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DMF: DEPLOYABLE MODULAR FRAME FOR INFLATABLE SPACE HABITATS

Abstract

Inflatable Space Modules for space exploration are now a reality. In 2016, Bigelow Aerospace tested the first inflatable module (BEAM) on the ISS, achieving success. This technology allows to overtake the volume limits imposed by the most common launchers, substantially changing the common idea of constructing and living into space.

Nevertheless, inflatable modules technology lacks of a reliable and functional platform to efficiently use all this space. Due to its limited dimension, the International Standard Payload Rack (ISPR), currently used on International Space Station (ISS), is not suitable for this purpose.

The project aims at developing a new standard for payload rack in the inflatable space modules: the Deployable Modular Frame (DMF). The DMF expands itself radially from the center of the module, starting from four structural pylons. It creates a solid infrastructure in which it is possible to configure a large range of different spaces as storages, laboratories, workstations and living quarters.

The DMF consists of two main parts: the deployable frame (DF) and the modular rack (MR). Once the frame is deployed, it provides four linear slots suitable to install the modular racks. The rack is the basic element that allows to store any type of equipment inside the frame. Once they are installed in the frame, the racks can slide on the frame's rails, dynamically changing the space inside the module.

This system, inspired by the Random Access Frame (RAF) designed by A. Scott Howe for the Jet Propulsion Laboratory (JPL), achieves a high deployability through the use of constant force springs, deploying a radial rail system which reduces the work effort of the astronauts on the rack. This asset reverses the internal configuration proposed by the Bigelow Aerospace. The frame includes stereo-vision cameras system to verify the correct deployment of the inflatable modules and the frame itself. The stereo-vision system checks whether the correct shape is constantly maintained.