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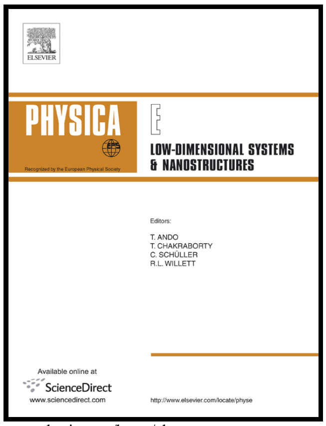

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Nonlocal axial load-bearing capacity of two neighboring perpendicular single-walled carbon nanotubes accounting for shear deformation

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Abstract

This study is devoted to examine load-bearing capacity of a nanosystem composed of two adjacent perpendicular single-walled carbon nanotubes (SWCNTs) which are embedded in an elastic matrix. Accounting for the nonlocality and the intertube van der Waals forces, the governing equations are established based on the nonlocal Euler-Bernoulli, Timoshenko, and higher-order beam theories. These are sets of coupled integro-ordinary differential equations whose analytical solutions are unavailable. Hence, an efficient meshless methodology is proposed and the discrete governing equations are obtained via Galerkin approach. By solving the resulting set of eigenvalue equations, the axial buckling load of the elastically embedded nanosystem is evaluated. The roles of the radius and slenderness ratio of the constitutive SWCNTs, free distance between two tubes, small-scale parameter, aspect ratio, transverse and rotational stiffness of the surrounding matrix on the axial buckling load of the nanosystem are comprehensively addressed. The obtained results can be regarded as a pivotal step for better understanding the mechanism of elastic buckling of more complex systems such as elastically embedded-orthogonal membranes or even forests of SWCNTs.

Keywords: Axial buckling behavior; Two adjacent single-walled carbon nanotubes; Nonlocal beam theories; Modeling of van der Waals forces; Reproducing kernel particle method; Assumed mode method.

1. Introduction

Since the first detection of carbon nanotubes (CNTs) by Radushkevich and Lukyanovich in 1952 [1], their structures had not been carefully engineered and researched until 1991 by

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