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NOVEL FLUID-DRIVEN ARTIFICIAL MUSCLES FOR USE IN LUNAR ENVIRONMENT

Abstract

Lunar exploration is well recognized for its important strategic value and the lunar construction is almost inevitable for future lunar missions. At present, the main actuators used in lunar surface are motors and hydraulic rods, which have disadvantages of heavy weight and unfriendly to the lunar environment. Comparatively speaking, Pneumatic artificial muscle holds promise for safety and powerful actuation for myriad common machines and robots, and it has the advantages of simple structure, easy to maintain and light wight, and so on. Overall, pneumatic artificial muscle is suitable for the lunar environment. Here we propose an innovate architecture which consists of a compressible skeleton, flexible skin, and a fluid medium. A mechanical model is developed to explain the interaction of the three components. Our artificial muscles can be driven by fluid at negative pressures. This feature makes actuation safer than most other fluidic artificial muscles that operate with positive pressure in space environment. Experiments reveal that these muscles can contract over 60% of their initial length, and produce peak power densities over 3kW/kg all equal to, or in excess of, natural muscle. This architecture for artificial muscles opens the door to rapid design and low-cost fabrication of actuation systems for numerous applications at multiple scales, ranging from dexterous robot hands to wearable robotic exoskeletons to large deployable for space exploration.