

Nonlinear Analysis of Laminated Composite Structures Using A Refined Shell Finite Element

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(Host: Arash Yavari, CE)

Abstract

A shell finite element for the nonlinear analysis of laminated shell structures and through-thickness functionally graded shells will be presented [1-3]. A first-order shell theory with seven parameters is derived with exact nonlinear deformations and under the framework of the Lagrangian description. This approach takes into account shell thickness changes and, therefore, 3D constitutive equations are utilized. A tensor-based finite element formulation is used to describe the deformation and constitutive laws of a shell in a natural and simple way by using curvilinear coordinates. In addition, a family of high-order elements with Lagrangian interpolations is used to avoid membrane and shear locking; no mixed interpolations are employed. Numerical comparisons of the present results with those found in the literature for typical benchmark problems involving isotropic and laminated composite plates and shells as well as functionally graded plates and shells are found to be excellent. These results show the validity of the developed finite element model. Moreover, the simplicity of this approach makes it attractive for applications in contact mechanics and damage propagation in shells.

Bio-Sketch

Dr. Reddy is a Distinguished Professor and inaugural holder of the Oscar S. Wyatt Endowed Chair in Mechanical Engineering at Texas A&M University, College Station, Texas. Dr. Reddy is the author of over 360 journal papers and 16 text books on theoretical formulations and finite-element analysis of problems in solid and structural mechanics (plates and shells), computational fluid dynamics, numerical heat transfer, and applied mathematics. The books authored by Dr. Reddy include: *An Introduction to Continuum Mechanics with Applications*, Cambridge University Press, 2008; *An Introduction to Nonlinear Finite Element Analysis*, Oxford University Press, 2004 *An Introduction to the Finite Element Method*, McGraw-Hill, 1984 (third edition, 2006); *Energy Principles and Variational Methods in Applied Mechanics*, John Wiley, 1984 (second edition 2002); *Applied Functional Analysis and Variational Methods in Engineering*; McGraw-Hill, 1986; *Mechanics of Laminated Composite Plates and Shells: Theory and Analysis*, CRC Press, 1997 (second edition, 2004); and *Theory and Analysis of Elastic Plates and Shells*, Taylor & Francis, 1999 (2nd edition in preparation).

If you would like to schedule a time to meet Dr. Reddy, please contact Arash Yavari, arash.yavari@ce.gatech.edu or Cecelia Jones, Cecelia.jones@me.gatech.edu