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EXPERIMENTAL DEVELOPMENT OF A PASSIVE REGOLITH SAMPLER FOR LUNAR MISSIONS

Abstract

Recent focus on lunar exploration spurred by the Google Lunar X Prize and NASA's Commercial Lunar Payload Services Program has led to renewed interest in novel instrumentation for lunar science. The Space Enabled Research Group invented the Passive Regolith Sampler (PRS), which can be used in a variety of commercial and scientific missions to facilitate characterization of the lunar dust environment. The device is used in the investigation described herein to better understand the effectiveness of sticky materials in passively gathering lunar regolith which comes into contact with rover wheels. Its baseline design configuration incorporates paraffin wax which, upon softening, can encapsulate and retain soil particles. The PRS can be attached to the outer circumference of a rover wheel in a manner that does not interfere with mobility and can be modified for the environmental conditions of its host rover; the paraffin hydrocarbon chain length can be lengthened or shortened to adjust the melting temperature of the wax and maximize the efficacy of the device.

In late 2020, the Mohammed Bin Rashid Space Centre (MBRSC) of Dubai announced plans to send the Rashid rover to the lunar surface as part of the Emirates Lunar Mission (ELM) [1]. The study described herein will use the ELM mission as a baseline design context to evaluate the PRS as a potential experiment.

This paper will present ground tests conducted with lunar regolith simulant which accurately models the particle size distribution of true lunar regolith, as well as other material properties. The initial goal is to understand the impact that hole size and spacing have on regolith retention. Design and analysis work will be described in detail. Initial studies of the mechanics of wax/regolith integration were conducted by Hernández Lara and Stober and the mixing process will be characterized in significantly greater depth under a wider variety of environmental conditions herein [2].

[1] Gibney, E., "UAE Ramps Up Space Ambitions with Arab World's First Moon Mission," Nature, doi: 10.1038/d41586-020-03054-1

[2] Hernández Lara, A.E. and Stober, K.J., "Conceptual Design: ISRU Moon Regolith Concrete and Construction Modules," AIAA 2021-0540, AIAA SciTech Forum 2021