

An Inflatable/Self-Rigidizable Structure for the Reflectarray Antenna

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Abstract

An innovative inflatable/self-rigidizable structure has been developed for the Ka-band (32 GHz) three-meter reflectarray antenna. Although this type of antenna is primarily developed for space applications to achieve very low mass and small launch-vehicle stowage volume, it can also be employed for ground and sea-based applications. The basic electromagnetic component of this kind of antenna consists of a feed horn and, depending on the operating RF frequency, up to three layers of thin film membranes. One of the membrane layers, called the radiating layer, has a large number of copper patch elements. The antenna is basically a flat reflector rather than the conventional parabolically curved reflector. A planar frame structure, which can be deployed by inflation pressure in space, is used to support the membrane layers. At launch, the inflatable structure is deflated and both the flattened structure and the membrane can be rolled up on a mandrel for high packaging efficiency. After being deployed in space, the inflatable structures are rigidized such that any small damage caused by micro-meteoroids and/or space debris to the structure will not impact the long term antenna performance. Compared to the traditional design of using mechanically deployed structures, inflatable antennas are very lightweight, compact, and low-cost. Therefore, they are very attractive for space, ground, and sea-based applications.

Several technology demonstration models of inflatable antennas for space applications have been developed. The structure of the most advanced unit used a self-rigidizable inflatable structures technology. This paper will discuss the structural development of inflatable reflectarray antennas.