HUMAN EXPLORATION OF THE SOLAR SYSTEM SYMPOSIUM (A5)
Poster Session (P)

Author: Dr. David Dunham
KinetX, Inc., United States, david.dunham@kinetx.com

Dr. Robert W. Farquhar
KinetX, Inc., United States, robert.farquhar@kinetx.com
Dr. Natan Eismont
IKI RAS, Russian Federation, NEismont@iki.rssi.ru
Dr. Sergey Aksenov
Moscow Institute of Electronics and Mathematics of National Research University Higher School of Economics (MIEM NRU HSE), Russian Federation, aksenov.s.a@gmail.com
Prof. Roberto Furfaro
University of Arizona, United States, robertof@orex.lpl.arizona.edu
Mr. John Kidd
University of Arizona, United States, johnkiddjr@gmail.com

HUMAN EXPLORATION OF NEAR-EARTH ASTEROIDS AND MARS ENABLED BY LUNAR AND SOLAR GRAVITY ASSISTS

Abstract

At the last IAC in Beijing, we showed how a one-year flyby of the asteroid 1994 XL1 could be accomplished with a reusable spacecraft that would depart from an Earth-Moon L2 halo orbit, and return to the same orbit, for a deterministic delta-V cost of only 432 m/sec. This was accomplished by using high-energy Earth orbits that were drastically modified with lunar swingbys and small propulsive maneuvers in the dynamically chaotic regions near collinear Sun-Earth and Earth-Moon libration points. The work extends ideas developed by the International Academy of Astronautics' exploration study group presented at the 2008 IAC in Glasgow. A new half-year Near-Earth Asteroid (NEA) trajectory will be presented, followed by a rendezvous with the very accessible NEA 2000 SG344, and finally a flight to Mars with rendezvous with Phobos, with a return to an Earth-Moon or Sun-Earth libration-point orbit after returning from each object. The trajectories will use highly-elliptical Earth orbits (HEOs) whose line of apsides can be rotated using lunar swingbys. The trajectories work best when the perigee of the trajectory departing to the interplanetary destination is near the lunar orbit plane, but methods for handling trajectories whose departure perigees are relatively far from the lunar orbit plane will be addressed. The HEO provides a convenient and relatively fast location for rendezvous with crew, or to add propulsion or cargo modules, a technique that we call "Phasing Orbit Rendezvous". In this way, the spacecraft can be uncrewed much of the time while it is within the Earth-Moon system, with the astronauts using a small spacecraft to leave Earth to rendezvous with the larger interplanetary vehicle 10 to 20 days before the perigee maneuver applied at perigee for the departure from HEO. Most of the basic dynamical ideas have already been demonstrated by the third International Sun-Earth Explorer, the first libration-point spacecraft and the first to fly by a comet.