Satellite Maneuvers Using the Hénon’s Orbit Transfer Problem: Application to Geostationary Satellites

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Abstract: The main objective of the present paper is to study minimum fuel maneuvers to change the position of a spacecraft in orbit around the Earth. The control used is a bi-impulsive maneuver, where the first impulse is applied in the initial position of the satellite to send it to a transfer orbit that will cross the desired final position of the spacecraft. Both initial and final position of the satellite belongs to the same Keplerian orbit. The goal is to find the transfer that has the minimum total increment in velocity and that performs the desired maneuver.

Keywords: Astrodynamics; orbital maneuvers; bi-impulsive control.
Mathematics Subject Classification (2000): 70M20, 70H12.

1 Introduction

In this paper, the problem of transfer orbits from one body back to the same body (known in the literature as the Hénon’s problem) is used to study maneuvers that has the goal of changing the position of a satellite, in the sense of sending it to a different point (true anomaly) of the same orbit. The net result is a relocation of the satellite in the same orbit. The problem of transfer orbits from one body back to the same body has been under investigation for a long time. Hénon [6] originally developed a timing condition for orbits that allow a spacecraft to leave a massless body \( M_2 \), go in an orbit around the primary \( M_1 \) and meet \( M_2 \) again, after a certain time. This was treated as the problem of consecutive collision orbits in the restricted three body problem. Several authors then worked on improvements of this problem. Hitzl [7] and Hitzl and Hénon [8,9] studied stability and critical orbits. Perko [12] derived a proof of existence and a timing condition

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