Skid Steer Drive System for Lunar Outpost Rovers

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Company Background:

Lunar Outpost is an industry leader in lunar surface mobility, commercial space robotics, and space resources. From our terrestrial product lines revolutionizing the air quality sector on Earth to the creation of oxygen on Mars, our impact spans the solar system. Lunar Outpost's exploration class rover, the Mobile Autonomous Prospecting Platform (MAPP), will be the first commercial rover on the Moon and the first rover in history to explore the lunar South Pole.

Since our founding in 2017, Lunar Outpost has raised Venture Capital from top-tier investors and continues to attract strong investment partners as we continue to prove the opportunity that advanced mobility, robotics and autonomy provides to the new space economy and here on Earth. In 2021, Lunar Outpost announced that our commercially funded MAPP rover—including payload mass allocations for MIT and Nokia — was scheduled for delivery by an Intuitive Machines lander to the lunar South Pole. Lunar Outpost has since secured two additional contracted lunar surface missions, one of which is fully commercial and the other a NASA funded science exploration rover. In addition to the three missions above, Lunar Outpost has also won a contract with the Australian Space Agency to design and develop a lunar rover for Australia's first mission to the Moon as part of the Trailblazer program. In 2024, Lunar Outpost was awarded a Lunar Terrain Vehicle Services (LTVS) contract by NASA to develop a human-rated Moon rover as part of the Artemis campaign.

With over a dozen active contracts across commercial, defense and civil space, Lunar Outpost is The Next Leap that will enable humanity to become interplanetary.

Description of Work to Be Done:

The goal of this project is to research skid steer control system principles, determine what open-source libraries are available, and decide on a generic skid steer vehicle control scheme in C++ with ROS2. The generic scheme will allow the same controller to be used on vehicles of different sizes and wheel configurations. This controller should be able to accept sensor feedback to adjust for wheel slip and other environmental conditions. The generic implementation will be tested in a Gazebo 2 simulation with the MAPP rover, ROS2 tutorial based turtlebot3, and a ROS2 demonstration vehicle called Dolly. Once the scheme is confirmed in simulation, the software will be put on a 2nd generation MAPP rover for real world testing. The team will be expected to write unit testing for the infrastructure and if time permits, tools for producing code coverage analysis

will be requested. At the end of the project, the students will have produced a ROS2 Skid Steer package that can be used by Lunar Outpost for future missions and vehicles.

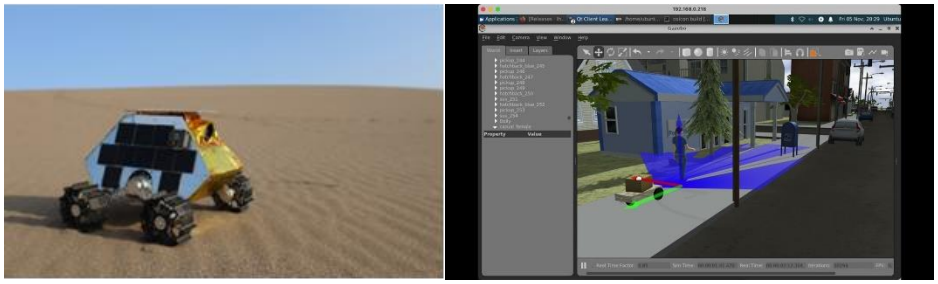

Figure 1: MAPP Rover and Dolly Rover in ROS2 Gazebo

Students will focus their efforts on four specific areas:

1. Researching available open-source skid steer libraries and understanding the fundamentals of skid steer control to create a vehicle generic control scheme.
2. Implementing the generic control scheme in ROS2 with C++ and testing it using one of the previously discussed vehicles in Gazebo 2.
3. Writing a testing infrastructure that runs unit tests and Software In The Loop (SITL) tests.
4. Verifying the generic control scheme by testing other vehicle profiles mentioned above in Gazebo 2.
5. Load software onto a real MAPP rover, verify functionality, and implement Hardware In The Loop (HITL) testing.

Reach goal:

- If the students can prove their skid steer control architecture works on a MAPP rover, they will be allowed to load the code onto a much larger autonomous vehicle and do a explore the differences of vehicle response.

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 and the required steps they must take to complete the project. From there, the project overview will be created, and the work divided into tasks. As a final product, the Field Session team will develop a GUI that can interact with the rover.

Desired Skills for Students:

- C++ and ROS Experience

We understand not all the students in the group might have the desired technical skills. However, if they can problem solve and have a willingness to learn, they can excel in this project with the help of our talented engineers.

Preferred Team Size: 3-4 students

Given this project's scope, a group of 4 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.

Location Where Work Would Be Performed:

We have offices in Arvada, CO. The office is less than a 15-minute drive from CSM campus and should provide a convenient location for the students to meet. We also provide free snacks to keep the team fueled throughout the day. Open to a hybrid schedule if/when necessary, if communicated clearly to Lunar Outpost and team members.