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INTRODUCTION TO THE DEVELOPMENT STATUS OF SOUTH KOREA'S MARS ORBITER

Abstract

The South Korean government announced the "Space Economy Roadmap" in November 2022, declaring its plan to plant the national flag on the surface of Mars by 2045. In December 2022, it also released the 4th Basic Plan for Space Development Promotion, presenting a vision to become a leading space economy by 2045. The plan outlined three specific goals: expanding the scope of space exploration, increasing investment in space development, and fostering private space industries. This study introduces the current status of South Korea's Mars orbiter development. Earth and Mars align in relative positions approximately every 2.14 years, and due to differences in their orbital inclination, fuel consumption varies significantly depending on the launch year. Therefore, determining the optimal launch period for Mars exploration requires Porkchop plot analysis. The Porkchop plot serves as an 'interplanetary fuel efficiency map,' making it highly effective for analyzing launch dates based on departure and arrival times. Earth-to-Mars interplanetary transfer trajectories are categorized into Type 1 and Type 2, depending on the angle between Earth, the Sun, and Mars. A comparison of these two trajectories is performed to select the one that consumes the least energy. South Korea's Mars orbiter, set to launch in 2035 from the Naro Space Center aboard the KSLV-3, is assumed to have a total mass of 1,600 kg. After reaching a circular orbit at an altitude of 250–300 km, the Mars orbiter will perform a short coasting flight before executing the Trans-Mars Injection (TMI) to leave Earth's sphere of gravitational influence and head toward Mars. The Mars orbiter's spaceflight duration from Earth to Mars takes approximately 6 to 8 months. The Mars orbiter must perform Mars Orbit Insertion (MOI) deceleration to be captured into Mars orbit. Two methods were studied: performing around four deceleration maneuvers using high thrust or entering the initial Mars orbit with high thrust and then using the Martian atmosphere aerobraking. The Mars target orbit is assumed to be circular at an altitude of 400 km with an inclination of 90 degrees. This study confirmed the launch window, Earth-to-Mars interplanetary transfer trajectories, Mars orbit insertion, and target orbit design for the Mars orbiter.