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MISSION DESIGN OF DESTINY+

Abstract

DESTINY+ (Demonstration and Experiment of Space Technology for INterplanetary voYage, Phaethon fLyby and dUSt analysis) is a small-sized high performance deep space vehicle proposed at ISAS/JAXA. DESTINY+ is now phase-A and supposed to become a project in 2018. The mission design of DESTINY+ is divided into some phases. First phase is an orbit injection into an extended elliptical orbit launched by the Epsilon rocket. Second phase is many revolution transfer to raise apogee altitude by low thrust propulsion system to the moon orbit nearby. And the distant flyby and the swing-by around the moon is designed to give DESTINY+ momentum to escape Earth gravitational field. At an interplanetary phase, DESTINY+ goes to an Asteroid Phaethon for flyby observation. After the Phaethon flyby, DESTINY+ is planned to go back toward Earth for gravity assist and go to another asteroid. DESTINY+ has several mission objectives, including: demonstration and experimentation of space technology for interplanetary voyages; and the investigation of the process to the end of evolution of a primitive body; the limitation of initial state and the evolution process of the meteor shower dust for science missions. This paper discusses DESTINY+'s low-thrust trajectory design and the related system analysis. As for the many revolution transfer phase, the low-thrust trajectory is optimized by the multi-objective optimization using genetic algorithm. In this phase, we minimize the time of flight, the passage of time of radiation belt, the work time of IES and the maximum eclipse period. After the spacecraft reaches to the moon's path, it utilizes the moon swing-by several times to connect to the transfer trajectory for Asteroid Phaethon. Parallel to the trajectory design, the radiation effect analysis, thermal environmental analysis, attitude analysis

and ground station visibility analysis for operation are achieved. From these studies, we can show the feasibility of the mission design of DESTINY+.