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Configuration Design and Optimization of the Movable Leg-Foot Lunar Soft-Landing Device

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Abstract : Lunar exploration is a necessary foundation for deep-space exploration. For the functional limitations of the fixed landers which are widely used currently and are to expand the detection range by the use of wheeled rovers with unavoidable path-repeatability, a movable lunar soft-landing device based on cantilever type buffer mechanism and leg-foot type walking mechanism is presented. Firstly, a 20 DoFs quadruped configuration based on pushrod is proposed. The configuration is of the bionic characteristics such as hip, knee and ankle joints, and can make the kinematics of the whole mechanism unchanged before and after buffering. Secondly, the multi-function main/auxiliary buffers based on crumple-energy absorption and screw-nut mechanism, as well as the telescopic device which could be used to protect the plantar force sensors during the buffer process are designed. Finally, the kinematic model of the whole mechanism is established, and the configuration optimization of the whole mechanism is completed based on the performance requirements of slope adaptation and obstacle crossing. This research can provide a technical solution integrating soft-landing, large-scale inspection and material-transfer for future lunar exploration and even mars exploration, and can also serve as the technical basis for developing the reusable landers.

Keywords : configuration design, lunar soft-landing device, movable, optimization
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