Autonomous Driving Division

- **Path Planning** Developed, **published**, and **patented** a Delaunay Triangulation based spatial constraint generation algorithm for mapless autonomous vehicle navigation in a dynamic environment
- **Development** Implemented a Python based path planning simulator and the algorithm's modules for fast development iterations
- **Algorithms** Implemented Hybrid A\* and Funnel algorithm for path planning in triangulation mesh
- **Simulation** Engaged in simulator development using CARLA by automating map generation process from real-world datasets
- **Publications** Published in 1) IROS 2021 Conference and 2) US Patent Application No. 17/515,522

## Publications

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### A Sim-to-Real Pipeline for Deep Reinforcement Learning Autonomous Navigation in Cluttered Rough Terrain (RAL, IROS2021)

Hu. H, Kaicheng Zhang, Aaron Hao Tan, Michael Ruan, Christopher Agia, and Goldie Nejat

- Proposed a pipeline to transfer challenging rough terrain navigation policy from simulation to the real-world using high fidelity simulation, abstract observation space, and domain randomization
- Achieved a 87% real world navigation success rate given a 90% simulation success rate. A 72% increase in navigation success along with a faster travel time and shorter distance against existing methods

### Spatial Constraint Generation for Motion Planning in Dynamic Environments (IROS2021, Patent)

Hu. H, Peyman Yadmellat

- Proposed to generate spatial constraint using triangulation mesh for long-term mapless path planning in a dynamic environment
- Overcame the static triangulation mesh assumption and the object masking issue in existing methods
- Achieved up to 18% increase in navigation success rate and up to 28% increase in valid plans compared to existing methods

## Education

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### University of Toronto

Toronto, Canada

Master of Applied Science, Mechanical Engineering

Sep. 2018 - Aug. 2021

- **Specialization** Deep Reinforcement Learning, Machine Learning, Mobile Robotics; GPA (4.00/4.00)

### University of Toronto

Toronto, Canada

Bachelor of Applied Science, Mechanical Engineering

Sep. 2013 - Apr. 2018

- **Specialization** Robotics and Mechatronics Minor; Dean's Honor List for all terms; GPA (3.81/4.00)