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MANUFACTURING OF THE PROTOTYPE INFLATABLE CONICAL ANTENNA – REXUS DEPLOYMENT (PICARD)

Abstract

Inflatable structures can solve many of the issues in the development of CubeSats, allowing, for instance, the larger structural elements necessary for long-range radio applications. Similarly, metal-polymer strain rigidisation mitigates the inherent structural stability issues faced by inflatables, particularly micrometeorite impacts and low strength. This paper will discuss a technology readiness level experiment to ascertain the feasibility of deploying a conical, helical, wideband radar antenna from a CubeSat on board a Rocket Experiments for University Students (REXUS) sounding rocket flight. The experiment aimed to deploy the 80cm antenna from a single unit CubeSat, strain rigidize the structure, measure the radio frequency emissions, then eject the antenna and inflation system. This paper describes the processes and concerns around the manufacture of the experiment module, and in particular, the antenna itself. The antenna was designed as a composite of aluminium and polyimide film with a polyurethane bladder to be strain rigidized in order to ensure structural stability of the inflatable. The outer layer of the antenna composite was polyimide film, while the inner was alternating helical strips of polyimide and aluminium. When fully pressurised, the aluminium is plastically deformed, while the polyimide remains in its elastic region. Upon depressurisation, the two materials will return to different equilibrium lengths, resulting in a pre-tensed, rigid, structure. The experiment flew on the REXUS sounding rocket (courtesy of the German Aerospace Centre and the Swedish National Space Board) reaching an apogee of approximately 80 km, and analysis thus far has shown that all systems performed successfully. Video shows complete deployment and ejection, while RF measurements indicate an estimated 75% antenna efficiency. Finally, preliminary results for strain rigidisation are positive, but require further analysis.