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

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NOVEL KINEMATIC CONTROL TECHNIQUE FOR ELECTROACTIVE POLYMER ROLLING ROVERS

Abstract

Shape deformable vehicles using electroactive polymers (EAP) 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 a novel technique is proposed in order to control the motion of a rolling rover actuated by means of EAP. In particular, the inverse kinematics equations have been extended by taking into account the mass distribution of the system in order to control the position and velocity of the center of mass of the system. Two different lumped mass dynamic models are developed: the first one considers a fixed contact point with the ground and gives indications on the first time instants of the system dynamics, whereas the second one is extended in order to take into account the time evolution of the contact point. The second developed model can be therefore used to understand which EAP sectors have to be activated to maximize the rover locomotion performance, i.e. for example to maximize the rover acceleration in the first instants motion, and to perform routine operations, such as for example maintaining a constant velocity during travel. 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 kinematic control technique, and for evaluating the real prototype locomotion performance.