

SPACE EXPLORATION SYMPOSIUM (A3)  
Mars Exploration – Part 1 (3A)

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## MULTI-OBJECTIVE MISSION DESIGN FOR THE MARS SYSTEM

**Abstract**

Chinese Mars mission will start in the near future, which plans to explore Mars and implement landing on one moon of Mars, Phobos or Deimos. One problem arisen in this mission concept would be the probe's orbit after captured by Mars is usually not coplanar with the moons' orbits which nearly lie in the equatorial plane of the planet. And thus it requires a large amount of fuel for orbital maneuvers to rendezvous with the moon, which might make the mission of landing unachievable. This study aims at developing an approach to address this problem.

First in this paper, the relationships between the argument of periapsis, orbital inclination and periapsis radius of the captured orbit are analyzed. The result is then used to design a special Earth-Mars transfer orbit that ensures the apoapsis of the captured orbit locating in the equator plane of Mars. Since the probe's speed at the apoapsis is low, the orbital maneuver at this point can significantly reduce the fuel consumption. Based on this approach, the paper proposes a mission mode including a major probe and a sub-probe. The major probe is designed to orbit the Mars, and the sub-probe will fly to and land on one of the moons. The sub-probe will be released at the apoapsis of the captured orbit that locates at the equatorial plane. At last, this paper presents a four-impulse strategy for the sub-probe to rendezvous with Mars's moon, and the corresponding fuel consumption is evaluated. The result shows that the fuel consumption is significantly reduced using this approach.