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Moon Exploration – Part 2 (2B)

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DUAL ROVER ROBOTIC MISSION ARCHITECTURE FOR EXPLORATION OF A POTENTIAL LAVA TUBE SKYLIGHT ON THE LUNAR SURFACE

Abstract

In the past several years, hole-like features have been discovered on the lunar surface by missions such as the Japanese orbiter SELENE and NASA's Lunar Reconnaissance Orbiter (LRO). Based on visual and laser altimeter data, these features may be skylights of lava tubes or caves. Confirmed underground spaces on the moon could be very useful for future exploration and even settlement. A dual rover system has been developed by Google Lunar X-Prize (GLXP) entrant Team Hakuto and the Space Robotics Lab of Tohoku University in Japan. The purpose of the system is to investigate a potential skylight as part of a mission to fulfill the GLXP requirements and conduct scientific exploration.

Various architectures have been proposed in order to investigate a skylight from its perimeter and from within. In this system, an approximately 1kg, two-wheeled child rover is tethered to a sub-10kg, four-wheeled skid-steer rover. The two rovers, named "Tetris" and "Moonraker", respectively, can travel to and around the feature, with the child rover sent into it at various points. An adjustable-length tether provides descent and ascent capability, as well as power and communications capability to the child rover. Visual and other data will be collected and processed to provide a 3D map to scientists on Earth.

This dual rover system has been under development for several years. In this paper, a potential skylight target and the Moonraker/Tetris system will be described, with an emphasis on successful experimental results proving the mobility of the dual rover system. In particular, lab and field experiments verifying the performance of the tether subsystem during locomotion will be presented. Lab and field experiments verifying the tethered operation of the Tetris during descent and ascent into a surface feature will also be presented. Aspects of mobility verified include: control algorithm with operator input, obstacle avoidance, terrain (vertical and horizontal) traversability and child rover retrievability.