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DEVELOPING A NOVEL HYBRID PERPETUAL MECHANICAL FLYWHEEL ENERGY
GENERATOR (HPM-FEG) TO OPTIMIZE ENERGY FOR SUSTAINABLE SPACE MISSIONS.**Abstract**

This research paper presents the design and development of a novel Hybrid Perpetual Mechanical Flywheel Energy Generator (HPM-FEG) designed primarily for space application. Mechanical batteries have long served as reliable energy storage devices, yet their limitations in space applications, particularly in vacuum environments, necessitate exploration of alternative solutions. Flywheel energy generator systems emerge as promising candidates to address this challenge, offering potential as primary energy sources for satellites, probes, and other space applications. The proposed HPM-FEG integrates innovative hybrid perpetual mechanical principles with advanced flywheel technology to optimize energy generation and storage in the demanding conditions of space. This method can be compared to solar power generating technology, which is currently widely used in space applications. Through a systematic approach encompassing theoretical modelling, computational simulations, the design achieves a delicate balance between energy density, reliability, and operational longevity critical for sustained space missions. The hybrid perpetual mechanical system incorporates regenerative mechanisms to enhance energy recapture during deceleration phases, ensuring continuous energy generation and sustained operation over extended mission durations. The research paper outlines the comprehensive design methodology, encompassing considerations such as material selection, structural integrity, thermal management, and vibration mitigation to ensure robust performance in the harsh space environment. The proposed HPM-FEG design, showcasing its ability to provide reliable, high-density energy generation capabilities for space applications. Innovative flywheel technology provides a possible option for increasing the autonomy, reliability, and duration of space missions.