Abstract Submitted
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Topology optimization of natural convection: Flow in a differentially heated cavity CLIO SAGLIETTI, PHILIPP SCHLATTER, KTH Mechanics, Stockholm, MARTIN BERGGREN, UMU Computing Science, Umeå, DAN HENNINGSON, KTH Mechanics, Stockholm — The goal of the present work is to develop methods for optimization of the design of natural convection cooled heat sinks, using resolved simulation of both fluid flow and heat transfer. We rely on mathematical programming techniques combined with direct numerical simulations in order to iteratively update the topology of a solid structure towards optimality, i.e. until the design yielding the best performance is found, while satisfying a specific set of constraints. The investigated test case is a two-dimensional differentially heated cavity, in which the two vertical walls are held at different temperatures. The buoyancy force induces a swirling convective flow around a solid structure, whose topology is optimized to maximize the heat flux through the cavity. We rely on the spectral-element code Nek5000 to compute a high-order accurate solution of the natural convection flow arising from the conjugate heat transfer in the cavity. The laminar, steady-state solution of the problem is evaluated with a time-marching scheme that has an increased convergence rate; the actual iterative optimization is obtained using a steepest-decent algorithm, and the gradients are conveniently computed using the continuous adjoint equations for convective heat transfer.

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