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Motion Performance Analyses and Trajectory Planning of the Movable Leg-Foot Lander

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Abstract : In response to the functional limitations of the fixed landers, those are to expand the detection range by the use of wheeled rovers with unavoidable path-repeatability in deep space exploration currently, a movable lander based on the leg-foot walking mechanism is presented. Firstly, a quadruped landing mechanism based on pushrod-damping is proposed. The configuration is of the bionic characteristics such as hip, knee and ankle joints, and the multi-function main/auxiliary buffers based on the crumple-energy absorption and screw-nut mechanism. Secondly, the workspace of the end of the leg-foot mechanism is solved by Monte Carlo method, and the key points on the desired trajectory of the end of the leg-foot mechanism are fitted by cubic spline curve. Finally, an optimal time-jerk trajectory based on weight coefficient is planned and analyzed by an adaptive genetic algorithm (AGA). The simulation results prove the rationality and stability of walking motion of the movable leg-foot lander in the star catalogue. In addition, this research can also provide a technical solution integrating of soft-landing, large-scale inspection and material transfer for future star catalogue exploration, and can even serve as the technical basis for developing the reusable landers.

Keywords : motion performance, trajectory planning, movable, leg-foot lander
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