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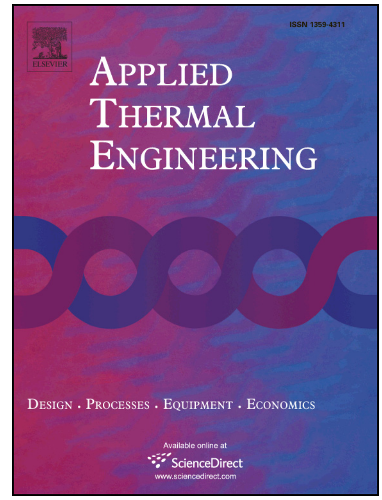

A simulation-based two-step method for optimal thermal design of multiple compartments

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A simulation-based two-step method for optimal thermal design of multiple compartments

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Abstract:

To achieve the target of temperature control with minimum power consumption, a simulation-based two-step method for optimal thermal design of multiple compartments is proposed. First, the flow passages are designed to accomplish the goal of allocating the cooling capacity based on thermal load distribution. Thermal load analysis is performed to obtain an approximate flow rate. Multiple tools, including genetic algorithm(GA), design of experiment(DOE), response surface method(RSM) and computational fluid dynamic(CFD) are coupled to find the approximate solutions of the design variables. These approximate solutions are set as an estimation of the Pareto solutions of the tradeoff between temperature targets and power consumption. Secondly, a multi-objective genetic algorithm and CFD are coupled to find the Pareto solutions. A model of multiple compartments with different thermal loads is evaluated as demonstration. The results reveal that the response surfaces based on a 200% over-determined provide a satisfactory predicting capability. The solution space is greatly reduced in the first step with less computational cost. The approximate solutions obtained from the design of flow passages are an excellent estimation of the optimal solutions. For the second step, the Pareto solutions satisfying the requirement of temperature control are acquired through the evolution of 10 generations.

Keywords: multiple heat sources; multiple flow passages; two-step method; optimal

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