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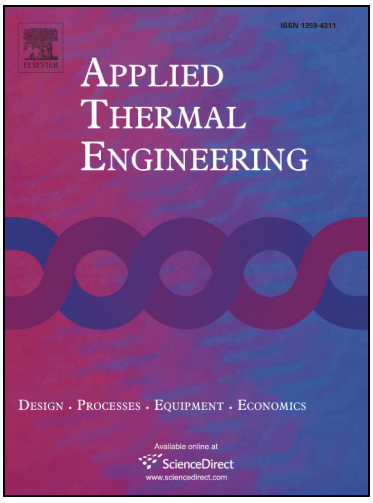

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Multi-objective optimization of cooling galleries inside pistons of a diesel engine

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Abstract

In order to solve a trade-off problem between temperature and thermal stress of pistons for cross section design of a cooling gallery, a multi-objective optimization and a co-simulation workflow are carried out to calculate an optimal design and thermal solutions inside the piston's thermal system of a diesel engine. Six structural parameters are selected as decision variables to describe the cross section shape of the cooling gallery. An oil filling ratio is regarded as an additional variable for finding the optimal volume fracture of the cooling gallery. The objective functions include the maximum temperature and the maximum thermal stress. In order to avoid a new gallery shape over the borders of the piston's cross section, several constraints need to be satisfied in the optimization. Multiple tools of the optimization, including the Sobol Sequence, the Support Vector Machine for regression, a variant of the non-dominated sorting genetic algorithm II, and the k-means clustering method, are integrated together to seek the optimal solutions for the design problem.

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