Accessibility Constraint Mapping for On-Road, Off-Road, To/From-Building, and Indoor Autonomous Transit & Delivery

Relevance to the Automotive Industry:	Automated and autonomous navigation are becoming increasingly important. An area where much fundamental work can be done on mapping and navigation is in environments other than roads, for example sidewalks, walkways, parking lots, and other areas between roads and buildings. These spaces will be used by autonomous robots and delivery vehicles, and even for people as they move between vehicles and buildings.
Research Location:	Assistive Robotics Lab, Virginia Tech
Homepage (Engl.):	http://seb199.me.vt.edu/arlab/
Faculty Mentor:	Prof. Alan Asbeck
Faculty Mentor Email:	aasbeck@vt.edu
Graduate Mentors:	Hani Awni, MS in Mechanical Engineering
Graduate Mentor Email:	awni1@vt.edu
Project Description: Jun 03 - Aug 09, 2019 (10 weeks, 40 h/week)	As part of broader efforts to improve university campus physical accessibility for both disabled users and autonomous robots, the Accessibility-SLAM project strives to recognize & localize arbitrary 'accessibility constraints' into a map from SLAM, then use those constraint-augmented maps to navigate arbitrary robots or users with different access needs. Due to the high volatility of the outdoor, offroad environment between roadways and buildings, it's crucial for this access constraint detection to be fully automated and easily scalable for new constraints. This NSF REU project focuses on constraints emergent from two categories of sources: the *terrain*, such as loose gravel, mud, streets, or broken sidewalks, and *barriers in the built environment* such as missing curb cuts, stairs, or narrow passages. These two different sources are best addressed by two students, one student developing constraint recognizers for terrain-based constraints and the other developing them for built environmental barriers-based constraints. **PHASE A** (2 weeks): Working collaboratively, use existing literature and interviews to identify desired accessibility constraints. Identify which constraints are functions of the terrain itself vs functions of physical built environment. **PHASE B** (2 weeks): Using the existing wearable mapping device, gather specific test sensor data for the individual researcher's chosen access constraints. **PHASE C** (4 weeks): Individually build as many effective 'access constraint recognizers' as possible, each of which entails a ROS node integrated with the existing SLAM & navigation pipeline. Verify their efficacy through application to larger multi-building campus maps provided by the graduate student project lead. **Phase D** (2 weeks): Finally, the NSF REU students prepare a written summary report and documentation of the research performed, and deliver an end-of-summer technical presentation on the research performed.
Target publications:	International Conference on Robotics and Automation
Necessary Skills/ Knowledge:	• Programming experience in Python or C++
Desirable Skills/ Knowledge:	• Experience with, or knowledge of, ROS • Familiarity with computer vision or convolutional neural networks
Additional Online Resource(s):	The SLAM mapping library of choice: http://wiki.ros.org/rtabmap_ros

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.