Richard (Han) Hu

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Experiences

XPENG Robotics *Jan. 2022 - Present*

Machine Learning Engineer, Motion Control Center

- **Deep Learning** Developing a locomotion controller for legged robots that combines reinforcement learning and traditional model-based control to increase robot stability
- **Pipeline** Building and refactoring our reinforcement learning pipeline to be flexible and modular by adopting modular design architecture, clean code practices, and user centered design philosophy.
- **Systems** Developed MLOps tools and infrastructure to automate team-wide workflow, such as cloud based model sharing system, pipeline unit and integration test, deployment data collection and analysis tools. Reduced redundant manual work by 80%

Autonomous System and Biomechatronics Lab *Sep. 2018 - Aug. 2021*

Researcher, 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*

Support Researcher, 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

A Sim-to-Real Pipeline for Deep Reinforcement Learning Autonomous Navigation in Cluttered Rough Terrain

Hu. H, Kaicheng Zhang, Aaron Hao Tan, Michael Ruan, Christopher Agia, and Goldie Nejat *RAL and IROS2021*

- 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
- Acheived 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

Hu. H, Peyman Yadmellat *Patent and IROS2021*

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

Education

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)