Abstract (Oral Presentation; Structures Theme)

DEVELOPMENT OF INFLATABLE ANTENNA STRUCTURES

Michael Lou, Houfei Fang, AND Bernardo Lopez

Jet Propulsion Laboratory, California Institute of Technology
M/S 125/224, 4800 Oak Grove Drive, Pasadena, California, U.S.A.
E-mail: michael.c.lou@jpl.nasa.gov

Many past, current, and future space missions require in-space deployment of large flight systems. These flight systems include telescope reflectors, solar arrays, solar sails, sunshields, radar antennas and aerobrakes. In-space deployment has traditionally been performed by mechanically deployable structures that are heavy, bulky and of complicated designs. Recently, a newly emerging technology, space inflatable structures, has received much attention because these structures could potentially achieve order-of-magnitude mass and launch volume savings for large deployable systems. In particular, focused research efforts were initiated by NASA to apply space inflatable structures technology to the development of large space radars. In the past several years, the Jet Propulsion Laboratory (JPL) has been engaging in the development of inflatable antennas for several classes of space radars, including the L-band synthetic-aperture radar (SAR) and the Ka-band reflectarray radar. Innovative structural system concepts for radar applications were generated and analyzed. Engineering models for these inflatable/rigidizable antennas (see Figures 1 and 2) were also designed, fabricated, assembled and tested.

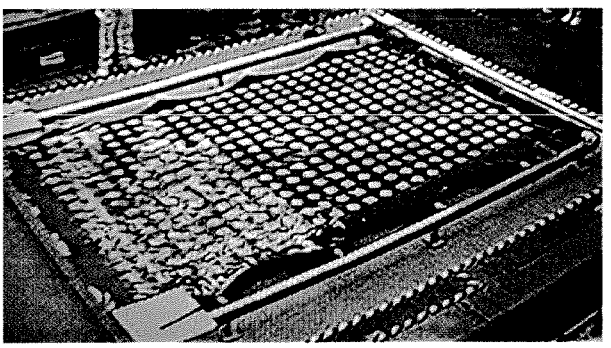

Figure 1. Engineering Model of the L-Band Inflatable SAR

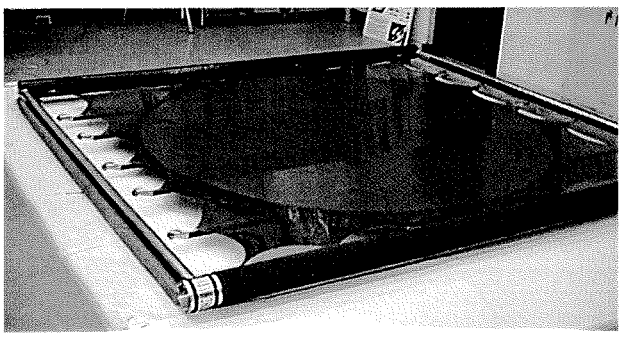

Figure 2. Engineering Model of the 3-M Ka-Band Inflatable Reflectarray

The basic building-block structural element of the JPL inflatable antennas is a new type of inflatable boom, called the spring-tap-reinforced stretched aluminum laminate boom (or simply the STR boom). The STR boom has many advantages over other inflatable booms currently under development. This boom is of a very simple design and ultra-lightweight, has excellent packaging efficiency, uses space qualified materials, and requires very low inflation deployment pressure. More importantly, in-space rigidization of the STR boom does not require heat power or any chemical process and is, therefore, free of contamination and outgassing problems. The rigidity of a deployed STR boom is derived mainly from the reinforcing spring tape and interaction between the tapes and the stretched aluminum laminate boom wall. The processes of packing, deployment, and rigidization of a STR boom can be repeatedly performed without causing noticeable damage to the boom. This means that the flight unit of an inflatable structural system using STR booms can undergo packaging/deployment testing and its deployed configuration carefully measured in the ground to enhance mission reliability .

This paper discusses the design, analysis, and testing of the STR boom and describes the development of inflatable radar antennas at JPL.