Paper ID: 85331
student

IAF SPACE SYSTEMS SYMPOSIUM (D1)
Interactive Presentations - IAF SPACE SYSTEMS SYMPOSIUM (IPB)

Author: Mr. Luca Breggion
Politecnico di Milano, Italy, luca.breggion@mail.polimi.it

Mr. Steffen Wedig
Technical University of Munich, Germany, steffen.wedig@tum.de
Mr. Alexis Paillet
Centre National d'Etudes Spatiales (CNES), France, alexis.paillet@cnes.fr
Dr. Aidan Cowley
ESA, Germany, aidan.cowley@esa.int

SELECTIVE SOLAR LIGHT SINTERING PROCESS OPTIMIZATION VIA A MODEL-BASED SYSTEMS ENGINEERING APPROACH

Abstract

The space sector is experiencing an increase in the complexity of systems and missions, rendering traditional text documents insufficient. Model-Based Systems Engineering (MBSE) is a promising approach to manage system complexity, enhance communication among different teams and stakeholders, and facilitate early assessment of system design. With the renewed interest in returning to the Moon, resource utilization has become a critical aspect of space exploration. To decrease launch costs and enhance human capabilities on the Moon, it is crucial to use resources available on the lunar surface. In this context, integrating In-Situ Resource Utilization (ISRU) and Additive Manufacturing (AM) becomes crucial for various concepts. These include the construction of future Moon bases, the fabrication of landing pads, and the production of essential tools for astronauts. Among the AM technologies, Selective Solar Light Sintering (SSLS) is a promising approach in line with the ISRU approach due to its low energy requirements and binder-free process. This study utilizes MBSE to optimize SSLS within the framework of ISRU. The chosen approach uses the Architecture Analysis and Design Integrated Approach (ARCADIA), coupled with Capella software, to formalize mission goals, identify user needs, and propose technical solutions for solar sintering of lunar regolith. The feasibility study, structured around the methodology's four engineering levels, aims to craft comprehensive models encompassing all mission aspects. Commencing with stakeholders' needs, the study progressively delves into the functionality of each subsystem and component, fostering a deeper understanding of the model. MBSE significantly enhanced the definition of the solar sintering architecture by offering a dynamic visualization of the model. Simplified diagrams effectively give overviews of intricate functional exchanges, establishing clear connections among functions, actors, and component subsystems. Having clear visualization tools played a crucial role in efficiently conveying complex ideas, making MBSE an invaluable tool throughout the design process. The fully engineered architecture has been meticulously assembled, and comprehensive testing with regolith simulant has validated the operational effectiveness of the solar sintering setup. This paper represents an important step in bridging theoretical design with practical application, exemplifying the efficacy of MBSE methodologies in guiding the development of a complex system from its conceptual design phase to a finite product.