

Real Time Wheel Slip Detection and Error Corrections for Enhanced Lunar Navigation

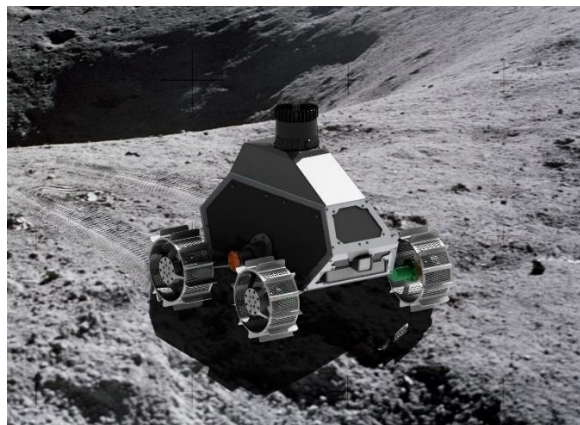
Justin Cyrus, CEO Lunar Outpost, (justin@lunaroutpost.com)

Company Background:

Lunar Outpost Inc. is an advanced technology company with a focus on developing technologies that have both terrestrial and space applications. Comprised of engineers with experience working on NASA, defense, and commercial programs, Lunar Outpost is engaged in contracts with the U.S. Air Force, NASA, local and state government organizations, and leading research institutions. Other current projects include a prototype life support system for Lockheed Martin's Lunar Habitat module; the Lunar Prospector (MAPP), a rover designed to map resources on the Lunar surface; the Bloomberg Mayor's Challenge; Denver's Smart Cities Initiative and more...

Description of Work to Be Done:

The work to be done is towards implementing an odometry update system developed at West Virginia University in collaboration with Cornell, available publicly on their GitHub page, on to the MAPP platform. The goal of this project will be to create a system that detects discrepancies between the MAPP rover's inertial-measurement-unit (IMU) and wheel encoder velocity readings to determine when the rover wheels are slipping. The system will then be combined with WVU's previously developed odometry zero-type update system to correct accumulated wheel encoder error from wheel slip and thusly enable encoders as a viable odometry source on the lunar surface.



A Rendering of MAPP on the Lunar Surface

The students will be involved in every phase of the project 'from design through implementation'. During the design phase the students will interact with Lunar Outpost engineers to see what will provide value for operation on the lunar surface. From there the project overview will be created and the work divided into tasks.

As a final product, the software will intake data from the IMU and wheel encoders and process the data on-board an NVIDIA Jetson TX2 or Raspberry Pi. The three main functionalities will be: 1. Ability to



detect slip events. 2. Eliminate accumulated wheel odometry error. 3. Being able to localize with only IMU and wheel encoder data.

Justin Cyrus, the CEO of Lunar Outpost, will be managing this project on the Lunar Outpost side. Mr. Cyrus has extensive software development and project management experience and can help mentor the student team throughout this course.



MAPP being tested at Colorado School of Mines' Lunar Testbed Facility

Desired Skill Set for Students:

We understand that all the students in the group might not have the desired hard technical skill. As long as they have the ability to problem solve and the willingness to learn then our engineers can help teach some of these hard-technical skills.

- ROS
- C++
- Python
- Familiar with Linux
- Raspberry Pi /Arduino Experience

Preferred Team Size: 3-5 Students

Given the scope of this project a group of 5 students is preferred but 3 students could also excel given they are willing to problem solve and learn.

Internships at the End of The Course:

We are happy to consider offering internships at the end of the course. During Previous Summer Field Sessions, we had up to 3 out of the team of 5 continue on with us.

Location Where Work Should Be Performed:

We have offices in Golden and in Boulder, CO. The office in Golden, CO is located at 17700 S Golden Rd Unit 102 and has space for a student team. This office is less than a 5-minute drive from CSM campus and should provide a convenient location for the students to meet. We also provide free beverages and snacks to keep the team fueled throughout the day.