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RE-ENTRY PREDICTION METHOD IN THE CASE OF ATMOSPHERIC DISTURBANCE: THE TIANGONG-1 RE-ENTRY CASE

Abstract

Atmospheric disturbance is one of the most important factors affecting the accuracy of re-entry prediction. Because of the absence of a rigorous physical basis, the atmospheric models are not precise enough. It is generally believed that characterizing the atmospheric precisely is not a solvable scientific problem in a short time, but it is reasonable to solve a practical problem using the statistical characteristics of the atmospheric model error. We present a novel re-entry prediction method applying to the case of atmospheric disturbance. Firstly the attitude of the re-entering object is estimated based on the ballistic coefficient results, which is used to determine the timing of the statistical analysis. Then the characteristic of the atmospheric model error changes with disturbance of the upper thermosphere is analyzed, which results a table of ballistic coefficient corresponding to the disturbance level. Finally a time division parameter strategy is used in orbit propagation. The method is testd using TIANGONG-1. The distribution of the thermospheric total mass at middle and low latitudes is analyzed, and the correlation between the atmospheric model error and the atmospheric disturbance is tested. The result shows that the proposed method can effectively improve the accuracy of re-entry prediction when the space environment is disturbed.