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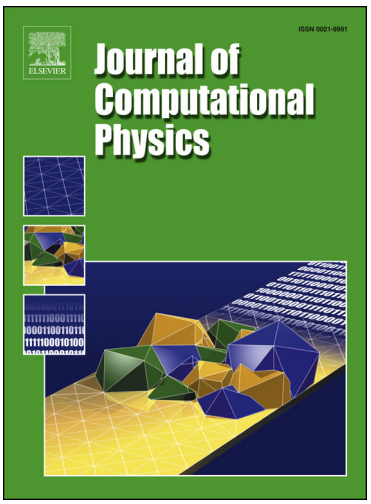

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David J. Munk, Timoleon Kipouros, Gareth A. Vio, Grant P. Steven, Geoffrey T. Parks

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Topology optimisation of micro fluidic mixers considering fluid-structure interactions with a coupled Lattice Boltzmann algorithm

David J. Munk[a,*], Timoleon Kipouros[b], Gareth A. Vio[a], Grant P. Steven[a], Geoffrey T. Parks[b]

[a] *The University of Sydney, Sydney, 2006, Australia*
[b] *University of Cambridge, Cambridge, CB2 1PZ, United Kingdom*

Abstract

Recently, the study of micro fluidic devices has gained much interest in various fields from biology to engineering. In the constant development cycle, the need to optimise the topology of the interior of these devices, where there are two or more optimality criteria, is always present. In this work, twin physical situations, whereby optimal fluid mixing in the form of vorticity maximisation is accompanied by the requirement that the casing in which the mixing takes place has the best structural performance in terms of the greatest specific stiffness, are considered. In the steady state of mixing this also means that the stresses in the casing are as uniform as possible, thus giving a desired operating life with minimum weight.

The ultimate aim of this research is to couple two key disciplines, fluids and structures, into a topology optimisation framework, which shows fast convergence for multidisciplinary optimisation problems. This is achieved by developing a bi-directional evolutionary structural optimisation algorithm that is directly coupled to the Lattice Boltzmann method, used for simulating the flow in the micro fluidic device, for the objectives of minimum compliance and maximum vorticity. The needs for the exploration of larger design spaces and to produce innovative designs make meta-heuristic algorithms, such as genetic

*Corresponding author
Email address: david.munk@sydney.edu.au (David J. Munk)