Reliable Autonomous Navigation in a Complex Environment via a Low-cost Range Finder Sensor

Period: Spring 2019

Brief Project Description: The student would work with Professor Ying Wu and two of the PhD students in Professor Wus computer vision lab to implement real-time robust autonomous navigation system based on a low-cost range finder sensor (e.g., a low-resolution Lidar sensor). The basic idea is that the chosen robot platform (e.g., a Turtlebot-3) should be able to navigate within a rather complex environment in real time at a proper speed, from current position to any given destination point robustly and smoothly. It should be able to perform reliable SLAM and to detect obstacles at various sizes. The student may have his/her own choices of the robot platform and the sensor to balance many factors like total cost, sensor performance, and various real scenes (e.g., indoor and outdoor scenarios).

Needed Expertise: Robot Operating System (ROS), programming (C/C++, Python), computer vision (EECS 332/432/433, OpenCV), machine learning (scikit-learn), point cloud library (PCL), experiences working with Lidar sensors and embedded systems.

Responsibilities: The student will work with Professor Wu and his PhD students during the spring of 2019. The student will be responsible for setting up a hardware system, and adapting open source SLAM software to demonstrate self-localization and mapping. The student can choose any well-built hardware platform and properly integrate a low-cost range finder sensor. The student should make hardware development so that the sensor can be powered and communicated with the whole system correctly. The student can use the existing ROS package for SLAM, but is also encouraged to perform open-ended research starting from implementing the state-of-the-art and effective navigation methods. To evaluate the performance, the team will design a testing protocol to cover various kinds of uncertainties, including illumination, complexity of the scene, various obstacles, various interference from human, etc. The student is expected to work independently and may ask for the graduate students advice on both hardware and software besides the instructors guidance.

Expected Outcome: The anticipated outcome is an autonomous robot that is be able to navigate in rather complex environment only based on a low-cost range finder sensor. For instance, when the destination point is given on the map, the robot can respond quickly and move toward it in a robust and smooth manner without hitting any objects in the way. Quantitative evaluation of the navigation performances will be obtained.