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Effect of cutout on stochastic natural frequency of composite curved panels

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Abstract

The present computational study investigates on stochastic natural frequency analyses of laminated composite curved panels with cutout based on support vector regression (SVR) model. The SVR based uncertainty quantification (UQ) algorithm in conjunction with Latin hypercube sampling is developed to achieve computational efficiency. The convergence of the present algorithm for laminated composite curved panels with cutout is validated with original finite element (FE) analysis along with traditional Monte Carlo simulation (MCS). The variations of input parameters (both individual and combined cases) are studied to portray their relative effect on the output quantity of interest. The performance of the SVR based uncertainty quantification is found to be satisfactory in the domain of input variables in dealing low and high dimensional spaces. The layer-wise variability of geometric and material properties are included considering the effect of twist angle, cutout sizes and geometries (such as cylindrical, spherical, hyperbolic paraboloid and plate). The sensitivities of input parameters in terms of coefficient of variation are enumerated to project the relative importance of different random inputs on natural frequencies. Subsequently, the noise induced effects on SVR based computational algorithm are presented to map the inevitable variability in practical field of applications.

Keywords: Cutout, composite, support vector regression, random natural frequency, uncertainty quantification, noise