

IAF ASTRODYNAMICS SYMPOSIUM (C1)
Interactive Presentations - IAF ASTRODYNAMICS SYMPOSIUM (IPB)Author: Ms. Zhiyuan Cao
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Beijing Institute of Technology (BIT), ChinaANALYSIS OF MULTIPLE GRAVITY-ASSIST OPPORTUNITIES BASED ON FEASIBILITY
DOMAINS**Abstract**

A set of multiple gravity-assist (MGA) opportunities for given sequences and constraints can be predicted by a semi-analytical method featuring feasibility domains rather than optimization. It has been examined that opportunities predicted by the semi-analytical method are conservative and the evolution of feasibility domains reflects the effect of given initial and terminal constraints. In this paper, a detailed analysis of parameters within MGA feasibility domains is carried out, giving a better understanding of the distribution of MGA opportunities. First, the semi-analytical method of MGA opportunity assessment based on feasibility domains is reviewed briefly, including the construction and pruning of feasibility domains, the extraction of relative phases from feasibility domains, and the search for relative phases under the accurate ephemeris. Second, values of parameters (including the length of launch windows, the phase difference, the time of flight, the launch capacity, and etc.) within the set of MGA opportunities and their variation patterns are calculated and analyzed. Third, the possibility and availability of all conservative windows are assessed based on above parameter analysis and examined by accurate trajectory optimizations, taking the Cassini-like mission and the heliopause exploration as examples. The Δv -optimal window is distinguished from redundant windows according to their possibility and availability. The results show that the Δv -optimal MGA window appears in the longest windows predicted by the semi-analytical method for the given MGA sequence. Meanwhile, diverse solutions for a given MGA sequence emerge in conservative windows if the terminal constraint is relaxed. In addition, it is observed that lengths of conservative windows are more closely related to the terminal constraint than the initial constraint. The research in this paper can provide a better understanding of the distribution of MGA opportunities, which distinguishes the Δv -optimal window from the conservative ones, reveals variation patterns of trajectory parameters within feasibility domains, and illustrates the effect of the terminal constraint.