

系统工程

改进的Pareto多目标协同优化策略

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摘要:

为了提高标准协同优化的收敛性并扩展其多目标优化能力, 将Pareto多目标遗传算法用于协同优化的系统级优化, 提出了一种改进的Pareto多目标协同优化策略 (enhanced collaborative optimization using Pareto multi-objective genetic algorithm, ECO-PMGA)。为了保证非劣解集的Pareto最优性与均匀性, 提出了一种考虑拥挤度的非劣解逐级排序方法。ECO-PMGA采用2-范数形式的学科间一致性约束以提高学科级优化的效率。通过两个典型的优化算例对ECO-PMGA的数值稳定性与搜索Pareto非劣解集的能力进行了检验。研究表明, ECO-PMGA的收敛性与数值稳定性得以显著提高, 而且ECO-PMGA具有良好的Pareto多目标优化能力。因此, ECO-PMGA在复杂耦合系统的多目标优化设计方面具有较高的实用价值。

关键词: 协同优化 Pareto多目标遗传算法 多学科设计优化 Pareto最优

Enhanced Pareto multi-objective collaborative optimization strategy

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Abstract:

In order to improve the convergence performance of standard collaborative optimization strategy and extend its multi-objective optimization compatibility, by adopting Pareto multi-objective genetic algorithm in the system level optimization, an enhanced collaborative optimization using Pareto multi objective genetic algorithm (ECO-PMGA) is proposed. A sequential ranking method considering the crowded degree is developed to ensure the Pareto optimality and even distribution of non inferior solutions. The interdisciplinary consistency constraints of 2-norm format are employed to improve the efficiency of discipline level optimizations in ECO-PMGA. The numerical stability and capability of searching Pareto non-inferior solution set are validated through two typical optimization problems. The results indicate that the convergence of system level optimization and numerical stability of ECO-PMGA are fairly enhanced, moreover, the ECO-PMGA shows a good performance in achieving Pareto optimal set. Accordingly, the proposed ECO-PMGA is practical and valuable for multi-objective optimization problems for complex and coupled systems.

Keywords: collaborative optimization Pareto multi-objective genetic algorithm multidisciplinary design optimization Pareto optimal

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