

The Summer Undergraduate Research Fellowship (SURF) Symposium
3 August 2017
Purdue University, West Lafayette, Indiana, USA

Hazard Assessment of Meteoroid Impact for the Design of Lunar Habitats

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ABSTRACT

The design of self-sustaining lunar habitats is a challenge primarily due to the Moon's lack of atmospheric protection and hazardous environment. To assure safe habitats that will lead to further lunar and space exploration, it is necessary to assess the different hazards faced on the Moon such as meteoroid impacts, extreme temperatures, and radiation. In particular, meteoroids pose a risk to lunar structures due to their high frequency of occurrence and hypervelocity impact. Continuous meteoroid impacts can harm structural elements and vital equipment compromising the well-being of lunar inhabitants. This study is focused on the hazard conceptualization and quantification of the most frequent range of meteoroids that impact the Moon, tens of grams to few kilograms. Probabilistic frequency analysis of compiled lunar meteoroid impact data was performed to estimate impactor diameter, mass, and potentially damaging energy. Selected probabilities of exceedance and return periods were determined to establish expected meteoroid characteristics within a time frame. The estimates of meteoroid characteristics are anticipated to contribute to the structural design of lunar habitats. This study ultimately provides a risk assessment platform of meteoroid impacts to proceed forward in the colonization of the Moon.

KEYWORDS

Meteoroid impact, hazard quantification, lunar habitat design, hazard assessment