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Space Vehicles for Exploration & Propulsion for Deep Space (3)
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ROVER'S AUTO-STABILIZER CONTROL SYSTEM

Abstract

Rover spacecraft represent a significant advancement in uncrewed space exploration, enabling the collection of valuable data from remote and challenging environments. However, their speed and maneuverability are often limited by difficult terrain. This paper introduces an innovative design and simulation framework for an Autonomous Rover Stabilization Control System (ARSCS) aimed at improving rover mobility and stability on uneven, rugged landscapes. The ARSCS autonomously counteracts destabilizing forces that could cause tipping or overturning, enhancing the rover's performance and safety. By improving stability and mobility, ARSCS enables rovers to explore more challenging terrains, extending mission reach and impact. The design methodology incorporates mathematical modeling for system control, AI algorithms to analyze suspension data, and MATLAB-based simulations to validate the system's functionality. The system operates through Linear Variable Differential Transformer (LVDT) sensors in the suspension, which provide real-time data to the controllers. If a disturbance occurs, the pistons, acting as the final control element, apply counteracting forces to restore equilibrium and prevent tipping, ensuring rover stability across complex terrains.