22nd IAA SYMPOSIUM ON VISIONS AND STRATEGIES FOR THE FUTURE (D4)
Innovative Concepts and Technologies (1)

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AMOCSIS: A FLEXIBLE APPROACH FOR BUILDING LARGE AND STIFF STRUCTURES IN SPACE

Abstract

The AMoCSiS-approach (Automated Manufacturing of Composite Structures in Space) is a technology experiment in on-orbit manufacturing conducted by the German Aerospace Center (DLR). Distinguished from prevailing methodologies reliant solely on 3D printing technologies, AMoCSiS leverages the synergistic potential of two primary components: carbon fiber reinforced plastic (CFRP) tubes and additive manufactured thermoplastic nodes. This distinctive approach makes use of the inherent strengths of CFRP's specific stiffness and the flexibility offered by additive manufacturing processes, establishing AMoCSiS as a standout in the field of on-orbit manufacturing technologies.

The core of the AMoCSiS approach lies in the integration of manufacturing processes for both tubes and nodes within its framework, utilizing densely packed, premanufactured materials. The continuous CFRP tube manufacturing process consists of a series of units designed to autonomously load a coil of material and automatically unroll, cut, and form it into tubular a shape. Subsequent to this, a joining unit applies heat and pressure to melt and distribute a thin strip of thermoplastic along the overlapping region of the formed tube, resulting in the creation of closed tubes with selectable lengths. This innovative process not only ensures the integrity of the structures but also allows for replenishment, thereby extending their lifespan and enabling the construction of larger, more intricate structures.

Nodes, fabricated from established thermoplastics such as PEEK or PEI via additive manufacturing, serve as components connecting tubes to form truss structures. Robotic arms are employed in the assembly of these structures, facilitating precise bonding between tubes and additive manufactured nodes through a mechanical snap mechanism.

The inherent flexibility of the AMoCSiS approach enables the development of truss structures with diverse dimensions and physical properties, even post-deployment. This adaptability, coupled with its wide-ranging applicability, particularly in the construction of large and robust structures, underlines the transformative potential of AMoCSiS in space engineering endeavors. Moreover, considerations for scalability envision its integration as a submodule for future missions, further amplifying its utility and relevance in the context of evolving space exploration initiatives.

This paper provides an in-depth exploration of the AMoCSiS-Approach, clarifying its operational intricacies. It delves into the creation of a Technology Readiness Level 4 demonstrator for tube manufacturing, offering detailed explanations of each unit's function. Furthermore, it discusses the field of applications, highlighting its potential in comparison to established rigid and deployable structure technologies.