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ARTIFICIAL NEURAL NETWORKS BASED JOVIAN-MOON THREE-BODY FLYBY MODEL

Abstract

Multiple Jovian moon flybys are common and essential for orbital transfers in Jupiter system exploration missions because the fuel consumption can be greatly reduced. Due to the complex dynamic model of Jupiter system, the traditional patched-conic method using the influence sphere model method is difficult to meet the accuracy requirements of the preliminary analysis of the missions. In order to improve the preliminary design accuracy and find low-cost transfer trajectories, the restricted three-body model is used for describing the motion during the flybys. However, the restricted three-body problem cannot be solved analytically and requires numerical integration for computation, which requires long computational time for design of complex Jupiter missions. Therefore, this paper proposes to use artificial neural network models to improve the computing efficiency. First, the input parameters and output parameters are selected. The grid density is reduced by selecting appropriate data. Second, the selected data is trained to obtain corresponding weights and deviations, and then a database is established. Then, the output results are mapped from the input parameters through unknown nonlinear functions. Last, an artificial neural network is designed to complete the initial design of the rapid task transfer trajectory that can be achieved with the given initial time and orbital elements. In the numerical simulations, the design of flyby trajectory for Europa exploration is chosen as an example. The simulation results are expected to show that the artificial neural network based model can achieve high accuracy and fast computational speed.