Sensitivity Filters In Topology Optimisation As A Solution To Helmholtz Type Differential Equation

The focus of the study in this article is on the use of a Helmholtz type differential equation as a filter for topology optimisation problems. Until now various filtering schemes have been utilised in order to impose mesh independence in this type of problems. The usual techniques require topology information about the neighbour cells, which is difficult to obtain when the mesh program is separated from the computational code, especially for irregular meshes. The problem becomes even tougher in parallel environments, where the domain is decomposed into multiple non-overlapping partitions. Obtaining information about the neighbour sub-domains is an expensive operation. The proposed filtering technique requires only mesh information necessary for the finite element discretisation of the problem. The main idea is to define the filtered variable implicitly as a solution of a Helmholtz type differential equation with homogeneous Neumann boundary conditions. The properties of the filter are demonstrated for various 2D and 3D topology optimisation problems in linear elasticity, solved on sequential and parallel computers.

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