SYMPOSIUM ON STEPPING STONES TO THE FUTURE: STRATEGIES, ARCHITECTURES, CONCEPTS AND TECHNOLOGIES (D3)
Infrastructures and Systems to Enable International Future Exploration and Utilization of Space (3)

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3D PRINTING TECHNOLOGY FOR A MOON OUTPOST EXPLOITING LUNAR SOIL

Abstract

In recent years rapid prototyping (or "3D-Printing") technologies are gaining increasing interest in the architecture community for their promise to allow direct construction of buildings with virtually any shape. Some of these technologies have the capability to agglomerate inert materials like sand using a special "ink". This feature is especially attractive for the space community, and in particular for in-situ resources utilization related to manned space exploration.

In 2009 ESA awarded a GSP (General Study Programme) contract to an industrial consortium formed by Alta SpA (Italy, a company with a strong heritage in space technology development), Monolite Ltd. (UK, holding the patent for the D_SHAPE Construction Scale 3D Printing technology), Foster+Partners (UK, one of world's major architecture practices) and Scuola Superiore Sant'Anna Perceptual Robotics Laboratory (Italy, a leading laboratory in the field of robotics and automation). The objective of the study is to assess the concept of 3D printing technology as a potential way to build habitat on the Moon using lunar regolith.

In the initial phase of the study, the physical and chemical characteristics of lunar regolith and terrestrial regolith simulants are assessed with respect to the working principles of the D_SHAPE technology. Tests in air and under vacuum are performed in order to demonstrate that reticulation takes place using regolith simulant and a Moon-representative environment. Specimens of the reticulated "concrete" are manufactured and subject to tensile testing, to assess mechanical properties of the final construction material. In parallel, the general requirements of a Moon outpost are specified, and a preliminary design of the habitat is performed. Based on such design, a section of the outpost will be selected and manufactured at full scale using the D_SHAPE printer and the selected regolith simulant. Finally, based on the results of the study, the guidelines for future spatialization and automation of the printer and for design and 3D printing of the outpost will be drawn. The study conclusion is foreseen by end of 2010.

At present, the D_SHAPE technology is, among the many different rapid prototyping system, the one which is closer to allowing full scale construction of buildings. The paper will present the status of the study and the preliminary assessment of feasibility for the 3D printing technology using lunar soil.