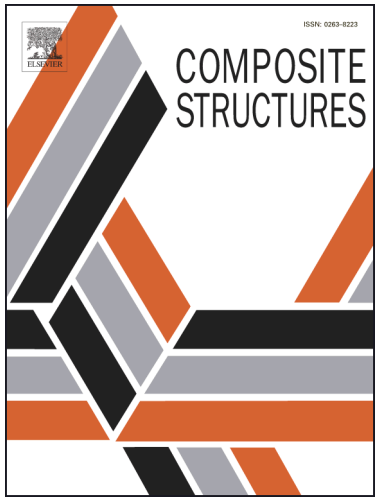

Mesh Free Model of Nanobeam integrated with a Flexoelectric Actuator Layer

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Mesh Free Model of Nanobeam integrated with a Flexoelectric Actuator Layer

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Abstract

This paper is concerned with the development of a mesh free model for the static analysis of smart nanobeams. The top surface of the substrate nanobeam is integrated with a flexoelectric layer which acts as the distributed actuator of the nanobeam. A layer wise displacement theory has been used to derive the model. Both thick and thin substrate nanobeams are considered for presenting the numerical results. The responses of the smart nanobeams computed by the present new mesh free model based on the layer wise displacement theory excellently match with those obtained by the exact solutions. The performance of the active flexoelectric layer either as an axial or as a shear actuator has been investigated. Variation of the control authority of the active flexoelectric layer with its thickness has also been investigated. The model derived here suggests that the mesh free method can be efficiently used for the numerical analysis of smart nanostructures coupled with flexoelectric actuator layer.

Keywords: Flexoelectricity, exact solutions, mesh free model, smart structures, nanobeams

1. Introduction

Research on nanostructures has been extensively being carried out during the last decade for developing micro or nano-electromechanical systems. For example, Peddieson *et al.* [1] analyzed the bending of nanobeams using the concept of nonlocal elasticity. Nilsson *et al.* [2] fabricated and characeterized ultrashort nanocantilevers. Employing the conventional approach of finite element analysis, Bhusan and Agrawal [3] confirmed that an elastic model can be used for the analysis of nanobeams. McFarland and Jonathan [4] investigated the effect of microstructure on the stiffness of microcantilever. Lu et al. [5] carried out static and dynamic analysis of plate like thin-film structure using a generalized thin plate theory. Reddy [6] presented the reformulation of existing beam theories for analyzing nanobeams. Extensive