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DESIGN AND FABRICATION OF A LUNAR SOFT ROBOT WITH CRAWLING AND JUMPING LOCOMOTION MODES

Abstract

For a period of time in the future, Earth-Moon space will be the main field of space economy and the strategic space for the development of various countries. Considering good compliance, excellent adaptability and safe interactivity, soft robots will play an important role in the process of exploring and utilizing the moon. However, soft robots usually have only one locomotion mode and mostly adopt crawling locomotion due to their low response speed and output force. Although the crawling mode can achieve precise movement in small distances and can cope with the terrain of slopes and slits on the moon, its ability to surmount obstacles such as moon craters and rocks is limited. Compared with crawling, jumping can make better use of the moon's hypogravity and adapt to the complex terrain environment. Accordingly, in this paper, we propose a rigid-flexible coupling pneumatic actuator that can switch between monostable and bistable. The pneumatic actuator consists of a pre-bent elastic strip and two soft positive-pressure pneumatic bending actuators. Furthermore, by taking this presented pneumatic actuator as the main structure, a lunar soft exploration robot which can both crawl and jump is developed. When the actuator on the back of the elastic strip is inflated and deflated, this robot can achieve crawling locomotion under monostable pattern; when the actuator on the abdomen of the elastic strip is inflated, the robot can rapidly release energy by leveraging snap-through and achieve jumping locomotion under bistable pattern. Experimental results show that the lunar soft robot designed in this paper has flexible movement and strong obstacle surmounting ability, and can adapt to various complex terrains on the lunar surface.