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Design of curved composite panels for optimal dynamic response using lamination parameters

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Abstract

In this paper, dynamic response of composite panels is investigated using lamination parameters as design variables. Finite element analyses are performed to observe the individual and combined effects of different panel aspect ratios, curvatures and boundary conditions on dynamic responses. Fundamental frequency contours for curved panels are obtained in lamination parameters domain and optimal points yielding maximum values are found. Subsequently, forced dynamic analyses are carried out to calculate equivalent radiated power (*ERP*) for the panels under harmonic pressure excitation. *ERP* contours at the maximum fundamental frequency are presented. Optimal lamination parameters providing minimum *ERP* are determined for different excitation frequencies and their effective frequency bands are shown. The relationship between the designs optimized for maximum fundamental frequency and minimum *ERP* responses is investigated to study the effectiveness of the frequency maximization technique. The results demonstrate the potential of using lamination parameters technique in the design of curved composite panels for optimal dynamic response and provide valuable insight on the effect of various design parameters.

Keywords: Optimization, curved composite panels, vibration, fundamental frequency, equivalent radiated power, lamination parameters

1. Introduction

Laminated composites become increasingly widespread due to their high stiffness and strength, low density and directional properties which offer additional potential for design tailoring. These materials are particularly suitable for the construction of shell structures, such as panels of the land, sea and air vehicles [1]. In certain applications, laminated composite panels can be exposed to dynamic excitation which may cause resonances leading to excessive