Uncertain dynamic response of a simply-supported thin rectangular plate subjected to an impact load

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ABSTRACT

This paper focuses on the transient dynamic analysis of a simply supported thin rectangular plate with uncertain Modulus of Elasticity, subjected to an uncertain impact load. The plate is assumed to be homogeneous and orthotropic. Uncertainty is associated with the Young's modulus of the plate and also with the applied impact load. Two methods viz. adaptive Taylor methods and direct optimization based interval finite element approach are used in the present work to obtain time-history response of the structure with uncertain parameters. In case of first approach, the governing PDE of transverse bending of thin plates is considered. Adaptive Taylor series expansion along with Gradient method based on computation of time-dependent partial derivatives is used on this PDE to determine the bounds on the response as a function of time. In case of second approach based on optimization, the parametric uncertainties are quantified by triangular membership functions based on the fuzzy approach, and the uncertain transient analysis is performed using the alpha-sublevel technique. Newmark's beta method is applied to solve the transient response problem at the core of the analysis. In order to solve the sequence of optimization problems, *fmincon* optimizer from the MATLAB optimization toolbox is used. The present work demonstrates the effectiveness of the direct optimization approach based fuzzy finite element method and adaptive Taylor methods and Gradient method in evaluating the dynamic response of thin rectangular plate with multiple uncertainties.

Keywords: orthotropic plate, Optimization, interval finite elements, adaptive Taylor methods, Gradient method, transient dynamic response.