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ORIGAMI-INSPIRED SELF-DEPLOYABLE REFLECTARRAY ANTENNA

Abstract

Reflector antennas operating at high frequencies require a high surface accuracy: deviations from the target geometry accuracy result in a loss of RF performance (e.g., antenna gain and efficiency). As a result, the aperture may need to be larger, or a more complex backing structure must be engineered to achieve the reflector surface accuracy to deliver the equivalent gain of an efficient solid reflector. This would typically increase the mass, the stowed volume, and the design complexity. The combination of unfurling ability and high surface accuracy requirements makes the design of larger aperture deployable antennas (e.g., Cassegrain, Offset) for SAR (Synthetic Aperture Radar) applications challenging for missions where platform size and payload mass are limited. Inspired by the Japanese art of folding paper, Oxford Space Systems (OSS) is currently working on a design concept for an innovative SAR reflectarray antenna, targeting the X-Band frequency range, with the aim of achieving a relatively large aperture from a small, stowed volume suitable for a small satellite. The reflectarray antenna architecture has many potential advantages over other antenna designs. It is a cost-competitive technology with excellent stowage efficiency, which can be further improved with origami-based folding mechanisms/kinematics. It requires a straightforward deployment mechanism and in contrast to conventional parabolic reflectors, it does not need a separate reflector surface or a backing structure. So far, work on space deployable reflectarray antennas (e.g., MARCO, OMERA and ISSARA missions from NASA) has focused on multi-degree of freedom structures, meaning independent self-actuated hinges. This paper presents an elegant single degree of freedom , origami-inspired reflectarray architecture that does not require actuation on all the hinges. Thanks to its Hold-Down Release Mechanism (HDRM) and spring-loaded hinges, OSS reflectarray antenna is self-deployable. It maintains the required flatness accuracy thanks to a novel hinge integrated latching system. The OSS reflectarray antenna possesses a 12:1 stowage ratio, which enables installation on a small satellite platform (even down to 50kg). The reflectarray has been designed to work in the X band frequency with vertical dual linear polarization in the concept study. However, the architecture can be scaled up or down to suit other frequency bands, making the OSS reflectarray compatible with many applications and platforms.