19th 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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PULSAR: TECHNOLOGY DEMONSTRATORS FOR ON-ORBIT ASSEMBLY OF VERY LARGE STRUCTURES

Abstract

Autonomous assembly of large structures in space is a key enabling technology for future missions which will require structures of increasing size, exceeding the capacity of modern launch vehicles when deployed as a single piece. One such type of missions is the deployment of space-based telescopes. The James Webb Space Telescope (JWST), planned for launch is 2021, is a good example of how constraints of the launch vehicle affect the complexity of the spacecraft design, with the need for a large number of release mechanisms to deploy its 6.5m segmented primary mirror. Future projects, such as the Large UV Optical Infrared Surveyor (LUVOIR), target even larger primary mirrors, further increasing the required launch vehicle volume.

It becomes clear that a paradigm shift is required to enable this continued increase in spacecraft size and complexity. The introduction of in-orbit assembly has the potential to fulfill this need. To this end, the European Commission, through its Space Robotic Technologies Research Cluster (SRC), has funded the PULSAR (Prototype for an Ultra Large Structure Assembly Robot) project. It aims at developing and demonstrating the core technologies enabling the in-orbit assembly of the 8m-diameter primary mirror of a space telescope with an autonomous robotic system.

In the scope of PULSAR, three technology demonstrators are developed. The demonstrator of Precise Assembly of Mirror Tiles focuses on autonomously assembling a fully-functional section of a primary mirror in lab conditions. The demonstrator of Large Structure Assembly in Free-floating Environment implements a near full-scale assembly scenario in a neutral buoyancy facility. Finally, the demonstrator of In-Space Assembly in Simulation (dISAS) addresses the complete autonomous assembly sequence of a primary mirror composed of 36 individual Segmented Mirror Tiles (SMT) in a high-fidelity computer simulation environment.

This paper will present the global objectives of the project, an overview of the implemented demonstrators, and results of the demonstration campaigns carried out in March 2021.