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Author: Ms. Eloïse Ropert
ISAE - Institut Supérieur de l'Aéronautique et de l'Espace, France

Mr. Hemanth Alapati
ISAE-Supaero University of Toulouse, France
Mr. Davide Demartini
ISAE-Supaero University of Toulouse, France
Mr. Julien LEBLOND
ISAE-Supaero University of Toulouse, France
Mr. Thibaut Bonduelle
ISAE - Institut Supérieur de l'Aéronautique et de l'Espace, France
Mr. Titouan Offredo
ISAE-Supaero University of Toulouse, France

ARCHITECTURAL DESIGN FOR ATTITUDE STABILIZATION OF A SPACE MEGASTRUCTURE

Abstract

The emergence of space megastructures opens up new possibilities for space usage and exploration. The Space Hub Hestia is a space megastructure designed to host payloads of different sizes and provide them power, telecommunication and thermal drain. Hestia serves a variety of functions, including research, logistics, and housing. As such, this innovative architectural design is required for efficient attitude stabilization. In order to maximize a space megastructure's operational effectiveness and structural integrity in the dynamic space environment, this paper explores the architectural design principles and attitude and orbit control systems that are essential for preserving the megastructure's intended purpose.

In this paper, a study of the architecture of sensors and actuators is carried out. It includes a state of the art and a decision matrix for the selection of the most appropriate sensors and actuators. The study highlights the forces and torques acting on the megastructure, and how to achieve orbital and attitude stabilization. The control strategy would use a combination of feedforward and feedback loops, using on-board sensor data to continuously adapt to the dynamic on-orbit environment and ensure accurate attitude stabilization. The study of a deployment plan for the megastructure in orbit is detailed, with the structure, AOCS and propulsion corresponding to each stage. Each new payload is docked to a port on the megastructure, and must be taken into account in the overall dynamics of the megastructure. The study of a disassembly plan for the end-of-life of each payload and the megastructure is detailed.

In conclusion, architectural design for attitude stabilization of space megastructures addresses key challenges in control, dynamics and microdynamics of space structures. This paper contributes to the field of space structures, offering a viable path for the sustainable and efficient operation of future space megastructures.