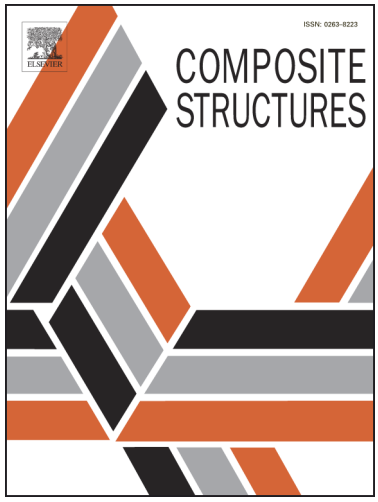

Geometrically Nonlinear Transient Analysis of Moderately Thick Laminated Composite Shallow Shells with Generalized Differential Quadrature Method

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Geometrically Nonlinear Transient Analysis of Moderately Thick Laminated Composite Shallow Shells with Generalized Differential Quadrature Method

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Abstract

In this article, geometrically nonlinear transient analysis of moderately thick laminated composite shallow shells is performed using generalized differential quadrature method. First-order shear deformation theory of doubly curved shells is used to consider transverse shear effect and Von-Karman nonlinear strain-displacement relationships are used to consider geometric nonlinearity due to large displacements. Virtual work principle is used to derive the equation of motion. Partial derivatives in the equation of motion is expressed with generalized differential quadrature method and time integration is carried out using Newmark average acceleration method. Several laminated composite plate, cylindrical and spherical panel problems from the literature are solved with the proposed method. Transient responses are compared with those obtained with other methods in the literature.

Keywords: Generalized Differential Quadrature, Transient Analysis, Geometric Nonlinearity, Laminated Composite Shell, First Order Shear Deformation Theory

1. Introduction

In recent years, composite shell structures are increasingly used in aerospace, civil, automotive, marine and other industries due to its light-weight feature and high strength-to-weight ratio. Therefore understanding the behavior of these structures under common and extreme loading conditions is very important to enable safe and economical designs. Analyses of composite shells are more complicated than other structures due to anisotropic behavior and bending-stretching coupling. There are several books published which cover the mechanical behavior of shell structures (focusing on shallow or deep, thin or thick shells) [1-7].

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