Richard (Han) Hu

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Experiences

XPeng Robotics   *Jan. 2022 - Present*

Senior Machine Learning Engineer, Motion Control Center

- **Innovation** Led biomimetic gait controller projects using reinforcement learning, surpassing state-of-the-art (SOTA) methods in all metrics, including 1.5x enhanced disturbance rejection and doubled maximum velocity, with successful adaptation to new rough terrains and tasks. Two patents pending.
- **Locomotion** Developed a quadruped robot locomotion controller combining reinforcement learning with model-based control, achieving state-of-the-art disturbance rejection.
- **Optimization** Devised an analytical method to iterate reinforcement learning reward function, cutting model iterations by up to 70%.
- **Infrastructure** Overhauled the reinforcement learning pipeline with a modular approach, reduced manual tasks by 80%.
- **Strategy** Examined state-of-the-art machine learning techniques for quadruped control, large language models, manipulators, and embodied AI, offering strategic insights for departmental product development.

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

Developer, Master Thesis

- **Deep Learning** Directed and **published** a novel sim-to-real pipeline in Pytorch for end-to-end reinforcement learning in rough terrain navigation, achieving an 87% real world and 90% simulation success rate, marking a 72% improvement over against benchmarks.
- **Development** Created a distributed robot system using ROS, C++, Python, and SolidWorks, encompassing a simulator, LiDAR and VIO SLAM, position controller, hardware driver, reinforcement learning framework, 3D reconstruction, sensor interfaces, and teleoperator.
- **Analysis** Conducted real-world navigation, comparison, and ablation studies, proving the pipeline's efficacy with an 87% real-world success rate from a 90% simulation success rate, representing up to a 72% improvement over existing methods.
- **Publication** Published in 1) IEEE Robotics and Automation Letters 2021 and 2) IROS 2021 Conference.

Huawei Noah's Ark Lab   *May. 2020 - Jan 2021*

Developer, Autonomous Driving Division

- **Path Planning** Developed, **published**, and **patented** an innovative Delaunay Triangulation-based algorithm for mapless autonomous vehicle navigation in dynamic settings, resulting in an 18% improvement in navigation success and a 28% rise in valid planning compared to conventional methods.
- **Simulation** Involved in based CARLA simulator development for automating the map generation process using 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*

- Devised a pipeline for transferring complex rough terrain navigation policies from simulation to real-world applications, utilizing high-fidelity simulation, abstract observation space, and domain randomization.
- The pipeline realized an 87% success rate in real-world navigation, grounded in a 90% simulation success rate. It also marked up to a 72% increase in navigation success over existing methods, complemented by quicker travel times and reduced distances.

Spatial Constraint Generation for Motion Planning in Dynamic Environments

Hu. H, Peyman Yadmellat   *Patent and IROS2021*

- Proposed using triangulation mesh to generate spatial constraints for long-term mapless path planning in dynamic environments.
- Resolved the limitations of static triangulation mesh assumption and object masking issues prevalent in existing methods.
- Attained up to an 18% improvement in navigation success rate and a 28% increase in valid plans compared to existing methodologies.

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)