INTERNATIONAL CONFERENCE ON HIGH-SPEED VEHICLE SCIENCE & TECHNOLOGY

Author: Prof. Zhanxia Zhu
National Key Laboratory of Aerospace Flight Dynamics,Northwestern Polytechnical University,Xi'an,China, zhuzhanxia@nwpu.edu.cn

Mr. Hongqing Liu
National Key Laboratory of Aerospace Flight Dynamic, Northwestern Polytechnical University, China,18392151125@163.com
Prof. Yuan Jianping
National Key Laboratory of Aerospace Flight Dynamics,Northwestern Polytechnical University,Xi'an,China, jyuan@nwpu.edu.cn

A MULTIOBJECTIVE HYPERSONIC REENTRY TRAJECTORY OPTIMIZATION MODEL

Abstract

Hypersonic vehicles have large advantages in flight speed,defense penetration and flight range,as well as the good prospects in military and civilian aspects.Therefore, hypersonic technology has been developed rapidly in recent years, and become the focus of research gradually.The trajectory optimization technique as a key of hypersonic technology has also been concerned widely.However,the complex environment of reentry process and the dramatic changes in atmosphere bring about many challenges in optimization process.Therefore, a more effective algorithm is very necessary to reentry trajectory optimization.Aiming at the establishment of multi-target reentry trajectory optimization model of hypersonic vehicle, this dissertation carries out the following research contents:

For reentry trajectory optimization problem with multiple objectives and priority,the direct collocation method is adopted to transform motion equations into algebraic constraints,and the varying domain multi-objective optimization algorithm is also introduced to establish the optimizationmodel.Firstly,theoriginal problem is transformed into a nonlinear multi-objective programming with priorities using direct collocation approach.Then,the objectives are fuzzified into fuzzy goals,and the constant tolerance of each objective is substituted by the varying domain.According to the principle that the objective with higher priority has higher satisfactory degree,the priority order is modeled as the order constraints of the varying domain.The corresponding two-side,single-side and hybrid-side varying domain models are presented for different fuzzy relations respectively.By regulating the parameter,optimal reentry trajectory satisfying priority requirement can be achieved.The effectiveness and advantage of the proposed method are verified by simulation.