14TH IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Novel Concepts and Technologies to Enable Future Building Blocks in Space Exploration and Development (3)

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SELF-ASSEMBLY OF STRUCTURES ON THE LUNAR SURFACE USING ROBOTIC ENSEMBLES

Abstract

The construction of structures, whether in space or on planetary surfaces using astronauts is risky and expensive. Therefore, the utilization of robots for these tasks will be a necessity in future space exploration. There is a wide spectrum of possibilities for the utilization of robots with, in principle, two extreme strategies. The first one involves de use of few robots, highly sophisticated and complex, capable of at least near humane dexterity, but incorporating mechanical strength, physical power and resistance to extreme environments which humans lack. Despite its versatility, this option has some notorious potential practical disadvantages, like: high unitary cost, very high complexity and therefore multitude of failure points and difficulty of repairing, large per-unit power consumption and fragility of the mission as a whole due to the lost or degradation of one or few units. The second possibility is the utilization of a large number of small simple robots, each one with a limited capacity to perform simple tasks, operating in a largely autonomous but cooperative way based on mutual backfeeding. The advantages of this option are basically the simplicity of each unit and, consequently, its electro-mechanical robustness, low cost, minimal power consumption and, very importantly, the independence of the success of the mission with respect to the lost or failure of even a considerable number of individual robots. As a proof of concept, a small ensemble of robots will be implemented in a full payload that can be deployed in the lunar surface using a third party lander, such as the Griffin Lander of Astrobotic. The payload will consist of a module instrumented for communications, initial operation, transport to the lunar surface, deployment of the set of robots and, if necessary, of the tools and material and/or control surfaces, and visual and electronic validation of success. In general lines, the mission will consist on the deployment onto the lunar surface of a set of robots that will perform, in an independently verifiable way, a cooperative task which will include

the construction or deployment of a small structure outside the lander.