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Multi-objective optimization of non-rigid stratospheric airship

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Abstract

Multi-objective optimization of a non-rigid stratospheric airship envelope based on Pareto genetic algorithm is systematically introduced. The simplified Finite Element Model (FEM) of the airship envelope considering aerodynamic forces and static forces is built and Finite Element Analysis (FEA) is conducted. Based on the FEA, multi-objective optimization of the airship envelope is implemented using Pareto genetic algorithm. During the optimization process, the expression of aerodynamic drag force coefficient $C_{D,V}$ of the research airship envelope, which represents the aerodynamic objective, is given out based on the CFD (Computational Fluid Dynamics) simulations. In addition, all the structural objectives including weight, stress and deformation of the envelope are obtained based on the FEA, which has higher accuracy than directly using empirical equations. To intuitively track the convergence of the optimization process, a convergence index is proposed. In a single optimization run, Pareto optimal set can be obtained.