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IAF SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 3 (2C)

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LUNAR ROVER TERRAMECHANICS SIMULATION STUDY

Abstract

Context. Terramechanics is the study of vehicle interaction with a surface and its surface properties. Typically, this concerns wheeled or tracked vehicles and granular or soil surfaces. The theories of terramechanics allow for an in-depth study of vehicle interaction with various planetary surfaces. The rover wheel studied was designed for lunar surface exploration.
Aims. Use the Discrete Element Method (DEM) to study the simulated interaction between the rover and the lunar surface.
Methods. Simulate a single-wheel interaction between the rover wheel and the lunar surface using DEM. The Johnson–Kendall–Roberts (JKR) interaction model for particle contact is used, similar to the typical Hertzian model but able to consider cohesion and bonding. A simulation is derived for Earth conditions with lunar simulant FJS-1 and Toyoura sand. This is compared with experimental data using Toyoura sand. The traction coefficient, wheel sinkage and wheel trace are evaluated and compared. Final simulations are run using expected lunar conditions.
Results. Simulations and experiments have been successfully completed. Preliminary analysis shows a strong correlation between the experimental and simulated data. This supports using simulation to study the predictive behaviour of the wheel on the lunar surface.
Recommendations. The DEM is a powerful tool but suffers from an abundance of choice and time required. The soil itself, the wheel properties and the physics models used need to be clearly defined and understood. A DEM model can be fundamentally incorrect and give deceptive results without suitable calibration. Future studies will consider experiments that use reduced gravity and lunar surface results to refine the simulations. Additionally, particle image velocimetry will be used to study soil flow.