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Human Exploration of the Moon and Cislunar Space (1)

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A NOVEL ARCHITECTURE TO ENABLE MOON UTILISATION FOR SCIENCE AND EXPLORATION

Abstract

This paper is the conclusion of six months of project work completed by an international and multidisciplinary team of graduate students, from 10 different countries as part of the ninth edition of the 'SpacE Exploration and Development Systems' (SEEDS) Master's programme.

Recent surveys indicate the lunar environment hosts resources that could be utilised for the benefit of future human exploration. Water, oxygen, hydrogen, and iron-rich minerals are among the resources that can be exploited through in-situ resource utilisation . Capitalizing on these could reduce cislunar mission costs through the local resupply of environmental control and life support systems, propellant production, and additive manufacturing for structural applications. The benefits of lunar resources can extend to the expected cislunar station by sustaining mission operations, increasing Earth independence, and supporting the evolution of its capabilities. The successful utilisation of lunar resources may therefore provide the basis for humanity's next giant leap in exploration.

Presented here is 'Moon Utilization for Science and Exploration' (MUSE); a mission architecture that aims to exploit the Moon's significant potential for sustainably advancing science and human exploration into deep space. The research activities of this paper relate to the 2025-35 timeframe following the construction of a lunar space station derived from NASA's Deep Space Gateway concept. This paper presents a systems level design of the required architecture to support and sustain this station and maximise its utilisation. The building blocks of the architecture include the station itself, surface resource utilisation systems, exploration rovers, and the return of humans to the lunar surface.