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Numerical analysis of mechanical behaviors of FG-CNT reinforced composite plates

Lu-Wen Zhang
Shanghai Ocean University, China

Traditionally, composites are reinforced by glass, carbon, basalt or aramid fibers; these reinforcement materials have been used for decades but the recent discovery of carbon nanotubes (CNTs) has led to a new type of CNT-reinforced composite being considered. Trailed by the concept of functionally graded materials (FGMs), the FG-CNT reinforced composite that has been proposed follows the functionally graded pattern of reinforcement, which is uniaxially aligned in the axial direction with its material properties graded in the thickness direction. In this study, the plate considered is of moderate thickness and, hence, the first-order shear deformation theory (FSDT) and Von Kármán assumption are adopted to incorporate the transverse shear strains, rotary inertia and moderate rotations. An improved moving least-squares (IMLS) approximation for the field variables is proposed for linear and geometrically nonlinear analysis of the studied plates. The modified Newton-Raphson method combined with the arc-length iterative algorithm is employed to solve the nonlinear deformation of the FG-CNT reinforced composite plates. Improvements in computational efficiency and elimination of shear and membrane locking are achieved using a stabilized conforming nodal integration scheme to evaluate the system's bending stiffness. Through detailed parametric studies, CNT distribution, CNTs volume fraction, aspect ratio and thickness-to-width ratio and different boundary conditions are demonstrated to effect significantly on the mechanical behaviors of FG-CNT reinforced composite plates.

Biography

Lu-Wen Zhang currently lectures at College of Information Science and Technology in Shanghai Ocean University. Her research areas are theoretical development and application of numerical algorithms and computational methods for problems in mechanics, mathematics and bioscience. She has published over 50 SCI journal articles and her publications have been cited over 500 times. Her current h-index is 13 (ISI).

lwzhang@shou.edu.cn

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