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Topology optimization with mixed finite elements on regular grids

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Abstract

Recently, new families of mixed finite elements have been proposed to address the analysis of linear elastic bodies on regular grids adopting a limited number of degrees of freedom per element. A two–dimensional mixed discretization is implemented to formulate an alternative topology optimization problem where stresses play the role of main variables and both compressible and incompressible materials can be dealt with. The structural compliance is computed through the evaluation of the complementary energy, whereas the enforcement of stress constraints is straightforward. Numerical simulations investigate the features of the proposed approach: comparisons with a conventional displacement–based scheme are provided for compressible materials; stress–constrained solutions for structures made of incompressible media are introduced.

Keywords: topology optimization; mixed finite elements; complementary energy; incompressible materials; stress constraints.

1. Introduction

Stress–constrained topology optimization is an effective tool to investigate layouts that are fully feasible with respect to the strength of the material or any prescribed requirement involving the stress field, see e.g. [1, 2, 3]. When addressing a discrete problem of stress–constrained optimal

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