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RETHINKING ROVER DESIGN WITH RECONFIGURABLE ROBOTICS

Abstract

The diverse Martian terrain poses significant challenges for traditional rovers, hindering their ability to navigate slopes, rough patches, and hidden obstacles and survive dust storms. Examples like Spirit's (2004) sand entrapment, Opportunity's (Meridiani Planum) slope struggles, and Curiosity's (Gale Crater) rocky challenges highlight the need for more adaptable solutions. This study proposes hyper-modular robots as a promising answer. These robots consist of fundamental unit cells categorized into four modules: locomotion (wheels, legs, etc.), computation (data processing, analysis), sensors (LiDAR, cameras, etc.), and energy (power source). Each cell features a unique barcode for identification and standardized connection ports for seamless communication and power transfer. This modular design allows for self-assembly into various configurations based on mission needs and encountered terrain. Beyond movement, the robots can dynamically adjust their structure (e.g., wheelbase, ground clearance) for optimal traversal. Current research showcases the potential of this technology in general robotics. However, achieving robust and reliable connections between modules, given the proposed intricate magnetic attraction and barcode identification design, remains a critical challenge. This study not only describes the design principles of these robots but also acknowledges the development challenges and emphasizes the need for further technological innovation to unlock the full potential of this adaptable solution for Martian exploration.
Keywords : Hyper Modular, Locomotion, Barcode, Wheelbase.