

Multidisciplinary Design Optimization with a New Effective Method

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Abstract: Collaborative optimization (CO) is one of the most widely used methods in multidisciplinary design optimization (MDO), which is an effective methodology to solve modern complex engineering problems. CO consists of two-level optimization problems which are system optimization problem and subspace optimization problem. The architecture of CO can reserve the autonomy of individual disciplines in maximum, while providing a mechanism for coordinating design problem. However, CO has low computation efficiency and is easy to diverge. For the purpose of solving these problems, the former improved methods were studied. The relaxation factors were used to change the system consistency constraints to inequality constraints, or the response surface estimation was used to surrogate the system consistency constraints. However, these methods didn't avoid the computational difficulties very well, furthermore, some new problems arose. The concept of optimum constraint sensitivity was proposed, and the quadratic constraints in system level were reformed. Hence, a new collaborative optimization was developed, which is called system level dynamic constraint collaborative optimization (DCCO). The novel method is able to increase the exchange of information between system level and disciplinary level. The optimization results of each disciplinary optimization can be feedback to system level with the optimum constraint sensitivity. On the basis of the information, the new system level linear dynamic constraints can be constructed; it is better to reflect the effect of disciplinary level optimizations. The system level optimizer can clearly capture the boundary where disciplinary objective functions become zero, and considerably enhance the convergence. Two standard MDO examples were conducted to verify the feasibility and effectiveness of DCCO. The results show that DCCO can save the solving time, and is much better in terms of convergence and robustness, hence, the new method is more efficient.

Key words: multidisciplinary design optimization (MDO), collaborative optimization (CO), dynamic constraint

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