Paper ID: 21859
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SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Upper Stages, Space Transfer, Entry and Landing Systems (3)

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ELECTRIC ORBIT RAISING - ADVANTAGES, TRANSFER ASPECTS, SOLUTIONS

Abstract

Electric orbit raising (EOR) seems to be become an important driver for future satellite and launcher designs. The majority of available commercial telecommunication platforms are already using electric propulsion (EP) technology for station-keeping, and many are now trying to exploit the higher specific impulse for the transfer from launch orbit to geosynchronous equatorial orbit (GEO). While nowadays those orbit transfers are pure chemical, the next step will be not only pure electric orbit transfers but also hybrid transfers.

Typical aspects of orbit transfers with electric propulsion and their impact on the trajectory will be discussed by this paper. First, the selection of a proper launch orbit and date is mandatory. Both might have strong influence on the transfer performance like the seasonal effects of eclipses. Next, there are several constraints and issues related to spacecraft sub-systems to be considered in trajectory computation and optimization, for example radiation, eclipses, heat dissipation and collision avoidance especially with assets in the GEO ring. Other aspects related to spacecraft technology are limitations in attitude, rotation and torques and are addressed as well as restrictions in thruster operations (e.g. cycling). Further, navigation and contact with ground station network or a single ground station must be taken into account for the whole transfer. Hybrid transfers, which combines chemical and electrical transfer are beneficial for very large GEO platforms in order to keep the transfer duration within 6-12 months. All transfer aspects together define the valid trajectory for the orbit raising.

Another aspect of electric orbit transfers is the operation of the spacecraft. Periodic updates of the attitude profile are proved necessary to cope with uncertainties and fulfill all transfer constraints. Only in that way the transfer follows the optimal trajectory as close as possible. The paper will discuss possible strategies for an operational concept where the spacecraft state will be updated by orbit determination to re-optimize the maneuver plan.

Finally the cross-impact of satellite concepts with the electric orbit raising capabilities and future launcher concepts will be discussed.