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Level Set Topology Optimization for Fluid-Structure Interaction

A. Neofytou[1], R. Picelli[2], H. A. Kim[3]

[1] Cardiff School of Engineering Cardiff University, The Queen's Buildings 14-17 The Parade, Cardiff CF24 3AA, United Kingdom, NeofytouA@Cardiff.ac.uk
[2] Cardiff School of Engineering Cardiff University, The Queen's Buildings 14-17 The Parade, Cardiff CF24 3AA, United Kingdom, picellir@cardiff.ac.uk
[3]Structural Engineering Department, University of California, San Diego, 9500 Gilman Drive, San Diego, CA 92093, USA, alicia@ucsd.edu

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This work presents a level set topology optimization method for compliance minimization under design dependent pressure loads. Specifically, the formulation of the level set method for coupled fluid-structure interaction problems is investigated. The main challenge in applying this type of loads to a topology optimization problem is determining the loading surface on which the pressure will act. In traditional density based topology optimization methods, intermediate values of densities for the solid elements arise and this requires extra boundary parameterization schemes [1]. Similarly, the Ersatz material method interpolates the material properties as functions of the local volume ratio of the individual phases [2]. In this work, an approach to overcome this challenge is proposed. The proposed method uses a partially coupled fluid-structure formulation [3], in which pressure loads are modelled by hydrostatic fluid finite elements. This allows the method to be applied to coupled multi-physics optimisation. Numerical results show the feasibility of the proposed approach.

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