Topology optimization of transient heat transfer problems using Fourier and Cattaneo idealizations

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Abstract

Most existing investigations on heat transfer problems, see e.g. [1], [2] and [3]. including those that are concerned with thermofluid models, are limited to the stationary case wherein the heat equation does not consider any transient effect. Furthermore, the Fourier conduction law is nearly always adopted that is affected by a non-physical infinite heat propagation velocity. The objective is this paper is therefore twofold:

1. On the one side optimal topologies for heat sink problems are determined that include nonstationarity of the response. The goal function that is minimized if the H_∞-norm of a suitably-computed transfer function that represents the natural extension of the heat compliance to the dynamic case;

2. Also, comparisons between optimal topologies that are based on Fourier (infinite heat propagation velocity) versus Cattaneo (finite heat propagation velocity) are presented in order to assess the important of an accurate model as far as heat propagation phenomena are concerned.

Numerical investigations are presented that are concerned with optimization problems that may be considered benchmarks of the current literature, though investigated in the static regime only thus far.

Keywords: **topology optimization, heat transfer, Fourier and Cattaneo laws**

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