Paper ID: 70797
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20th IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Systems and Infrastructures to Implement Sustainable Space Development and Settlement - Technologies (2B)

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# ESTABLISHING DISTRIBUTED CONTROL NETWORKS IN SMART LUNAR BASES

**Abstract**

There is growing momentum to return humans to the surface of the Moon and build semi-permanent lunar bases. Building a lunar base is a monumental step that will require a whole new infrastructure and support system. The lunar surface is a hostile environment, thus it is vitally important to ensure the base structures are able to protect the crew and systems from the elements with little to no vulnerability. There are many concepts developed for a human habitat that involve metallic struts, inflatables, as well as 3D printing with sintered lunar regolith. Some concepts adopt modular designs to improve the versatility and facilitate the expansion process. However, special consideration must be given to simplifying daily living activities and processing and storing critical data, such as imminent radiation events and compromised life support systems. Centralizing critical data and system operation in designated physical locations is a significant vulnerability.

In this paper, we explore the possibility of a distributed control network that permeates the base infrastructure. These structures are constructed using modular components that are able to collect, process, store, and communicate information in a distributed network. These components are able to make localized decisions independently and offload routine maintenance responsibilities from astronauts (such as self-diagnosing and initiating automated processes to remedy and/or to replace). For complex problems, the network is able to prepare appropriate warnings for astronauts. Further, their distributed processing power may recognize and recommend decisions along with the warning message.

We examine the technologies and algorithms available to establish a distributed network within modular base building block components. We analyze sandbags embedded with electronics as a potential candidate for the modular building block components. These sandbags demonstrate multi-functionality with different schemes of embedded electronics. Other than common structural sandbags, some sandbags can implement an LED matrix and act as signage for human and machine vision; some sandbags can implement pico-projectors to display detailed reports in dispersed locations. We also compare this concept of a "smart" and conventional lunar bases by simulating plausible catastrophes and examining either base's response and aftermath.