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PERTURBED LAMBERT'S PROBLEM SOLVER BASED ON DIFFERENTIAL ALGEBRA OPTIMIZATION

Abstract

Classical Lambert's problem is an astrodynamical problem implemented in industrial and scientific softwares to solve this specific two-boundary value problem under the hypothesis of a Keplerian dynamic. To design optimal trajectories or to compute initial guess for least-square orbit determination problems,it must be solved and implemented. Earlier works develop numerical and analytical techniques to solve the classical Lambert's problem in the mono-revolution and multi-revolution cases. On the one hand, this results in fast-computing and efficient methods that is employed in state-of-the-art softwares. On the other, the dynamical model is simplistic and the actual final position of the satellite differs of several kilometers once the revolutions number increases. A way to obtain a more close-to-reality solution is to consider a more complete dynamical model by taking into account orbital perturbing forces such as aerodynamic drag and perturbing gravity potential. As previously-introduced algorithms do not consider a perturbed dynamics, this paper develops an optimization algorithm based on the Taylor Differential Algebra to solve the perturbed Lambert's problem. The operations defined in the algebra allow to compute the polynomial approximation of the final state propagation as a function of the initial state to be computed. This polynomial expansion is used to reduce the final position error as in thrust-region optimization. A wide range of numerical simulation is performed in order to have a clear view of the algorithm performances. Test cases have been chosen between the main orbit families (LEO, MEO, GEO, HEO and GTO) in order to have a complete and clear overview of the developed algorithm. Moreover the infuence of the polynomial order is studied and a preference expansion order is selected to maximize the performance index. Obtained results are promising and further development are proposed to increment algorithm performances.