Paper ID: 89350
student

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures Control, Dynamics and Microdynamics (4)

Author: Mr. Hemanth Alapati
ISAE-Supaero University of Toulouse, France

Ms. Eloïse Ropert
ISAE - Institut Supérieur de l'Aéronautique et de l'Espace, France
Mr. Davide Demartini
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
Mr. Julien LEBLOND
ISAE-Supaero University of Toulouse, France

PROPOSAL OF AN ASSEMBLABLE GEOSTATIONARY MEGASTRUCTURE FOR PAYLOAD HOSTING

Abstract

The escalating demand for the geostationary orbit (GEO) in supporting communication, Earth observation, and scientific missions requires innovative infrastructure solutions to effectively manage the growing complexity of operations. This research introduces the concept of an assemblable GSO megastructure, a transformative solution positioned at 0 longitude, designed to optimize GSO operations. The proposed megastructure functions as a centralized facility for managing and hosting a diverse array of payloads in the GSO. Core features include precise mechanical and geometrical pointing towards Earth, ensuring an accuracy of 1 root mean square (rms) for maintaining line-of-sight communication and Earth observation capabilities. The megastructure will be designed to feature payload sizes of 20x20 meters, capable of hosting large telecom payloads with a maximum mass of 1.5 tons, reducing the need for multiple individual satellite deployments within communication networks. Additionally, it offers secondary slots of 2x2 meters, accommodating payloads up to 150 kilograms, advancing versatility for scientific instruments, experimental platforms, and microsatellites.

Constructing the assemblable GSO Megastructure in orbit presents a significant challenge, addressed through exploration of two potential assembly strategies. The research considers deploying a central core structure initially, followed by expansion with additional modules for a controlled and efficient construction process. Local manufacturing of truss segments within the GSO is also investigated, minimizing the number of large components required for deployment and reducing the risk of assembly errors. Design studies on assembly of the megastructure using a robotic arm with capability to assemble in orbit.

Economic feasibility is a critical aspect, addressed through a detailed business case analysis demonstrating potential cost savings and revenue generation. The clustering of similar payloads within the megastructure offers significant opportunities for resource optimization, reducing operational costs by utilizing shared infrastructure and support systems. This concept represents a paradigm shift in GSO infrastructure design and operation, introducing an assemblable architecture with adaptive capabilities and an innovative construction methodology. This paper will include a detailed design study of the megastructure, a definition of the initial concept of operations (CONOPS) for the assembly process and developed study into the use of robotics to assemble in space. This paper will aim to introduce a concept

that can benefit future studies in operating and constructing a megastructure in orbit, and the initial concept design of the megastructure.