SPACE EXPLORATION SYMPOSIUM (A3)
Small Bodies Missions and Technologies (4)

Author: Prof. Othon Winter
UNESP - Univ Estadual Paulista, Brazil

Prof. Elbert E.N. Macau
Instituto Nacional de Pesquisas Espaciais (INPE), Brazil
Mr. Haroldo Fraga de Campos Velho
National Institute for Space Research - INPE , Brazil
Dr. Scientific and Engineering Payload Team - ASTER
Brazilian Space Agency (AEB), Brazil

THE ASTER MISSION: STRATEGIES FOR EXPLORING THE TRIPE SYSTEM 2001SN263

Abstract

ASTER is the first Brazilian mission to an asteroid. In this work we present a follow up of the recent progress in this project. The target is the asteroid 2001 SN263. 2001 SN263 is composed of three bodies, called Alpha, Beta and Gamma. The components of the system have diameters of about 2.8 km (Alpha), 1.2 km (Beta) and 0.5 km (Gamma). With respect to Alpha, Beta, has a semi-major axis of about 17 km and Gamma, has a semi-major axis of about 4 km. Among the payload of the spacecraft there will be a multi-spectral camera, a laser range finder, a near infrared spectrometer and a mass spectrometer. Therefore, the spacecraft will have to map the surface of each one of the bodies and conclude the mission touching the larger body. In order to accomplish the scientific goals it was made a study of possible strategies to design a mission. The maneuvers will be made with thrusters using electric propulsion, i.e. low-trust propulsion. We have explored three possible approaches: a) Insertion of the spacecraft around Beta, then spiral descent to the orbit of the Gamma, then spiral descent to a low orbit around the main body (Alpha); b) Insertion of the spacecraft into an elliptical orbit that cross the orbits of the bodies Beta and Gamma and with periapsis close to the main body (Alpha) and multiple flybys of the bodies. c) A combination of the approaches a) and b), i.e., insertion of the spacecraft into the elliptical orbit and multiple flybys of the bodies, then approaching and orbiting the smaller bodies (Beta and Gamma). The three scenarios are explored searching for optimal maneuvers that reduce the propellant consumption. Starting from the system's L1 point with respect to the Sun, the spacecraft had several possible trajectories, the analysis was then made taking into account the optimal maneuvers for each new orbit or flyby separately and then globally. Such approach view to optimize the fuel consumption while maximizing the science output; in this way, for each of the instruments at each of the maneuvers presented above the designed optimal trajectory focus also in allowing the instruments to work at it best. Once a base optimal trajectory was obtained, the next step took place into analyze the robustness of the trajectory taking in account the allowed errors in the flybys and orbits based on the estimated instruments measurement capability.