Design of compliant mechanisms using topology optimization involving design-dependent effects

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Abstract

This study presents a topology optimization method for compliant mechanisms that accounts for boundary conditions influenced by variables such as thermal convection and pressure load. The objective is to design shapes that balance flexibility and stiffness in environments involving high-temperature fluids. Stress constraints are incorporated to mitigate issues such as stress concentration resulting from excessive flexibility. The method employs a novel approach to setting boundary conditions by integrating fictitious physical problems with level-set functions, allowing for the precise specification of various boundary types across different domains. Initially, a weighted-sum method is used to define the objective function and incorporate key evaluation functions to assess the performance of the thermal actuators. The method is demonstrated through numerical examples that address minimum mean compliance problems under conditions of thermal convection and pressure load, aiming to improve structural deformability while controlling deformation at the target surface plane. The effectiveness of the proposed method is verified through numerical examples under various conditions.

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