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SHOOTING APPROACH IN OPTIMIZED BOUNDARY VALUE ORBIT DETERMINATION

Abstract

Space debris is becoming a major threat for functional spacecraft. The debris population needs to be monitored and catalogued to better characterize the space environment. Optical surveys is one mean to get information about its population distribution. The observations acquired in optical surveys are sparse and cover a very small part of the orbit, hence the initial orbit determination becomes challenging. Commonly, two observation series are associated together to find out if they belong to the same object and an initial orbit is computed. The latter can be performed using the Optimized Boundary Value Initial Orbit Determination (OBVIOD) approach, which is an existing method to associate short-arc angles-only observations. In the original version of this method, the initial orbit determination takes place by solving the Lambert's problem with a model assuming pure Keplerian orbits without including perturbations. In this work, to include the latter we use a so-called shooting scheme. This approach takes a hypothesis at the initial boundary and propagates it to the second boundary, where the computed value and the original boundary value are compared. The hypothesis, which gives the desired output at the second boundary, is accepted as the solution. In the proposed algorithm, the propagation from the initial boundary to the final one involves perturbations such as solar radiation pressure, solar and lunar gravitational forces. A root-finding Newton method is used inside the shooting iteration. An additional difficulty in the proposed algorithm arises in multi-revolutions scenarios, where multiple solutions of the Lambert problem are possible. Tests were done using simulated short-arc angles-only observations, separated by single or multiple revolutions, and different area-to-mass ratio values for the observed objects. The performance of the orbit determination procedure is evaluated in the different scenarios.