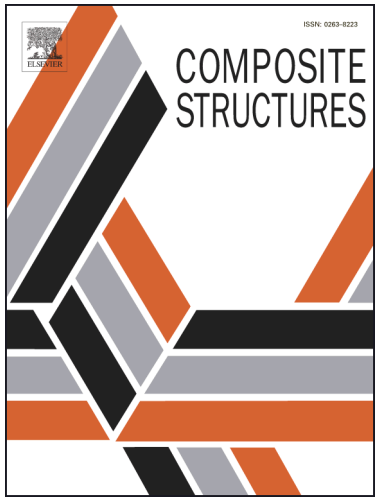

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Pseudo spectral method in nonlinear analysis of relatively thick imperfect laminated plates under end-shortening strain

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Abstract

In this paper, a pseudo spectral approach based on Legendre Basis Functions (LBF) is developed for geometrically nonlinear analysis of laminated composite plates with and without geometric imperfections. Both classical plate theory (CPT) and first- order shear deformation plate theory (FSDT) are investigated and the field variable shape functions are constructed using Point Interpolation Method (PIM). Boundary conditions are enforced easily and directly on each boundary nodes. Due to sharp fluctuations in the boundary conditions and the occurrence of Runge's phenomenon in the case of the uniform points, in the present study the domain is discretized with Legendre-Gauss-Lobatto nodes. The system of equations is introduced by discretizing the von -Karman's equilibrium equations and also boundary conditions with finite Legendre basis functions that are substituted into the displacement fields. The nonlinear system of equations is solved by using the Newton- Raphson technique, and since the number of equations is always more than the number of unknown parameters, the least squares technique is used. Some examples involving various boundary conditions and initial imperfections are solved to demonstrate the validity and capability of the proposed method.

Keywords:

Pseudo spectral method, CPT and FSDT theories, Legendre basis function, Least squares technique, Imperfection, Geometrically nonlinear behavior

1 Introduction

Composite structures find wide applications in aerospace, automobile, and shipbuilding industries, among many others. Rectangular plates supported at edges are one of the most common basic components in composite structures. Plate buckling is a phenomenon which may occur when the plate is subjected to compressive loads in its plane. It is well-known that when a plate structure