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DATA ANALYSIS OF THE MEDUSA DEVICE IN VACUUM CHAMBER AND ATMOSPHERIC ENVIRONMENTS.

Abstract

Active debris removal is becoming an important area of research due to the rapid growth of space debris and the need for some form of debris remediation. Debris remediation concepts fall into two general categories: contact-based and contactless. Contact-based schemes for debris capture have to overcome the challenge of capturing a non-cooperating object in space with no pre-designed attachment points. Various schemes involving, inter alia, nets and harpoons have been proposed. In this paper we explore the potential to use shape-memory alloys as a technological basis for a debris capturing solution that can be used multiple times. A proof-of-concept prototype was developed at the University of Cape Town, named MEDUSA (Mechanism for Entrapment of Debris Using Shape memory Alloy). This prototype has been designed as a validation payload for a CubeSat test platform to perform a small debris capture proof-of-concept demonstration. MEDUSA uses the shape-memory alloy ninitol, which gives it the ability to assume pre-programmed "open" and "closed" shapes after distortion. Each of the five arms of MEDUSA can attain both pre-programmed shapes to allow reversible operations. This paper presents the process from proposal of a new debris capturing mechanism (to "cage" a target). We conducted three capturing tests and three release tests in a vacuum chamber at Institute for Space Systems in University of Stuttgart in Germany. Lastly, a software known as "Particle Tracker" were developed to analyse the motion data generated during all tests.