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Author: Mr. Peter Watson
University of Strathclyde, United Kingdom

# EXPERIMENTAL ANALYSIS OF VIBRATIONALLY-INDUCED FLUIDIZATION OF LUNAR REGOLITH IN HOPPERS AND CLOSED CONTAINERS

**Abstract**

In the coming years a major spotlight is being placed on our return to the Moon with the goal of further exploring and ultimately creating a permanent presence on our satellite. This naturally leads to the need to identify the best or most efficient way to exploit the "locally" available lunar resources. Along these lines, this study considers "vibrations" as a novel means to implement an efficient management and transport of the so-called "lunar regolith" abundantly available on the moon surface. Although such a line of inquiry can be placed in the larger theoretical context represented by the vibro-fluidization of granular materials, specific challenges emerge in this case due to specific nature of the lunar regolith, which is typically characterized by strong frictional phenomena and ensuing electrostatic effects.

Two partially intertwined problems are considered, one focusing on how the flow rate of lunar regolith simulant through the orifice of a hopper vessel of fixed inclination walls can be increased through the application of vibrations with various orientations, frequency and amplitude and a second scenario in which the samples are forced to enter a fluidized (convective) state inside a closed rectangular container. In the latter case a parametric investigation is also conducted to assess the role played by the particle size distribution (by using different types of simulants and/or simulants that have been sieved). The degree of achieved fluidization inside the closed container is determined by looking at the patterning behaviour of the free surface of the material (where valleys and peaks tend to be created) and the convective motion itself established in its bulk.

It is shown that regardless of the metrics used to quantitatively substantiate the level of fluidization and the considered system (closed or open), a similar non-monotonic relationship exists between this measure of fluidization and the frequency of the applied vibrations. An additional degree of complexity is brought about by the completely different effect that vibrations can have on the dynamics according to their relative orientation with respect to the direction of gravity.