Paper ID: 15135
oral
student

SPACE DEBRIS SYMPOSIUM (A6)
Space Debris Removal Issues (5)

Author: Mr. Thomas Sinn
University of Strathclyde/Advanced Space Concepts Laboratory, United Kingdom

Ms. TEJAL THAKORE
Space Generation Advisory Council (SGAC), Germany
Mr. Philipp Maier
Space Generation Advisory Council (SGAC), The Netherlands

SPACE DEBRIS REMOVAL USING A SELF-INFLATING ADAPTIVE MEMBRANE

Abstract

In order to build future space stations or other large space structures, attention needs to be payed on the issue of space debris. For example, by considering the International Space Station or future space based solar power systems with their orbital modules of a few kilometres in diameter, space debris has become a problem in need of urgent attention. A novel technique of capturing space debris is the use of a self-inflating membrane which will be deployed from a satellite by using a completely passive deployment mechanism. Minimal complexity of the deployment sub structure and deployment process is of especially great importance for small satellites due to their volume and mass constraints. For this reason, the design approach undertaken in this research focuses on a passive deployment system without the need of any manual control. The basic idea is to use residual air inflation as a deployment mechanism. The structure can be easily folded in a very low stowage volume if the flat structure was manufactured under sea-level conditions. By subjecting the structure to space conditions, especially vacuum, the pressure difference between the inside of the structure and the environment will inflate the structure. The structure is a flat membrane with two rows of cells through the thickness, by adding a micro pump between these two neighbouring cell the pressure and therefore the volume can be changed. By changing the volume of the two local cells, the shape of the entire structure can be changed globally. This mechanism can be employed for capturing and mitigating space debris. The self-inflating adaptive membrane is able wrap itself around a piece of space junk or debris and either change the orbit or de-orbit space debris by using its own propulsion. One of the main advantages of this design is that it can be easily scaled. Currently, a prototype of a 1U cube satellite with a deployment space of 40 percent is built for a prove of concept mission on the DLR/SNSB/ESA's sounding rocket REXUS13/14 in March 2013. This 10x10x4cm3 storage space leads to a diameter of roughly one meter. This paper will present a summary of current space debris mitigation techniques, an overview of the alternation to guidelines set forth by UNCOPOUS in place to regulate the space debris disposal and mitigation to encourage future missions. The paper also outlines the design of the novel self-inflating adaptive membrane space debris remover.