Paper ID: 5235
student

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Upper Stages, Space Transfer, Entry and Landing Systems (3)

Author: Mr. Mohammad Reza Farmani
K. N. Toosi University of Technology, Iran, farmani60@gmail.com

Mr. Vahid Rezvani
K. N. Toosi University of Technology, Iran, vahid8229020@yahoo.com
Prof. Jafar Roshanian
K. N. Toosi University of Technology, Iran, roshanian@kntu.ac.ir

TRAJECTORY DESIGN FOR EARTH-MOON ORBITAL TRANSFER USING MULTIOBJECTIVE GENETIC ALGORITHM

Abstract

An optimum trajectory for Earth-Moon orbital transfer is proposed in this paper which decreases the time of flight (T) and the total characteristic velocity (V) of a spacecraft. A restricted three-body problem is used here to derive the equations of two dimensional flight motion from a Low Earth Orbit (LEO) to a Low Moon Orbit (LMO). As the moon is an important place for space explorations, the orbital transfers from Earth to Moon must be efficient and economical. In the space missions the rate of energy consumption which is equal to required V has an important effect on the mission cost and is in direct conflict with the time of the flight. These two objectives are dependent on some decision variables of the orbital transfer problem such as the radius of Earth and Moon park orbits, maximum available impulses, initial phase angle, flight path angle, and so on. Therefore, this optimization orbital transfer problem contains two conflicting objective functions that must be minimized simultaneously. Genetic Algorithms (GA's) are a group of heuristic optimization algorithms which have often been shown to be effective for difficult multiobjective optimization problems appearing in various industrial, economical, and scientific domains. GA's are originally inspired by biological evolution and natural selection which provide an alternative for solving optimization problems. Multi-Objective Genetic Algorithms (MOGA's) consistently outperform other traditional optimization methods in most of the multiobjective problems. In the current problem a MOGA algorithm has been proposed and applied to minimize both V and T subject to some different design constraints. The algorithm is applied to produce a set of feasible solutions called Pareto optimal solutions for the trajectory design optimization problem. The results of the current MOGA algorithm show that obtained trajectories minimize both V and T which reveals better results in comparison with previous studies that dealt with only single objective trajectory design problems.