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BOUNDARY-VALUE PROBLEM OF TISSERAND-LEVERAGING TRANSFERS

Abstract

Achieving low-cost interplanetary and inter-moon tour missions is indispensable in the field of spacecraft trajectory design. Tisserand-leveraging transfers (TILTs) have been proposed to compute a leveraging maneuver between two flybys, which use the circular, restricted, three-body problem (CR3BP) model. As TILTs take a higher accuracy and are more suitable for gravity-assisted trajectory design than V-infinity leveraging transfers (VILTs), we formulate this technique into a boundary value problem, which is similar to the Lambert problem, for conveniently solving potential low-cost transfer orbits. In the formulation of the boundary value problem, there are two major difficulties compared with the previous one based on VILTs. First, the CR3BP trajectory cannot be analytically propagated. Second, the end position of the Jovian transfer is no longer the same as the target moon's position. To overcome these difficulties, the transfer from an apogee or perigee of the Jovian orbit towards the target moon is described by the position of the apogee or perigee, the periapsis during the moon flyby, and the phase angle of the Jovian orbit transfer. Then, the artificial neural networks (ANNs) are employed to model the boundary problem solution of this orbit transfer. Thereafter, based on the trained ANN model, the boundary value problem of the TILTs can be formulated and efficiently calculated. The proposed method is expected to be validated by simulation examples of designing Jovian moon tour legs.