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Topology Optimization for Maximum Von-Misses Stress Constraint Problems Using the Level Set Method and the KS Function

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Abstract

Recently, topology optimization methods for structural problems have been applied to many industrial applications; however it is difficult to consider local phenomena, such as problems that include a maximum stress constraint. This paper presents a topology optimization method for three-dimensional structural optimization problems that include a maximum von Misses stress constraint, using level set-based structural boundary expressions incorporating a fictitious interface energy model [1]. This topology optimization method can control the geometrical complexity of the obtained optimal configuration, an important factor from an engineering standpoint. First, the level set based-topology optimization method is briefly discussed. A regularization term, based on the Tikhonov regularization method, is introduced to regularize the objective functional. Next, the topology optimization problem including a maximum von Misses stress constraint is formulated, using the Kreisselmeier-Steinhauser function [2] to replace the local constraint problem by a global constraint problem. Based on this formulation, a new topology optimization algorithm for stress-related problems is constructed, using the Finite Element Method (FEM) to solve the governing and adjoint equations and when updating the level set function. Finally, several numerical examples of three-dimensional problems are provided to confirm the validity and utility of the proposed topology optimization method.

References

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