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ORPHEUS: A NOVEL APPROACH TO LUNAR SURFACE ACCESS UTILIZING THE NASA LUNAR GATEWAY

Abstract

When humans first landed on the Moon fifty years ago, our objective was clear: to land and return home safely. Now, our objective is to not only return to the Moon, but to create a long-term campaign serving as a stepping stone to Mars. This is the inspiration for the 2019 RASC-AL competition, held by the National Institute of Aerospace, which has challenged university teams to develop novel Gateway-based human Lunar surface access concepts. The Orpheus team has developed an architecture that focuses primarily on reusability, reconfigurability, and commercial accessibility. Our architecture consists of three propulsive modules which conduct key mission activities at the Lunar Gateway, in Low Lunar Orbit (LLO), and on the Lunar surface. Two of the three propulsive modules make up the Lunar lander: the ascent and descent modules. The third module is a transport vehicle which transfers the complete Lunar lander stack from the Gateway to a polar LLO. From this LLO, the descent module will conduct a burn, and bring the lander stack to the Lunar surface at the Lunar south pole. After a mission stay of 2-6 days, the ascent module will stage from the descent module and rendezvous and dock with the transport vehicle in LLO which will then bring the ascent module back to the Gateway.

This paper will not only present our final architecture, but will also focus on the various subsystem sizing considerations, power considerations, surface operations, and general lander configuration trades. We will also present analysis that informs our mass, power, and cost budgets, as well as our long-term mission timeline. This analysis will qualify our critical architecture decisions, and promote a long-term strategy for human-driven Lunar surface access.

Our team consists of 9 individuals who have worked on the project since the end of October 2018. We meet at least once a week, and tasks are distributed to team members based on individual expertise, availability, and interest. The Orpheus team has developed a spreadsheet-based concurrent engineering model which yielded an efficient means by which all team members can contribute simultaneously while also ensuring accuracy and consistency in engineering data. From a project management perspective, it is a goal to utilize every team member's strengths in order to generate accurate engineering analysis.