Paper ID: 24174
oral
student

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

Author: Ms. Livia Savioli
CISAS – "G. Colombo" Center of Studies and Activities for Space, University of Padova, Italy

Prof. Alessandro Francesconi
University of Padova - DII/CISAS, Italy
Prof. Carlo Menon
Simon Fraser University, Canada
Mr. Francesco Branz
CISAS – "G. Colombo" Center of Studies and Activities for Space, University of Padova, Italy

MORPHING ADHESIVE INTERFACE FOR SPACE ROBOTIC APPLICATIONS

Abstract

Over the last years there has been a growing interest in the development of robotic technologies for attaching to, grasping and manipulating a wide range of objects, regardless of their shape, material and the presence of specific features on their surface. This issue has become of particular interest in the space field as regards the execution of 'on-orbit servicing' operations and the active removal of space debris, where the presence of non-cooperative objects requests the employment of grasping systems that are effective when the properties of the target object are unknown. In this framework, the paper deals with the study of an interface to be employed in a gripping device where morphing and adhesive capabilities are combined in a single smart system. On one hand, the morphing behaviour is provided by a shape memory polymer (SMP) support, whose main property is to drastically change the Young's modulus when activated by an external stimulus. In the specific case, it becomes soft and enhances a good compliance with the target surface when heated above a transition temperature, while it stiffens when cooled, holding the deformed shape. On the other hand, the adhesion is reached by means of electrostatic forces (electro-adhesion) generated when a high voltage, on the order of 1 – 5kV, is applied to a proper conductive pattern integrated to the polymer. Two different fabrication processes have been developed as regards how to embed the conductive pattern in the polymeric substrate: in the first one the pattern is realized by etching and embodied during the synthesis of the material; in the second one conductive particles are used to make the polymer conductive. Two sets of tests are then performed as regards the adhesion capabilities and the morphing behaviour, aiming to evaluate (1) the force level reached with the two different electro-adhesive patterns and (2) the morphing capabilities of the substrate, i.e. its ability to conform to objects of different shapes or with specific external features, and to determine how the compliance aids the adhesion properties.