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PROCEEDINGS

Concurrent Topology and Fiber Path Optimization for Continuous Fiber Composite Under Thermo-Mechanical Loadings

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ABSTRACT

This presentation introduces a concurrent topology and fiber-path optimization for continuous fiber composite under thermos-mechanical loadings. The optimization goal is to minimize the structural compliance of composite with thermos-mechanical coupling while satisfying volume fraction constraint, and ensuring the manufacturability by using continuous fibers and avoiding the appearance of over thin members. Level-set function is utilized to represent both shape boundary and fiber path. The zero iso-contour of level-set function is updated using a shape sensitivity analysis for anisotropic composite, and fiber paths in shape are given by level-set functions determined from shape boundary. A level-set-based mesh evolution method is introduced following the classical level-set method based on ersatz-material approach during optimization process to further improve the result's accuracy. A thickness control step based on a variational approach is also incorporated to enlarge the over thin members when they appear to ensure the optimized design manufacturable. The influences of thermal loadings are evaluated by applying different temperature increases to the composites, showing their large impacts on the optimized shapes. The developed algorithm has been applied to several numerical examples to demonstrate its effectiveness, showing that the method is very effective on reducing the structural compliance and ensuring manufacturability of continuous fiber composite.

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