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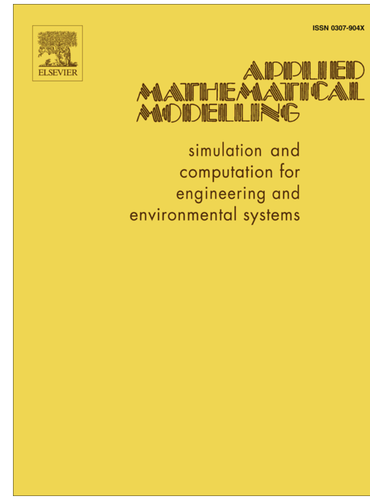

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Free vibration of wavy single-walled fluid-conveying carbon nanotubes under multi-physics fields

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Abstract

Fluid-conveying carbon nanotubes (CNTs) have attracted much attention and have been used in Nano-electromechanical systems (NEMS). In this paper, the free vibration of embedded single-walled fluid-conveying carbon nanotubes (SWCNTs) in magnetic and temperature fields is investigated. The CNTs are modelled as wavy Timoshenko beams. Based on the nonlocal beam theory, the governing equations of motion are derived using Hamilton's principle. These equations are solved by the Galerkin approach, leading to a set of ordinary differential equations from the partial differential equations of motion. Numerical examples are analysed to assess the difference between the present model and some models reported in the published literature and the effects of the nonlocal parameter, the fluid velocity and density, the temperature and magnetic field flux change, and the surrounding elastic medium on the dynamic behaviour of wavy CNTs are discussed. The numerical results validate the analytical model proposed in the present study and lead to conclusions that are potentially useful for the application of fluid-conveying CNTs as NEMS devices.

Keywords: Wavy single-walled carbon nanotubes; Nonlocal Timoshenko beam theory; Conveying fluid; Vibration; Multi-physical fields

1. Introduction

Nano-electromechanical systems (NEMS) have been widely used as sensors, switches, motors, robots, and transducers in physical, chemical, and biological applications, due to their advantages of high sensitivity and fast response [1]. Carbon nanotubes (CNTs), owing to their extraordinary mechanical, electronic, thermal and other physical attributions, have been

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