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Multi-objective Optimization Design for Null-flux Superconducting Electrodynamic Suspension Using NSGA-II and Response Surface Method

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The superconducting magnets (SCMs) and figure-eight coils (FECs) are core components for the null-flux superconducting electrodynamic suspension (NFSEDS). In this paper, the multi-objective optimization design of NFSEDS is investigated to decrease the size of SCM and FEC based on Non-dominated Sorting Genetic Algorithm-II (NSGA-II). Twelve design variables are selected including the size of the FEC and SCM, and the mass of the FEC and SCM are considered as the optimization objectives on the basis of ensuring the original suspension force and the ratio of levitation force to drag force (drag ratio). Meanwhile, the comprehensive sensitive analysis is carried out to stratify the design variables into nonsensitive or sensitive levels on the basis of experiment of design (DOE). Afterwards, the optimized scheme is selected from the Pareto front combined NSGA-II and response surface method, which greatly increased the optimize efficiency. The coupling relationship between the size of the superconducting magnet and its critical current is considered to avoid the quench of superconducting magnet. Finally, the authenticity of optimized results is verified by finite element simulation. The result shows that the mass of the FECs and SCM reduce 12.07% and 33.85% while the suspension force and drag ratio of the NFSEDS increase 20.23% and 7.05%. The optimal method can greatly reduce the mass of the FEC and SCM， and has great significance for design of NFSEDS.

Primary authors: CUI, Libin (Southwest Jiaotong University); WANG, Yiyu (Southwest Jiaotong University); SU, Zhenhua (Southwest Jiaotong University); GONG, Tianyong (Southwest Jiaotong University); LUO, Jun (Southwest Jiaotong University); MA, Guangtong (Southwest Jiaotong University)

Presenter: CUI, Libin (Southwest Jiaotong University)

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