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ORBIT DESIGN AND OPTIMIZATION FOR THE LANDING EXPLORATION OF FAR-SIDE OF THE MOON BY COOPERATION OF THE PROBE AND LUNAR RELAY SATELLITE

Abstract

As the lunar relay satellite is required for the landing exploration of far-side of the Moon, under the target of the above exploration mission, and on the basic principle of saving launch cost, the low-cost lunar exploration orbit with lunar relay satellite carried by the probe is designed and optimized by the hp-adaptive pseudospectral method. Through cooperation of the probe and relay satellite, the landing exploration mission of far-side of the Moon could be well completed. By establishing the motion equation in the Earth-Moon system under the three-body problem, recursivly computing the L1 & L2 (quasi) periodic orbits, and using the hp-adaptive pseudospectral method, the stitching points of the L1 and L2 constant manifolds, as well as the stitching points of the manifolds near the Earth and the Moon have all been found. Also, the fuel consumed by the orbital maneuvers has been figured out. Finally link the orbital sections, let the relay satellite be released by the probe at the right moment and runs on L2 point periodic orbit to provide relay service for the probe landing on the far-side of the moon for exploration. In this paper, a lunar exploration way which could well meet the signal relay requirements of the exploration of far-side of the moon, with lunar relay satellite carried by the probe, has been proposed. And by simulation, the velocity increment consumed in the entire layout process has been figured out. The simulation results show that the optimal orbit could not only meet the needs of the mission, but also be the lowest-cost orbit. The hp-adaptive pseudospectral method runs very fast, has better robustness, does not need to provide initial guess values of the state variables, and well solves the two body and three body system low-cost orbit design and optimization problem. The method and result in this paper could serve as a reference for the design of the synthetical low-cost orbit of the exploration of far-side of the Moon and for the design of the lunar relay satellite constellation.