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

Author: Mr. NamSuk Cho
Unmanned Exploration Laboratory (UEL), Korea, Republic of, whitewh0519@uel.co.kr

Mr. YeongSeop Kim
Unmanned Exploration Laboratory (UEL), Korea, Republic of, yeongseop.kim@uel.co.kr
Mr. TaeYoung Lee
Unmanned Exploration Laboratory (UEL), Korea, Republic of, taeyoung.lee@uel.co.kr
Mr. KangSan Kim
Space Generation Advisory Council (SGAC), Korea, Republic of, antonio.stark@spacegeneration.org

EFFECTIVENESS OF FIXED GROUSER PROTRUSIONS TO PERFORATED BASE STRUCTURE FOR LUNAR ROVER WHEELS

Abstract

A majority of vehicles driven on the lunar surface, most notably the Lunar Roving Vehicle of the Apollo era and the Lunokhod rovers by the Soviet Union were of heavier classes weighing a few hundred kilograms. More recent rovers, both current (Yutu series by China) and planned, are of lighter mass, weighing around or below 100 kg.

Driving or motorized traction on the lunar surface poses a number of challenges due to decreased gravity, impressionability of the lunar soil, and limited motor power and wheel diameters of most rovers due to payload limitations of lunar missions. Extraterrestrial rover missions utilize airless metal wheels to provide long-term durability on rough terrain but pose disadvantages in terms of speed, traction, and stability.

This study looks at different rover wheel designs and their performances in simulated lunar surface environments. Previous research showed that the accumulation of lunar soil inside the wheel structure decreases the efficiency of lunar wheels, leading to the adoption of a perforated, or mesh, structure for the wheel base. The lack of protrusion points of rovers results in slippage on dusty terrain, whereby grouser protrusions have been added to increase the surface area of contact with the soil, and add traction to the rover.

The study uses 3d printed polymer plastic wheel models on simulated lunar soil environments on ground testbeds. A total of six different wheel base and grouser protrusions variations were investigated, with both quantitative analysis on the distance covered per power used and the time taken, to qualitative assessments on the level slippage and sinking of the wheels into the testbed environment.

The study concludes with an analysis on the proposed grouser and perforation structure for wheels, with an extended consideration to other factors that can influence rover wheel performances, including wheel width, the number of wheels, wheel supporting structures, and the slope of surfaces.