Path Planning of Autonomous Quadrupedal Robots in Complex Environments

Relevance to the Automotive and Autonomous Systems Industries:	Quadrupedal robots can perform a variety of tasks previously not possible with traditional two-legged robots. Their four-legged bodies give them superior stability, maneuverability, and speed, making them ideal for various applications such as search-and-rescue missions, surveillance operations, delivery services and more.
Research Location:	Virginia Tech Hybrid Dynamics Systems and Robot Locomotion Lab
Homepage (Engl.):	https://www.kavehakbarihamed.com
Faculty Mentor:	Prof. Kaveh Akbari Hamed, Ph.D.
Faculty Mentor Email:	kavehakbarihamed@vt.edu
Graduate Mentors:	
Graduate Mentor Email:	
Project Description: May 22 - Jul 28, 2023 (10 weeks, 40 h/week)	The Virginia Tech Hybrid Dynamics Systems and Robot Locomotion Laboratory is investigating autonomous robot locomotion in complex environments. This includes the integration of perception packages with motion planning and control algorithms for deploying autonomous quadrupedal robots. This NSF REU project will be concerned with the integration of computer vision and perception packages with the existing quadrupedal robots in the laboratory. This project is designed for two NSF REU students working together to add autonomy to the path planning and control algorithms of **A1 robots** so that the robots can successfully traverse unstructured environments with static and dynamic obstacles. The A1 robots in the laboratory are already equipped with intelligent depth cameras, LiDAR, and NVIDIA TX2 for Visual SLAM. **PHASE A** (2 weeks): During this introduction phase, the two NSF REU students will review relevant research; investigate existing software and hardware; identify the challenges; and detail and distribute project responsibilities. **PHASE B** (3 weeks): The students will work on the acquisition of readily available data for cameras and LiDARs and document this work. **PHASE C** (3 weeks): Next, the student will integrate the perception data with the motion planning and control algorithms for obstacle avoidance. The student will first test and validate the individual components and then the integrated system. **PHASE D** (2 weeks): Finally, the NSF REU student will document the research performed, prepare a written report, and deliver an end-of-summer presentation on the research performed.
Target publications:	• The results of this work will be integrated with the work of PhD students in the laboratory and may be published as part of graduate students' work.
Necessary Skills/ Knowledge:	• Strong programming skills: C++, ROS, Python • Strong mathematical background (to formulate path planning problems)
Desirable Skills/ Knowledge:	• Knowledge of path planning algorithms for robotic systems • Knowledge of computer vision algorithms, machine learning, deep learning, and/or simultaneous localization and mapping (SLAM)
Additional Online Resource(s):	

NSF REU Students must have completed at least two semesters of engineering studies prior to the proposed summer research, and they must have at least one semester remaining before they can earn their BS in Engineering.