IAF SPACE EXPLORATION SYMPOSIUM (A3)
Space Exploration Overview (1)

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EVOLVING PERSPECTIVES: A COMPREHENSIVE ANALYSIS AND TAXONOMY OF MODULAR SPACE ROBOTS

Abstract

The landscape of space exploration is swiftly evolving, with modular space robots emerging as vital contributors to exploration strategies. This paper conducts a detailed examination of contemporary modular space robots, dissecting their designs and discerning their strengths and limitations. This understanding sets the stage for a systematic taxonomy that transcends conventional boundaries. Exploring the intricate relationship between the structure and function of rootic modules, we propose a unified spectrum for homogeneity and heterogeneity, dispelling the notion of separate categories. Additionally, we delve into (co-)relations with dimensions like granularity, establishing a comprehensive framework for a new taxonomical classification. Metrics for homogeneity and granularity are defined, forming the basis for a refined classification system. Infusing bioinspired perspectives, we introduce a fresh and innovative dimension to the classification and formal representation of these modular space robots. Our aim is to enrich the understanding of these systems by drawing inspiration from biological systems. Within a novel framework considering different dimensions of modularity, this paper explores existing modular space robot systems, identifying gaps and opportunities in current research. By emphasizing key dimensions, it provides insights for improvement, innovation, and collaboration. This approach ensures a forward-looking perspective, aiming to inspire the future development of modular space robots and fostering advancements in space exploration technology.