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A LIGHT EFFICIENT PETALSHAPED DEPLOYABLE SOLAR ARRAY SUBSYSTEM FOR MICROSATELLITE CONSTELLATIONS

Abstract

Over the years, power generation has increased due to improved solar cell efficiencies and an evolution from body-mounted solar panels to rigid and flexible deployables. In addition to total power, solar arrays are evaluated on performance metrics including stowed volume efficiency, power mass ratio and specific cost. More ever, they are constrained by required stiffness, or fundamental frequency, and strength, which is based on launch and operational loading. Solar arrays also need to reliably provide power over the life of the spacecraft. There is significant interest in improving solar array performance by designing arrays that are cheaper, lighter, more compactly stowed, and generate more power. This project proposes a light deployment solar array mechanism that can be scaled in most microsatellite structures to decrease the mass and increase the generated solar power simultaneously. Inspired from terrestrial solar arrays, this mechanism is designed to be versatile, highly compact and modular. More ever, it can deploy several levels of solar arrays in the shape of a flower sequentially. This modular concept is particularly constructed to fit in 200 kg class of microsatellites, but easily adaptable for others applications. This project was launched by bilateral collaboration between Airbus and O'Sol (French start-up incubated at ESA). It was innovatively devised to deploy solar panels in order to decrease the stowed volume and increase the solar area to be adapted to high power need or to lower efficient and cheaper cells and decrease the mass. For that, a unique architecture was designed which can deploy three levels of solar arrays in the shape of a flower by using a hybrid solution including passive hinge-spring mechanism for first sequence and one small stepper motor to trigger the required planar rotations. Furthermore, four different solar panel configurations were studied, using high efficiency AsGa 3j cells and silicon solar cells on flexible and rigid panel substrates. This innovative solution can reach mass mechanisms reduction by 20% vs state of the art and reaches a power ratio of 150W/Kg. Final model was numerically validated through modal and thermal analyses. Furthermore, related demonstrator (mock-up) of subsystem was manufactured (using 3D printer) in order to show whole concept as well as the kinematics of motions.