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21st 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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IN-ORBIT ASSEMBLY: A BASELINE FOR LARGE SPACE STRUCTURES THROUGH STANDARDISED TILES AND INTERFACEABLE ELEMENTS

Abstract

Novel mission concepts of large space infrastructures such as Space-Based Solar power, Large Scale Communications, ultra-wide telescopes, are not possible without in-situ assembly, due to modern launch vehicle constraints. Some of the key challenges of in-orbit assembly of large structures are standardized components, efficient and simple robotic assembly and structural integrity in the build.

This paper will detailan in-depth technology demonstration mission description of an in-orbit assembly mission utilizingrobotic assemblers. To do so, we propose utilizing a standardized and modular tile, or building block, that can embed diverse types of payloads, provide locomotion,and acts asa structural element by creating a more robust and sounder base frame. This multipurpose tile reducesproduction

costs. Two launches will be considered: a Hub stationwith the necessary mission subsystems; and a Supply Vehicle with cargo storage capability for the tile components. The aim is to highlight and test the aforementioned novel technologies to be used in space assembly. The mass and cost budgets will highlight the relationship between in-orbit mass injected and necessary cost, and any other requirements necessary for scalability.

For the demonstration building of the desired structure the Hub and Supply vehicle will rendezvous and dock in a Sun Synchronous Earth orbit. A 6degree of freedom robotic arm will navigate with the aid of a path planning algorithm through an electrically powered rail system embedded on the backside of the tile structure, performing the assembly process. The locomotion will beaided by tracks and ball joint interfaces for the rail. The tiles would be picked by the arm and transported from the cargo vehicle to its destination, interlocked with other tiles through an interface, building up the size of the structure and the reach of the assembler. The payload interface on the frontside of tile is designed to accept various kinds than can be replaceable. The Hub will provide AOCS, power, and communications to the structure during assembly.

The information presented in this paper is intended to be used as a starting point and reference source for sustainable future developments regarding in-orbit assembly of large space infrastructures. Our design is developed as a baseline, we have considered studies and have demonstrated the scalability capabilities of the proposed approach using standardized tiles. The scalability model created by this conceptenables through a streamlined and efficient manner projects for years to come.