IAF ASTRODYNAMICS SYMPOSIUM (C1)
Mission Design, Operations & Optimization (2) (5)

Author: Dr. Naoya Ozaki
Japan Aerospace Exploration Agency (JAXA), ISAS, Japan, naoya.ozaki@ac.jaxa.jp

Mr. Nishanth Pushparaj
The Graduate Universty for Advanced Studies[SOKENDAI], Japan, nishanth@ac.jaxa.jp
Dr. Takayuki Yamamoto
Japan Aerospace Exploration Agency (JAXA), Japan, yamamoto@isas.jaxa.jp
Dr. Diogene Alessandro Dei Tos
Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency (JAXA), Japan, diogenealessandro.deitos@ac.jaxa.jp
Mr. Onur Çelik
The Graduate University for Advanced Studies, Japan, onur.celik@ac.jaxa.jp
Mr. Ferran Gonzalez-Franquesa
The Graduate Universty for Advanced Studies (SOKENDAI), Japan, ferran.gonzalez@ac.jaxa.jp
Mr. Roger Gutierrez Ramon
The Graduate University for Advanced Studies, Japan, roger.gutierrez@ac.jaxa.jp
Ms. Kanako Machii
The University of Electro-Communications, Japan, Japan, m1932088@edu.cc.uec.ac.jp
Mr. Takuya Chikazawa
University of Tokyo, Japan, c.takuya@ac.jaxa.jp
Dr. Tomoko Arai
Chiba Institute of Technology, Japan, tomoko.arai@it-chiba.ac.jp
Dr. Yasuhiro Kawakatsu
Japan Aerospace Exploration Agency (JAXA), Japan, Kawakatsu.Yasuhiro@jaxa.jp
Prof. Kazutaka Nishiyama
Japan Aerospace Exploration Agency (JAXA), Japan, nishiyama@ep.isas.jaxa.jp
Prof. Takeshi Takashima
ISAS, JAXA, Japan, takashima.takeshi@jaxa.jp

MULTIPLE ASTEROID FLYBY TOUR DESIGN UTILIZING LOW-THRUST AND GRAVITY-ASSIST FOR DESTINY+ MISSION

Abstract

DESTINY+mission is a candidate for JAXAs Epsilon class small program to be launched in the 2020s. To enable lower cost and higher frequency deep space missions, the spacecraft will demonstrate advanced technologies that include a highly efficient solar electric propulsion. For the science mission, the spacecraft will perform high-speed flyby observation and explore the asteroid (3200) Phaethon as the nominal mission and several more asteroids as an extra mission. This paper presents the DESTINY+ mission analysis for multiple asteroid flybys utilizing electric propulsion and Earth gravity-assist techniques. We proposed a novel method that design multiple asteroid flyby trajectories by solving V-infinity leveraging boundary value problems. In the proposed method, the spacecraft focus on a single asteroid flyby for each Earth-to-Earth arc. In other words, the Earth-to-Earth arc can be tailored to flyby a favorable asteroid.

The proposed method therefore can design trajectories that flyby scientifically favorable asteroids rather than technically accessible asteroids. We discuss candidate asteroids that the spacecraft can potentially explore. The targets asteroids should be finally selected considering technical constraints, such as remaining propellant, and scientific returns. Multiple asteroid flyby tours are beneficial as precursor missions for future full-scale missions that include asteroid sample return missions.