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UNCERTAINTY-BASED MULTIDISCIPLINARY DESIGN OPTIMIZATION OF LAUNCH VEHICLES

Abstract

This paper based on launch vehicle deterministic optimization model, considering the robustness and reliability of the design, proposes an uncertainty-based multidisciplinary design optimization (MDO) of launch vehicles. This paper proposes a simple design loop of launch vehicles including population, aerodynamic, and trajectory discipline, based on analysis and simplification of the overall design process of launch vehicles. Combined with the analysis models of the three disciplines, establishes the full-system analysis model of launch vehicles, and improves the accuracy by applying DATCOM, which is used to calculate the aerodynamic parameters. The deterministic MDO model of launch vehicles is founded on full-system analysis model. Multi-Island genetic algorithm (MIGA) is introduced in this deterministic MDO model to minimize the take-off mass. Then a gradient analysis method consists of probability theories is used to analyze the uncertainty transfer in this system, the uncertainty-based MDO model is established. The comparison of deterministic MDO model results with uncertainty-based MDO model results shows that the robustness and reliability of uncertainty-based MDO model could be guaranteed.