

On-orbit Flight Control and Orbit Design of Lunar Exploration Probe

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Abstract

Lunar exploration is an inevitable choice for aerospace activity. According to the three step strategy of “round, fall and return”, now China has successfully finished the first and second period of lunar exploration program. China has already carried out flying surround moon, full surface imaging, landing softly, surface probe and deep flying into the space(include flying to L2 point, small star imaging). Beijing Aerospace Control Center (BACC) as the mission control center, has successfully carried out the missions of Chang’e-1 , Chang’e-2 and Chang’e-3 as the command unit of the lunar exploration flight control. BACC mainly burthen the orbit measure, orbit determination, status monitoring, control schedule and implement, long term operation and fault diagnose of “Chang’e” series satellites. Due to lunar probe’s particularity, it is different with other satellites surrounding earth. Lunar probe orbit is complicated, and it’s distance far-forth, therefore lunar probe has its own particularities and difficulties. With discussing of the key technologies aimed at lunar probe particularities, difficulties and success experience, this paper expatiates on several aspects including lunar satellites control technology, key process implementing, orbit design difficulties and its solutions, harvests gained from expanding mission.

Lunar probe management experiences are gathered and a mature on-orbit management mode is formed. Chinese lunar exploration management actuality is first analyzed. Taking Chang’e-2, Chang’e-3 and Chang’e-5T1 for example, this thesis introduces the engineering framework, task division, working mode, soft hardware structure, orbit design and personal division of labor in the mission. The merit and demerit of this mode are summarized then. The three missions have rounded and failed exploration of the moon. With the developing of following missions and the implementation of moon landing and returning, the current lunar

probe management mode , control technology and orbit design will be challenged. For the different missions and different demand of space flight, BACC, as the flight control command system, should clearly analyze the key technology of each mission and ameliorate the relevant soft hardware structure, management mode etc in order to adapt the mission demands. Each period of the lunar exploration is analyzed. The key technologies are arranged and effects and demands to the flight control are analyzed then. These will provide the reference to the future arrangement and abstraction of suitable flight control technology. The management modes of USSR , ESA and NASA's Mars Exploration Rover (MER) are simply introduced. The merit and demerit of the management to MER are summarized. Several types of methods suit for us are concluded. On the basis of the analysis to the management actuality home and abroad, taking Chang'e series satellites for example, this thesis designs the soft hardware structure , the operating mode and the orbit design. To advance the satellite management efficiency and enhance the safety and dependability, proposals to the amelioration of lunar probe are tabled, with the consideration of the visualization technology, situation analysis and information integrated process. To summarize Chinese lunar exploration spacecraft in orbit design and flight control performance. Hoping to expand and follow-up study of lunar and deep space exploration mission flight control technology.