Paper ID: 32246
student

MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Smart Materials and Adaptive Structures (5)

Author: Mr. Louis Wei-yu Feng
University of Cape Town, South Africa

Dr. Peter Martinez
University of Cape Town, South Africa

SHAPE MEMORY ALLOYS FOR SPACE DEBRIS CAPTURE APPLICATIONS

Abstract

Active debris removal (ADR) is becoming an important area of research due to the uncontrolled growth of space debris. Recent studies have suggested that around five large space debris should be removed per year starting in 2020 in order to stabilize space object population growth. The ability to capture a non-cooperating object is central to any active debris removal scheme. There have been several debris capturing mechanisms proposed, including articulated robotic arms, harpoons, nets and foam. This research proposes a capturing mechanism based on shape memory alloys. A prototype is being developed to capture a debris of size equivalent to a 1-U CubeSat.

Shape memory alloys (SMAs) are smart materials that have the ability to recover to a programmed shape after distortion. To begin the recovery process an external heat source must be provided. During the recovery process a considerable amount of force is generated that can be utilized to perform the capturing action. This research presents a prototype device to be installed on a cubesat, to perform space debris capture. The primary components used are nitinol and polyimide. When actuated by current, pre-programmed nitinol wires will enclose a capturing volume while moving from the Martensite state to the Austenite state. The mechanism is designed to allow reversible operation; another programmed nitinol element can open up the capturing volume for subsequent capture attempts. Polyimide is used to enlarge the capturing surface. Furthermore its electrical and thermal isolation properties protect the actuator from unexpected external heat introduced during capturing process. This prototype can lay a proof-of-concept foundation for future small-scale debris capturing devices.