Optimal stacking sequence of laminated cylindrical panel using genetic algorithm

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Abstract

The study of vibration characteristics of laminated cylindrical panels is of considerable technical significance in the context of modern industry and engineering. This paper presents stacking sequence optimization of laminated cylindrical panel based on the natural frequency. In optimizing process the genetic algorithm is used. The objective is to obtain the maximum possible natural frequency in panel. Layers' thickness are fixed and their angles are specified as design variables. Free vibration analysis is based on three-dimensional theory of elasticity. Cylindrical panel is simply supported at both sides and has infinite length. Numerical examples are presented for two and three layered anisotropic cylindrical panels.

laminated composite structures provide wide domain for engineers and designers to optimize structures for a particular or even multiple objectives. The problems are often formulated as a continuous optimization problem with the thickness and orientation of plies, as design variable [1], but for most particular problems, layers' thickness are fixed and orientations are limited to a set of angles, so the design problem becomes a stacking sequence optimization. The design space usually contains many local extremum, even singular ones and also many near optimum design may exist. Thus, there is a need for optimization techniques that can identify multiple and singular extremum. Optimization methods based on genetic algorithms have been applied to structural problems [2]. In the area of composite structural design. Genetic algorithms are used to optimize the stacking sequence of laminated plates for buckling load [3], to design stiffened composite panels against buckling [4] and to solve the optimal material tailoring problem [5].

In this paper, stacking sequence of laminated cylindrical panel (Fig. 1) is optimized based on natural frequency. In the optimization problem, it is desired to have the maximum possible natural frequency. Layers thickness are fixed and orientations are changed in a set of angles. Laminated cylindrical panel is considered anisotropic with infinitely length and simply supported edges. Free vibration analysis is based on fully three-dimensional elasticity considerations [6].

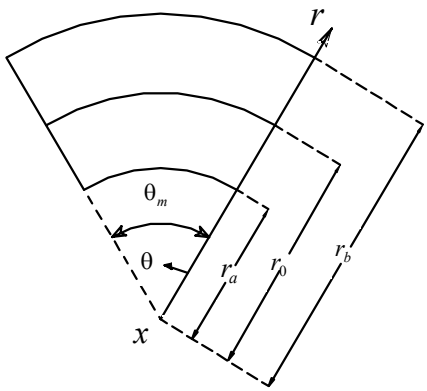

Figure 1: Geometry and coordinate system of laminated panel

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