Paper ID: 37734
oral

20th IAA SYMPOSIUM ON HUMAN EXPLORATION OF THE SOLAR SYSTEM (A5)
Human Exploration of Mars (2)

Author: Prof. Giancarlo Genta
Politecnico di Torino, Italy

Mrs. porzia federica maffione
Politecnico di Torino, Italy

INTERPLANETARY MISSIONS PERFORMED OUTSIDE THE OPTIMAL LAUNCH WINDOWS

Abstract

It is well known that the energy required for interplanetary travel depends on the launch and the arrival dates and that the launch windows are fairly narrow and depend on the particular launch opportunity. In the case of impulsive propulsion such a dependence is expressed by the so-called pork-chop plot, while for low thrust a similar plot, which can be called J-plot, has been proposed. As a consequence, in a human mission to Mars the stay on the planet (or in orbit about it) must be quite long, of the order of 500 days and any decrease of the time spent in space causes an increase of the stay on the planet. Together with these 'long stay' missions, it is possible to design 'short stay' missions in which the stay on the planet is of the order of 30-45 days, but they are characterized by higher energy requirements, which in some launch opportunities may be reduced performing a flyby of Venus. All this is true both for both impulsive thrust and low thrust propulsion. There are essentially two reasons for launching a spacecraft to Mars (or to any planet) outside the launch windows characterized by low-energy conditions: performing a mission which is longer than a 'short stay' mission but shorter than a 'long stay' one and performing an emergency mission either to allow astronauts on Mars to get back to Earth or to deliver cargo to Mars. These missions performed outside the traditional launch windows are considered to be impossible, or at least to be so energy intensive to be prohibitively costly. This is surely true for chemical propulsion, but is also applicable to solar electric propulsion and nuclear propulsion, both NEP and NTP. The aim of the present paper is studying these situations and to introduce a plot linking the two ways energy requirements with the duration of the forward and backward travel for any given stay on the planet. This plot allows to study the conditions which may make it possible to perform what may be called an 'intermediate stay mission', particularly for what the propulsion system requirements are concerned.