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INITIAL AND FINAL BOUNDARIES TRANSFORMATION WHEN SOLVING OPTIMAL CONTROL PROBLEM WITH AVERAGING TECHNIQUES AND APPLICATION TO LOW THRUST ORBIT TRANSFER

Abstract

Optimal control problem on low thrust orbit transfer are more efficiently solve with the use of averaging techniques. It has been apply successfully on low thrust satellite orbit transfer for minimum time or fuel optimization problems. Those optimal control problems present in the dynamic a high-speed evolution of the satellite longitude and a slow evolution of the other state variables. The solution of the optimal control problem creates trajectories with a large number of revolutions difficult to solve without applying averaging techniques on the longitude. In the state of the arts no special care is taken on the boundary conditions when transforming the initial control problem on an optimal control problem with an average satellite dynamic. Usually the boundary conditions of the 2 problems are taken identical. Looking on this fact, the paper will show that this approach introduce an error in the initial and final condition of the average problem. This lead to solve an optimal problem close to the one we expect but with a solution which is clearly not the average of the solution of initial optimal control problem. A transformation of the boundary condition when averaging is proposed to solve this issue. A new optimal control problem including this boundary transformation is solve and numerical test are performed on satellite orbit transfer examples to show the legitimacy of this approach and the accuracy improvement.