

## Advanced Deployable/Retractable Solar Panel System for Satellite Applications

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**Abstract :** Modern low earth orbit (LEO) satellites that require multi-mission flexibility are highly likely to be repositioned between different operational orbits. While executing this process the satellite may experience high levels of vibration and environmental hazards, exposing the deployed solar panel to dangerous stress levels, fatigue and space debris, hence it is desirable to retract the solar array before satellite repositioning to avoid damage or failure. Furthermore, to accommodate for today's technological world, the power demand of a modern LEO satellite is rapidly increasing, which consequently provides pressure upon the design of the satellites solar array system to conform to the strict volume and mass limitations. A novel concept of deployable/retractable hybrid solar array system, aimed to provide a greater power to volume ratio while dramatically reducing the disadvantages of system mass and cost is proposed. Taking advantage of the new lightweight technology in solar panels, a mechanical system composed of both rigid and flexible solar panels arranged within a petal formation is proposed to yield a stowed to deployment area ratio up to at least 1:7, which improves the power density dramatically. The system consists of five subsystems, the outer ones based on a novel eight-petal configuration that provides a large surface and supports the flexible solar panels. A single cable and spool based hinge mechanism were designed to synchronously deploy/retract the panels in a safe, simple and efficient manner while the mass compared to the previous systems is considerably reduced. The relevant challenge to assure a smooth movement is resolved by a proper minimization of the gearing system and the use of a micro-controller system. A prototype was designed by 3D simulators and successfully constructed and tested. Further design works are in progress to implement an epicyclical gear hinge mechanism, which will further reduce the volume, mass and complexity of the system significantly. The proposed system due to an effective and reliable mechanism provides a large active surface, whilst being very compact. It could be extremely advantageous for use as ground portable solar panel system.

**Keywords :** mechatronic engineering, satellite, solar panel, deployable/retractable mechanism

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