Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

PEM05-01 会場:303 時間:5 月 20 日 14:15-14:30

次世代宇宙航行と宇宙環境
space propulsion concepts using space environment

山川 宏[1*]
Hiroshi Yamakawa[1*]

[1] 京都大学生存圏研究所
[1]RISH, Kyoto University

Two types of space propulsion systems using space environment are discussed mainly in terms of orbit control capability.

1. Magnetic Sail in the Solar Wind Flow

Magnetic sail (Magneto-plasma sail) is an interplanetary space propulsion concept which produces the propulsive force due to the interaction between the artificial magnetic field around the spacecraft and the solar wind erupted from the Sun. The thrust can be approximated as continuous outward radial acceleration that is inversely proportional to the square of the radial distance from the sun.

A guidance scheme is proposed for orbital motion under continuous outward radial acceleration that varies in accordance to the solar wind intensity. The maximum attainable radial distance of the outbound trajectory is investigated, and a guidance scheme for achieving this target maximum distance is established under radial acceleration disturbances. The scheme not only provides a control law for continuous radial acceleration but also yields the amount and timing of impulsive maneuvers required to satisfy the guidance requirement at the terminal point.

2. Charged Satellite in the Earth Magnetic Field

The motion of a charged satellite subjected to the Earth’s magnetic field is considered. The Lorentz force, which acts on a charged particle when it is moving through a magnetic field, provides a new concept of propellantless electromagnetic propulsion. A dynamic model of a charged satellite, including the effect of the Lorentz force in the vicinity of a circular or an elliptic orbit, is derived and its application to formation flying is considered. Analytical approximations for the relative motion in Earth orbit are obtained. The sequential quadratic programming method is applied to solve the orbital transfer problem. A strategy to reduce the charge amount using sequential quadratic programming is also developed.

キーワード: 宇宙推進, 宇宙環境, 軌道工学
Keywords: space peopulsion, space environment, orbital mechanics