Paper ID: 84330
student

IAF SPACE EXPLORATION SYMPOSIUM (A3)
Interactive Presentations - IAF SPACE EXPLORATION SYMPOSIUM (IP)

Author: Mr. Jeremy Burg
Concordia University, Canada

Mr. Henry Alejandro Flores
Concordia University, Canada
Mr. Charles Gauthier
Concordia University, Canada
Mr. William Reniere
Concordia University, Canada
Mr. Julian Dubeau
Concordia University, Canada
Mr. Sam Kandaleft
Concordia University, Canada
Mr. Davide Zanetti
Concordia University, Canada

DESIGN AND PERFORMANCE ANALYSIS OF LIGHTWEIGHT COMPOSITE WHEELS FOR THE PEEKBOT LUNAR ROVER

Abstract

Lunar exploration is one of the most important milestones space agencies can achieve, with recent successes like the Chandrayaan-3 mission highlighting the scientific and cultural impact of successful missions. These endeavors necessitate state-of-the-art rovers, capable of handling the harsh temperatures and rough conditions of lunar soil. The PEEKbot lunar rover is a collaborative project mentored by the Canadian Space Agency involving various universities and student led projects to push the boundaries of lunar exploration. To this end, the project involves the use of Polyether ether ketone (PEEK) to design a small rover capable of surviving one lunar night, equivalent to 14 terrestrial days. Our team was tasked with the complete design and prototyping of the rover's wheel drive system, with the goal of achieving forward/backwards motion, point turns and climbs at slopes up to 25 degrees. The aim was to reduce the weight from 2.85 kg to below 0.5 kg per wheel. The team successfully met this constraint by changing the previous design from a meshed metal wheel, to an innovative shape made of space-grade composite materials. This design optimized the strength of the wheel while meeting the size requirements and harsh lunar conditions. The prototype was fabricated from 3D printed reinforced Onyx and 3K 2x2 Carbon Fiber twill weave with LR335 epoxy resin, with the proposed lunar version being made entirely of RS3 epoxy and M55J unidirectional carbon fiber to be manufactured by prepreg carbon fiber layup techniques. The performance of the wheels was evaluated at the Concordia Aerospace Robotics Laboratory through a full rover test. This location is equipped with a sandbox containing Glenn Research Center -1 Soil Simulant (GRC-1) which can be tilted at different inclinations to test the performance of the prototype rover in multiple scenarios. The test was conducted using a GRZ101 360 Mini Prism laser tracker to acquire quantitative measurements on the percentage slip for the rover. The team also performed a single wheel test with a fully 3D printed wheel to test different grouser dimensions. This was performed using an MCS-UC2-XYZ robotics gantry to obtain quantitative data and was done in parallel to propose optimal grouser configurations for future iterations of the project. The performance of the rover exceeded

expectations, as it was able to perform point turns, sunken wheel tests, and it climbed a slope of 15 degrees with 59% slip, and 25 degrees with 90% slip.