Paper ID: 42235
oral
student

IAF SPACE EXPLORATION SYMPOSIUM (A3)
Interactive Presentations - IAF SPACE EXPLORATION SYMPOSIUM (IP)

Author: Mr. Satinder Shergill
Cranfield University, United Kingdom

Dr. Jenny Kingston
Cranfield University, United Kingdom

ADAPTIVE IN-SITU RESOURCE UTILISATION (ISRU) FOR LONG TERM SPACE EXPLORATION

Abstract

This paper aims to present initial results from a pilot study assessing the feasibility of designing an 'Adaptive ISRU system', defined here as an ISRU resource extraction system adaptable to different rocky planetary bodies, and adaptive in its ability to extract resources.

Preliminary guiding questions for this study related to whether several ISRU processes could be combined within one enclosed system to enhance functionality and allow smoother transition between different levels of processing, and also whether a system that combines such processes can adapt to the different terrains present on planetary bodies within the inner solar system.

The main motivation behind this research is the incorporation of ISRU into long term interplanetary infrastructure. Through attempting to understand how and where ISRU can best be incorporated into long term interplanetary infrastructure, the direction of this research led to considering the need of ISRU systems to be adaptable. While upcoming precursor missions will inevitably help constrain mineralogical distribution and general environmental conditions at certain locations, there is still uncertainty inherent with constraining mineral content and distributions at surface and subsurface boundaries as well as regolith compaction at ISRU destinations of interest. Hence it is believed by the author that functional ISRU systems will need to be adaptive by nature, particularly if they are required to operate autonomously.

This paper addresses criteria that would be applicable to a range of different extraction scenarios suitable for the conditions expected on rocky bodies such as the Moon, Mars and Asteroids, as a means of ascertaining the feasibility of an adaptive ISRU system. Although the main focus is on excavation and processing, aspects such as storage and transit are also discussed. Alongside the significance of differing regolith retention and compaction rates, the obtainable and required particle sizes for ISRU processing, and how this should influence the ordering of combined processes is also considered.

The proposal of an adaptive ISRU system is based on a desire to focus on the commonalities found in extra-terrestrial environments to then be in a stronger position to deal with the differences.