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FEASIBILITY STUDY FOR LUNAR RESOURCES TRANSPORT AND DELIVERY THROUGH A PATH CLEARANCE VEHICLE (PCV)

Abstract

This work investigates several mission scenarios concerning the transport of water in rough lunar terrain. Detection of water ice deposits around the south pole and inside Permanently Shadowed Regions (PSR) leads to projects where these deposits can be transformed and used by astronauts. As a potential outpost for solar system exploration, the Moon has again become a priority in the US, China, Russia and Europe. Moreover, participation of the private sector is encouraged. These diverse political, economic, and scientific impulses have a common objective: ensuring a permanent human presence by the mid-2030s and be as independent of Moon-Earth trips as possible. One region in particular – called Connecting Ridge – has been identified as ideal for this purpose. This paper focuses on a 20 km circular working zone around it.

Once extracted, water cannot only be used for drinking or producing breathable oxygen, but also as fuel for ascent or descent vehicles. The necessity to transport water, or its processed derivatives, is therefore assumed in this paper. Due to the distance and roughness of the terrain between the Connecting Ridge and some PSRs, reasonably fast transportation of these commodities is challenging. On Earth, such goods are mostly delivered through pipes; their deployment, maintenance, and reliability are difficult to ensure on the surface of the moon. Moreover, vehicles allow for more flexibility than pipes in terms of targeting different locations. Roving vehicles have various benefits such as heritage and verification on Earth. Space Mining Technologies has developed a concept of a multi-purpose lunar surface vehicle that aims to clear a path between two different sites around Connecting Ridge. The main goal is to accelerate the transportation of payload on a dedicated path, free from obstacles, releasing the vehicle from a complex path optimisation process. This paper focuses on the path clearance process and provides a feasibility analysis of such a mission, along with a preliminary PCV design. Details on power, thermal, communication, GNC, OBDH and locomotion subsystems are given with relevant margins and assuming development of infrastructures from identified stakeholders. It provides a comprehensive review on the study and to address future work making this mission feasible.