AIML for Lunar Terrain Navigation

Project Manager: Ben Brokaw, Software Engineer, (ben@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. Department of Defense, NASA, local and state government organizations, and leading research institutions. Other ongoing projects include development of the MAPP rover, a robotic prospector designed to map resources and carry payloads on the lunar surface; deployment of the Canary environmental monitoring system in the energy sector and municipalities across the continent; and contribution to the Mars Oxygen In-Situ Resource Utilization Experiment (MOXIE) onboard the Perseverance rover.

Description of Work to Be Done:

The goal of this project is to design and implement visual-based navigation and terrain-relative navigation solutions utilizing Artificial Intelligence. These navigation solutions will be integrated with Lunar Outpost's current navigation stack to provide an even more robust lunar navigation solution. Skills will be developed in artificial intelligence, visual-based navigation, computer vision, linear algebra, and robotics. Development will be performed first on static single images, then onto video streams, and finally deployed on MAPP rovers for real-world functional testing.
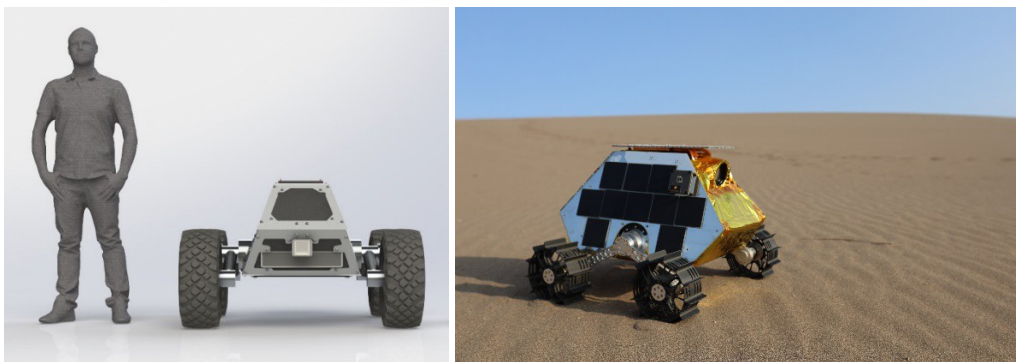

Figure 1: HL-MAPP for Earth based Applications and MAPP being tested at the Great Sand Dunes.

Students will focus their efforts on three specific objectives:

1. Creating an AI solution for terrain-relative and visual-based navigation
2. Utilize this solution to identify geological and other visually usable features
3. Train this solution and implement the software onto a Lunar Outpost MAPP rover

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 identify techniques that can be used for each area of 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 deploy their co-localization algorithm onto physical MAPP rovers.

Ben Brokaw, a Software Engineer at Lunar Outpost and Mines alum, and his team will be managing this project on the Lunar Outpost side. Mr. Brokaw has extensive software development and project management experience and can help mentor the student team throughout this course.

Desired Skills for Students:

- AI Language
- C++
- Python
- OpenCV
- Linear Algebra
- TensorFlow/PyTorch

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

Preferred Team Size: 4 students

Given the scope of this project 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 plan on a hybrid working environment spread between our offices and the Colorado School of Mines campus.