

From Earth Missions to Deep Space Exploration (05)
Habitation for Exploration Missions (3)

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POTENTIAL APPLICATIONS OF MODULARITY TO ENABLE A DEEP SPACE HABITATION
CAPABILITY FOR FUTURE HUMAN EXPLORATION BEYOND LOW-EARTH ORBIT

Abstract

Evaluating preliminary concepts of a Deep Space Habitat (DSH) enabling long duration crewed exploration of asteroids, the Moon, and Mars is a technically challenging problem. Sufficient habitat volumes and resulting masses are necessary to ensure crew health and functionality increase propellant requirements and decrease launch flexibility to deliver multiple elements on a single launch vehicle; both of which increase overall mission cost. Applying modularity in the design of the habitat structures and subsystems can alleviate these difficulties by spreading the buildup of the overall habitation capability across several smaller parts. This allows for a more flexible habitation approach that accommodates various crew mission durations and levels of functionality. This paper provides a technical analysis of how various modular habitation approaches can impact the parametric design of a DSH with potential benefits in mass, packaging volume, and architectural flexibility. This includes a description of the desired long duration habitation capability, the definition of a baseline model for comparison, a trade study methodology to investigate alternatives, and commentary on potentially advantageous configurations to enable different levels of habitability. The approaches investigated include modular subsystems, application of inflatable pressure vessels, and modular manufacturing approaches to habitat structure. The paper also comments upon the possibility of an integrated habitation strategy using modular components to create all short and long duration habitation elements required in the current exploration architectures.