

ASTRODYNAMICS SYMPOSIUM (C1)
Orbital Dynamics - Part 1 (3)

Author: Mrs. Bannihatti Parameshwarappa Dakshayani
ISRO Satellite Centre (ISAC), India

Mrs. NAGAMANI THANGAVEL
ISRO Satellite Centre (ISAC), India

Mr. Kiran B.S.

Indian Space Research Organization (ISRO), India

Dr. Narayanasetti Venkata Vighnesam

Indian Space Research Organization (ISRO), India

Mr. N.S. Gopinath

ISRO Satellite Centre (ISAC), India

STABILITY ANALYSIS OF A HIGHLY ECCENTRIC ORBIT AROUND MARS

Abstract

Indian Space Research Organization is planning a mission to Mars in the near future with its launch vehicle. Launch opportunity studies indicated earliest possible dates are around November 2013 and December 2016. The probable orbit for a maiden Indian mission to Mars with less thermally complex spacecraft forgoing aerobraking for orbit insertion could be a highly eccentric orbit. To achieve the mission goals, high eccentric orbit needs to be studied for its stability as the spacecraft experiences various perturbations which deviates the path of the spacecraft from the inserted orbit around Mars. A typical eccentric orbit of 500km periareion and 80000Km apoareion with inclination around 65deg is considered for the stability study. The study is carried out with a high fidelity trajectory generation software which accounts perturbations due to asphericity of Mars, Sun's solar radiation effect, Martian atmosphere and gravitational attraction due to Sun, Earth, Jupiter. The study indicated the perigee drop from 500 to 130 km in a span of 300 days which resulted in steep fall of apoareion due to periareion passage through dense atmosphere. This behavior of the orbit is further studied by different combination of perturbation to single out the cause of the perigee drop. The outcome of the study points to gravitational effect of sun to be the prime cause. The gravitational attraction of the sun acting on the spacecraft in a direction opposed to the spacecraft motion at the apoareion contributes to the periareion drop. This behavior of the orbit which could vary with orientation of the satellite's orbital plane and satellite node location necessitates further study with various inclination and longitude of ascending node of the satellite. Inclination ranging from 0 to 180deg with step of 30deg in combination with longitude of ascending node of 0 to 360deg measured from the IAU reference vector is considered for the study. The result of this study has indicated that periareion drop is noticed for inclination around 90deg with a range of 30deg and node around 60deg with a range of 60deg. Utilization of this study can be made in the choice of an eccentric orbit depending on the requirement of the mission to have it for longer period or with shorter one which could be used to study lower atmosphere due to natural decay of periareion by choosing proper combination inclination and longitude of the ascending node.