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ELECTRIC PROPULSION APPROACH FOR TRANSPORTATION OF TELECOM SATELLITES FROM GTO TO GEO.

Abstract

The interest in the application of electric propulsion as the primary propulsion system for the transfer of spacecrafts to GEO is not a new concept. The advantages related to this type of propulsion, such as higher I_{sp}, compared to classical chemical propulsion, allow savings of propellant. This translates mainly in cheaper launchers or additional mass for the payload. On the other hand the limitations of these technologies, i.e. low thrust levels, translating in longer mission time and higher power requirements, represent the greatest obstacles to their extensive application. This paper addresses key aspects of an all-electric mission for the transfer of telecommunication satellites from GTO to GEO. The advantages and criticalities, related to the peculiarities of the mission, are examined in order to highlight optimization parameters and tradeoff points. A reference mission for the transfer from GTO to GEO of an all-electric telecom satellite using available technologies is analyzed. The trajectory is modeled and influencing factors are considered both in terms of disturbing external actions and effects related to the space environment. The selection of the factors to take into account have been made considering the main differences from a typical chemical mission, mainly the greater time spent to perform the maneuver and the implications that follows. Tradeoff considerations have been presented to highlight possible different strategies as well as criteria for optimization processes and further analysis. Main limitation of the analysis is in the modelling of the mission considered. Being the report a first level analysis, the assumptions made can be strong, but the results obtained are considered significant as a basis for further investigation and general understanding of the problem. The mission is modeled in two simplified scenarios, for both an equivalent chemical transfer is presented as reference for comparison. The main aspects considered are transfer duration, propellant consumption, orbital perturbations, radiation and space debris influence. Attitude control implications are also briefly discussed. For all these aspects a first order analysis has been done, based on methods found in the literature. Focus has been given to the discussion of the results where the outcomes for further investigation are proposed. Among these, mission design variations has been proposed, notably the possibility to trade some of the propellant savings with an additional propulsion system to increase the thrust, and a proper sequence of maneuvers to reduce the exposure to high energy protons radiation.