Paper ID: 34350
student

19TH IAA SYMPOSIUM ON HUMAN EXPLORATION OF THE SOLAR SYSTEM (A5)
Human Exploration of Mars (2)

Author: Mr. Michele Pagone
Politecnico di Torino, Italy

Dr. Nicole Viola
Politecnico di Torino, Italy
Mr. Marco Berga
Thales Alenia Space Italia, Italy
Mr. Eugenio Gargioli
Thales Alenia Space Italia, Italy
Mr. Stewart Pelle
Thales Alenia Space Italia, Italy

MISSION ANALYSIS OF POTENTIAL EARTH-MARS CYCLER

Abstract

Since the early history of space exploration, Mars conquest seemed to be one of the most important steps to achieve. After Apollo mission's Moon landing, several concepts and projects, concerning a mission on the Red Planet, were developed. One of the most important contributes was given by Buzz Aldrin, who theorized the use of particular kind of orbits, called cycler orbits, as baseline for an enduring Mars colonization. In this dissertation a mission architecture based on this new concept was analyzed, in order to develop an alternative mission profile compared to the ones experimented with other manned missions. A cycler orbit is a kind of orbit which repeats every integer multiple of synodic period and which encounters two bodies with a precise schedule. In the case, the bodies considered are Earth and Mars. It is possible to inject a space station in the cycler orbit which allows a 'free' transfer of a crew from Earth low orbit to Mars low orbit and vice-versa. The architecture also consists of two staging posts orbiting respectively around Earth and Mars, taxi vehicles which link the cycler station with staging posts and descent/ascent vehicles. The work starts with an analysis of several classes of cycler. Through a trade-off analysis was identified an unique class of cycler as base for a further mission analysis. The mission analysis consists of an evaluation of orbital perturbation, the computation of ΔV required for injection and rendez-vous maneuvers, a trade-off analysis among different Earth staging posts, including the use of Low Earth Orbit, Low Luna Orbit and Earth-Moon Lagrangian points, and an identification of close approach windows of the cycler with the two planets, allowing an evaluation of mission duration. Critical mission sub-system were analyzed, including the propulsion system, the electrical power system and the entry, descent, landing system. The analysis allowed a weight evaluation for each element of architecture. Eventually, the presented mission concept was compared with the classical concepts, underlining the advantages and disadvantages of using the cycler orbits. The dissertation is supported by MatLab and orbital GMAT simulations. The ephemerides files are provided by JPL. The whole work was developed during an Aerospace Engineering master thesis in Politecnico di Torino, with the partnership of Thales Alenia Space Italia.