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TWO STAGES MULTIDISCIPLINARY AND MULTILEVEL DESIGN OPTIMIZATION METHOD AND APPLICATIONS TO HYBRID ROCKET MOTOR POWERED VEHICLES

Abstract

The aerospace vehicles are multidisciplinary systems with multilevel. They consist of subsystems, and subsystems consist of sub-subsystems and so on. Their engineering management organization are often hierarchical corresponding to their system structures. Therefore it is significant to develop the multidisciplinary design optimization (MDO) method which can improve the design level and account for the engineering management organization to promote the engineering management level. In this paper, a two stages optimal strategy for complicated system design optimization is proposed, based on the analysis of the key discipline and the analytical target cascading (ATC) method. In the first phase, the key discipline of the complicated system is defined through the analysis of design requirements and system model, then a single disciplinary optimization method on the key discipline is applied to get an initial design result rapidly. In the second phase, a MDO is conducted based on the initial design result to make the MDO more pertinence and efficiency. The ATC method is introduced in the second phase to account for the engineering management organization characteristic of being hierarchically. It would benefit for the designers to get a better understanding between what the upper system requires and what the lower systems has and thus get a better design result. In this paper, the system multidisciplinary analysis and modeling of a hybrid rocket motor (HRM) powered vehicle are carried out, then the two stage design optimization method is applied on the general design of the HRM powered vehicle. It is shown that the design optimization method can solve the design optimization problems of complicated systems such as aerospace vehicles with high efficiency and level.