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OPTIMIZATION OF SATELLITE CONSTELLATION RECONFIGURATION MANEUVERS

Abstract

Constellation satellites are required to perform orbital transfer maneuvers. Orbital transfer maneuvers, as opposed to orbital correction maneuvers, are seldom performed but require a substantial amount of propellant for each maneuver. The maneuvers are performed in order to obtain the desired constellation configuration that satisfies the coverage requirements. In most cases, the single-satellite position is immaterial; rather the relative position between constellation multiple-satellites is to be controlled. This work deals with the solution to the coupled optimization problem of multiple-satellite orbital transfer. The studied problem involves a coupled formulation of the terminal conditions of the satellites. The solution was achieved using functional optimization techniques by a combined algorithm. The combined algorithm is based on the First Order Gradient and Neighboring Extremals algorithms. An orbital transfer optimization tool was developed. This software has the ability to consider multiple satellites with coupled terminal conditions. A solution to a multiple-satellite orbital transfer optimization problem is presented in this paper. A comparison of this solution to the uncoupled case is presented in order to review the benefits of using this approach. It is concluded that the coupled transfer maneuver solution approach is more computationally efficient and more accurate. This approach is especially valuable in cases where the optimal solution cannot be intuitively deduced and in cases where there are specific constraints on each satellite in the constellation. Numerical solution for a number of representative cases will be presented. There are additional prospects of evolution of this approach to include orbital perturbations, coupled state variables, etc.