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DEVELOPMENT OF 2-WHEEL ROVER TEST MODEL FOR LUNAR CAVE EXPLORATION

Abstract

Recent discoveries of lunar lava tubes have highlighted their potential as critical sites for future human exploration and habitation, as they offer effective protection against radiation and micrometeorites while also exhibiting significantly reduced temperature fluctuations compared to the lunar surface. Investigating the internal environment and collecting geological data from these caves are essential for advancing human exploration. Lunar cave exploration presents significant challenges, including narrow and complex terrains, low light conditions, extreme temperature fluctuations, energy supply issues, and communication constraints. To address these challenges, this study develops a compact 2-wheel rover prototype, measuring 400 mm (D) x 250 mm (W) x 200 mm (H), specifically designed for lunar cave exploration. The proposed 2-wheel rover is engineered to navigate rugged cave environments while monitoring its surroundings under low-light conditions using an advanced sensor system. The prototype integrates an internal power system, autonomous driving capabilities, and communication protocols between sensors and controllers. To achieve lightweight manufactured, the chassis of the rover is fabricated with AL-6061 material. A round-shaped wheel with grouser is designed to enhance mobility and traction on uneven terrains. The suggested 2-wheel rover was tested in the "Majanggul" lava tube in Jeju Island, as the terrain closely resembles the conditions of the Moon environment. Future work includes testing wireless power transmission technologies to ensure reliable energy supply within caves. And experiments will be conducted with a composite sensor module mounted on the rover to validate its performance in simulated cave environments. It aims to deploy rovers with higher Technology Readiness Levels (TRL) that are more effectively adapted to challenging space environments in future missions.