First Encounter with Unmanned Ground Vehicles

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In this project, two undergraduate engineering students, a senior and a sophomore, participated in experimental studies using unmanned ground vehicles, on tasks including localization accuracy measurement, LiDAR upgrade and indoor SLAM. Students also responded to questions about their participation in this project. Overall, the students were able to perform the tasks with adequate productivity. The students attributed their interest in the project and their research capability to both TAMUQ curriculum and extracurricular experiences. In addition, both students confirmed that experience in this project made them more likely to take elective courses in mechatronics, robotics, and coding. Sustained cross-disciplinary effort should be promoted to enable such projects, which can simultaneously benefit students from different engineering program or even different branch campuses.

I. INTRODUCTION

The revised objective of this TEE project is to utilize an unmanned ground vehicle (UGV) as the hardware/software platform, to better understand students' learning needs related to areas of autonomous mobile robots.

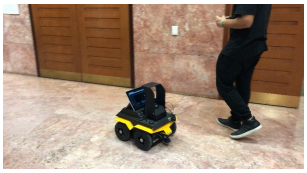
In this project, students engaged in the following activities:

- Measurement of a UGV's localization accuracy
- Sensor upgrade for a UGV

II. METHODS

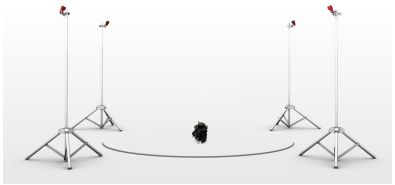
A. Collision Avoidance While Driving a Clearpath Robotics Jackal® UGV by Hand

- ROS node written to take LiDAR signals and feed them into the velocity control node and stop the UGV based on a distance criterion



B. Motion Capture Using an OptiTrack® System

- A camera-based motion capture tool with measurement errors < 1 mm



C. Localization Accuracy Quantification of

- Lap runs of the UGV in the TAMUQ building
- Comparison between actual displacement and UGV-perceived displacement

D. LiDAR Upgrade of the Jackal UGV

- Design and machine adapter mounting plates
- Install new LiDARs on the UGV
- Implement software update for new LiDARs

E. SLAM in TAMUQ Building

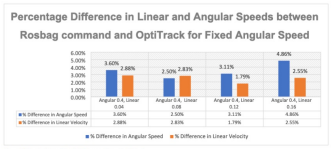
- Run UGV with the manufacturer's autonomy research kit (ARK) to carry out simultaneous localization and mapping (SLAM)
- Vary parameters (LiDAR hardware, LiDAR spacing parameter error, etc.) and collect respective data

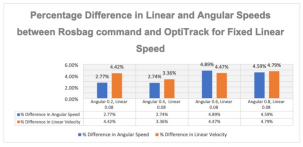
III. RESULTS

A. Collision Avoidance ROS Node

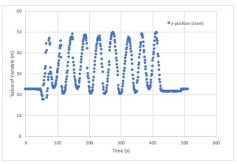
- Successfully implemented on the Jackal UGV

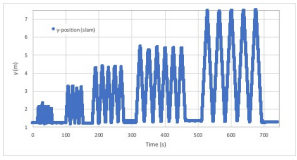
B. Motion Capture System Set Up and Preliminary Test Completed



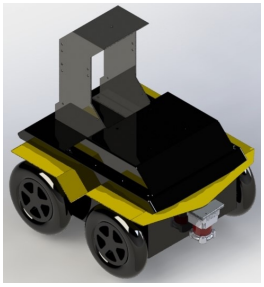


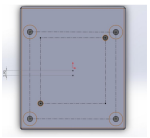
C. Jackal UGV Localization Accuracy with Original LiDARs



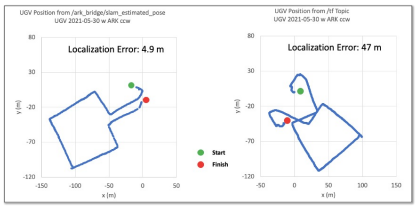


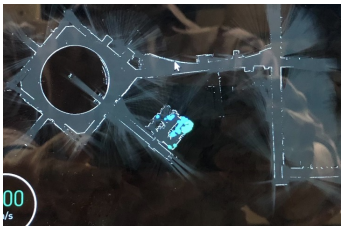
D. New LiDARs Installed and Tested





E. SLAM Results in TAMUQ Building





IV. SUMMARY

- Undergraduate mechanical engineering students carried out work in UGV applications and performance characterization
- Experiences in this project shaped by students' past education/training and may influence future elective course selection and career path choices.

ACKNOWLEDGMENTS

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