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AN IMPROVED MULTIDISCIPLINARY OPTIMIZATION APPROACH FOR SATELLITE DESIGN

Abstract

With the continuous development of satellite technology and application, there is an urgent demand for low-cost and high efficiency satellite technology. Satellite design is a sophisticated system engineering that needs to be integrated into multiple disciplines, involving orbits, structure, propulsion, posture control, thermal control, power, and so on. These subsystems usually interact with each other and are coupled to each other. The design process needs to be weighed and optimized repeatedly by multiple disciplines, so that the overall performance can be optimized. Satellite design exist a large number of variables, the design space is complex, there are a lot of extreme value point, very difficult to solve. Therefore, the time and money cost of design is very high. For these reasons, Scientists have been looking for new and efficient approaches to design satellites. In the early 1990s, AIAA formally proposed the multi-disciplinary optimization design method, which is a way to optimize the design of complex systems. The optimization design of the overall parameters of the satellite is a typical multidisciplinary optimization design problem. The collaborative optimization method is a distributed and multi-level optimization MDO method for complex system design problems. It decomposes the complex design optimization problem into the optimization problems of various disciplines and a system-level optimization problem. Its outstanding advantage is that it can be designed and optimized in parallel, with strong autonomy. However, the collaborative optimization method can easily fall into the defects such as local optimal or unable to converge, and the calculation is too large. In this paper, a hybrid method is proposed by introducing the teaching and learning optimization algorithm and the heuristic Memetic algorithm to improve the collaborative optimization method. The performance test was carried out with classic benchmarks and the test results proved the effectiveness of the improvement. For earth observation satellite overall parameter design problems, A multidisciplinary optimization model is established to optimize the performance of the earth observation performance, considering the design variables and constraints of several subsystems such as posture control, structure, propulsion, effective load and power supply, and optimizing the design with the improved method. The result shows that the improved method is better than the traditional optimization algorithm. It can effectively reduce the design time and computational cost. The optimization method and model have certain reference value for future satellite design.