Masters Defense

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USING VIRTUAL TESTING METHODOLOGY FOR TOPOLOGY OPTIMIZATION

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Abstract

Topology optimization has typically been carried out with the intent of maximizing the stiffness or minimizing the compliance of a structure. However, imposing pointwise constraints such a stress or displacement has proven to be difficult with the stiffness or compliance based formulation. In this thesis, the pointwise constraint topology optimization problem is tackled using Virtual Testing (VT) methodology. The prediction of the effective or bulk properties of composite materials (including voids) without actual experimental testing has significant importance in the design of composite structures. A virtual testing methodology has been developed to determine the effective mechanical as well as thermal properties of fiber reinforced composites using finite element analysis. The test results are used in driving topology optimization of isotropic and composite materials where void ratio and volume fraction are design variables. Response surface methodology and virtual testing are used to obtain the effective properties for the various void ratio-volume fraction combinations. Several examples are used to compare the results between compliance-based and pointwise constraint based topology optimization approaches.