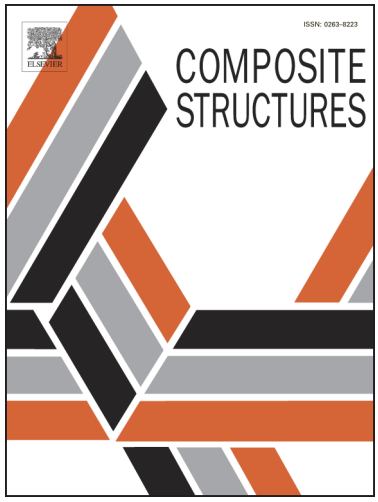

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Rotational and ply-level uncertainty in response of composite shallow conical shells

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Abstract

This paper presents the quantification of rotational and ply level uncertainty of random natural frequency for laminated composite conical shells by using surrogate modelling approach. The stochastic eigenvalue problem is solved by using QR iteration algorithm. Sensitivity analysis is carried out to address the influence of different input parameters on the output natural frequencies. The sampling size and computational cost is reduced by employing the present approach compared to direct Monte Carlo simulation. The stochastic mode shapes are also depicted for a typical laminate configuration. Statistical analysis is presented to illustrate the results and its performance.

Keywords: rotational uncertainty; central composite design method; natural frequency; shallow conical shell; sensitivity analysis; stochastic mode shapes

1. Introduction

Laminated composite shell structures are extensively used in aerospace, marine, automobile industries due to their high strength and stiffness to weight ratios. Modelling realistic composite structures is a numerically demanding task. However, turbomachinary blades such as wind turbine blades can be, as a first approximation, idealised as shallow conical shells in order to simplify the numerical simulation process. The production of shell-like structures is always subjected to large variability due to manufacturing imperfection and