# Modelling Dust Clouds Produced from Lunar Rover Operations

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## Introduction

The dominant cause of dust transport on the Moon are human activities such as spacecraft landing and launch, and rover operations [1]. When disturbed lunar dust becomes mobilized and triboelectrically charged. The abrasive and charged dust can damage electronic and mechanical components located nearby. Here, we consider the dust transport from rover operations on the lunar surface and how the local charging environment may affect the motion of the dust clouds that are produced. We have developed a Discrete Element Method (DEM) simulation to model the mobilization of dust from wheel interactions with the surface.

## Methodology

A DEM simulation of an Apollo 16 Lunar Roving Vehicle (LRV) wheel interacting with the lunar surface is in development (Figure 1). The wheel and fender CAD design are integrated into a simulated lunar surface environment using LIGGGHTS [2], an open-source DEM particle simulation software. The properties of most interest are the grain sizes and charges, and the electric field present at different times of day on the lunar surface [3]. The behaviour of the lunar dust particles are then analysed following their interaction with the moving rover wheel.

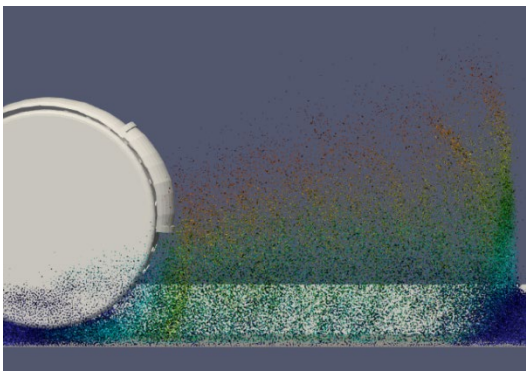

Figure 1: Example simulation output

## Applications

Following validation with LRV footage, we will consider whether dust cloud volume or velocity vary significantly when operating rovers during the lunar night, across the terminator, or in a Permanently Shadowed Region (PSR) where surface charging environments will differ. We can also test future lunar rover wheel and fender designs, operational scenerios, and wheel speeds to predict and minimise dust transport or mitigate negatitive impacts on sensitive instruments.

## Conclusions

We have developed a DEM simulation of the lunar surface which can be used to model rover wheel-dust interactions and dust mobilization. The simulation can be used to help understand the effects of different E-fields, rover wheel designs, and rover operational scenarios to mitigate against unwanted dust deposits.

## References

[1] Katzan and Edwards, 1991, Lunar Dust Transport and Potential Interactions With Power System Components, NASA contractor report #4404.
[2] CFDEM Project, 2021, LIGGGHTS, https://www.cfdem.com/liggghtsr-open-source-discrete-element-method-particle-simulation-code.
[3] Manka, 1973, *Photon and Particle Interactions with Surfaces in Space, Proc. Of the 6th ESLAB Symp*. 37, pp. 347-361.