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Maximization of fundamental frequency of layered composites using differential evolution optimization.

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Abstract

Differential evolution optimization is used to find staking sequences for maximization of the natural frequency of symmetric and asymmetric laminates. Clamped and simply supported boundary condition are considered. A meshless numerical method is used to compute free vibrations of square and rectangular plates. Obtained staking sequences for symmetric laminates are in accordance with the literature. Optimized staking sequences for 8 ply asymmetric laminates are also presented. Asymmetric staking sequences produced higher first natural frequencies. Posterior analysis shows that optimized asymmetric staking sequences are hygrothermally stable.

Keywords: Differential evolution, composite plate, free vibration, optimization, HTCC laminate, RBF method

1. Introduction

To take full advantage of the mechanical properties of fibrous composite materials, fiber orientation within the material can be tailored for custom purposes. Fiber orientation and geometry can influence the mechanical behavior of composite parts, including its behavior under dynamic loading. The stacking sequence of a laminate can then be optimized in order o meet stiffness and strength criteria [1].

For example, the maximization of the natural vibration of a structure is a recurrent problem in mechanical or civil engineering in the context of anti-resonance performance. An historical perspective on optimization of general mechanical structures can be found in [2], from Galileo with a beam design