Paper ID: 65846
student

IAF SPACE EXPLORATION SYMPOSIUM (A3)
Small Bodies Missions and Technologies (Part 2) (4B)

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MULTI-NODE PROBE BASED ON FLEXIBLE PHYSICAL CONNECTIONS FOR ASTEROID LANDING

Abstract

Asteroids exploration is currently a hot spot in deep space exploration. China will start asteroid orbiting and landing exploration shortly, and there is an urgent need to develop asteroid surface landing technology. But the weak gravitational environment and irregular surface of asteroids pose a challenge to the safe and stable landing of the probe. The traditional way of asteroid landing is mostly achieved by the function of propulsion system and buffer device. However, in the special environment of asteroids, the probe is prone to uncontrollable bounce and tumble, which may deviate from the scheduled landing area, and even cause the probe to malfunction and make the mission fail. Therefore, we propose a multi-node probe based on flexible physical connections. Each node is a small detector with similar functions. These flexible connections can realize energy dissipation through the relative motion between nodes. The landing accuracy is improved by reducing the node speed at the moment of landing and the number of node rebound. The surface topography of asteroids is complex, and the range of motion of the nodes is limited due to the existence of connections. These connections can be disconnected as needed during the obstacle avoidance process to increase the range of motion of a node so that all nodes can land on a flat area. Because the energy dissipation effects of different connection modes are different, an intelligent decision-making method of optimal connection is proposed to achieve the desired landing accuracy. Based on the influence of different connection modes on landing stability time and landing error, we establish the evaluation criteria of connection modes and design a multi-node position allocation algorithm to ensure the safe landing of each node. Finally, compared with the landing of a single probe, the multi-node probe has wider coverage and a higher mission return rate. The design of multiple nodes can simultaneously detect multiple areas on the asteroid surface, and the information can be obtained more comprehensively.
Keywords:Multi-node; Flexible physical connections; Asteroid landing