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Topology Optimization of compliant mechanism design using a constraint on the maximum stress

Daniel Milbrath De Leon[1], Joe Alexandersen[2], Jun Sergio Ono Fonseca[1], Ole Sigmund[2]

[1] Federal University of Rio Grande do Sul (UFRGS)
[2] Denmark Technical University (DTU)

Abstract

In this work a stress constraint is added to the classical problem of topology optimization of compliant mechanism design. The optimization problem formulation is written as the output port displacement minimization with a volume constraint, exactly as in [1] along with a restriction on the maximum stress. In addition to the SIMP approach, a projection method is applied together with a density filtering in order to push the design variables into nearly 0-1 values. The constraint on the maximum stress in the domain is applied using a global measure based on a normalized p-norm of the von Mises stresses proposed by [2]. Several examples are performed using different stress limits with the aim of capturing some trends on the addition of a strenght criteria in this classical problem. The results shown that the limitation imposed on the maximum stress helps to alleviate common problems in topology optimization of compliant mechanisms such as one-node and intermediate density hinges. Moreover, a discussion on the advantages and difficulties in using this formulation for topology optimization of compliant mechanism is also included in the paper.

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[2] C. Le, J. Norato, T. Bruns, C. Ha, D. Tortorelli, Stress-based topology optimization for continua, Structural and Multidisciplinary Optimization 41, 605–620, 2010.