MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Poster Session (P)

Author: Dr. Davide Cuccato
Italy, davidecuccato@yahoo.it

Dr. Silvio Cocuzza
CISAS – "G. Colombo" Center of Studies and Activities for Space, University of Padova, Italy,
silvio.cocuzza@unipd.it

PRELIMINARY INVESTIGATION OF AN INNOVATIVE SHAPE DEFORMABLE SPACE ROVER USING DIELECTRIC ELASTOMER ACTUATORS

Abstract

Shape deformable vehicles using dielectric elastomer actuators (DEA) represent a new frontier for the robotic exploration of planets surface thanks to their advantages with respect to classical rovers. In particular, these systems are characterized by small mass requirements, small volume requirements, since they can be folded during launch and then deployed during the mission, and increased locomotion performance. In this paper, the kinematics and dynamics of shape deformable vehicles using DEA are studied by means of different models. First, simple models with lumped parameters are developed, which can be used to describe the system dynamics with limited errors. Finite elements method (FEM) models are also developed in order to verify the accuracy of the aforementioned models, and for comparison purposes. Then, bidimensional element models are introduced in order to model the polymeric surface with a higher accuracy. In all the considered cases, the activated elements are modeled taking into account their geometrical variation, for example the variation of element length or element area, and their stiffness variation. The performed simulations showed that both the geometrical and the stiffness variations are responsible for the shape variation of the vehicle, which is related to its locomotion force. Finally, an experimental prototype is developed and tested in order to assess the feasibility of the vehicle from a production point of view, for the experimental validation of the developed dynamic models, and for evaluating the real prototype locomotion performance.