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SPRIG DRIVEN EXPANDABLE REFLECTOR FOR DEPLOYABLE ANTENNAS

Abstract

Solid dish antennas are a widespread technology nowadays, employed in many communication systems. Despite this, the mass and volume of this type of antenna are sometimes not compatible with the characteristics of space systems and their operating environment. This prevents their use in many more applications in which, actually, solid dish antennas could be very useful. Deployable antenna structures seem to offer a promising solution to this problem by combining an optimized structure with the same features of a solid dish.

This paper presents a new design for a parabolic reflector that extends its surface through a radial opening, umbrella-like mechanism. The light structure and the compact initial configuration of the reflector make this device a great option for those applications in which the physical constraints are a particular issue. The deployment is initiated by a single actuation system which releases the arms, making the reflector to expand its surface by nine times, compared to the stowed configuration. Furthermore, this design is characterized by an innovative system that exploits a central fixed parabola on the launch configuration. This guarantees operativeness also in the event of unexpected behavior of the deployment system, overcoming the need for other antennas for redundancy, otherwise required to assure that the correct functionality of the system is not compromised.

This kind of technology could be used to implement an aerial stratospheric telecommunication system composed of high-data-rate microwave radio link, for interception of communications and radar signals, for military and intelligence, Earth observation in low and midrange-frequency radar, deep space observation and remote sensing.

This paper presents a detailed 3D prototype design, deployment simulation and experimental test results. In addition, the major reliability parameters of parabolic reflectors, namely surface accuracy, stiffness of the dish and deployment actuation, will be analyzed and discussed in order to highlight their potentialities for future space and planetary missions.

The potential of this new concept was recognized by SNSB/DLR/ESA who selected it for a flight experiment on its REXUS/BEXUS project. During the flight in the stratosphere, the deployment mechanism will be tested and the performance of the mesh will be verified under extreme conditions, by comparing the results to those of an identical rigid system.