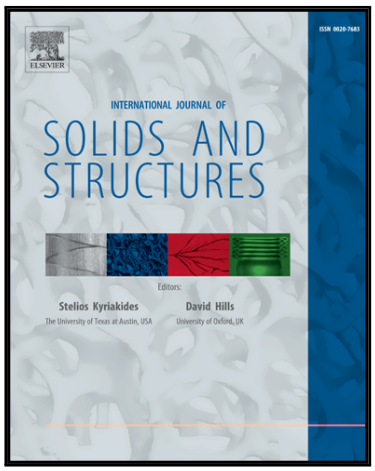

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Modeling of Initially Curved and Twisted Smart Beams Using Intrinsic Equations

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Abstract

The work presented in this paper provides a reliable method to model and analyze smart beams with arbitrary sectional geometries and material properties, including initially curved and twisted beams. It incorporates the modified constitutive equations into the intrinsic equations to formulate a generalized set of solutions applicable for both the actuator and sensor application of piezoelectric smart beams. The radial field problem, sometimes referred to as radially electroded problem, where the potential is applied on the surfaces along the length (i.e., along the reference line) of the smart beam, is considered in the present study. Three different cases of smart beam geometries are discussed to highlight the capabilities of this method. VABS 4.0, a prerelease version of the variational asymptotic cross-sectional analysis tool for composite beams, is used to obtain the intermediate results containing sectional properties, which are used as inputs into the modified intrinsic equations. The main advantage of this method is its ability to quickly and accurately analyze deformation in smart beams. The values of displacements and rotations obtained along the length can be further used to recover the unknown 3D displacements, stresses and electric potentials using recovery relations. Successful verification of results obtained from the linear equations is presented and is accomplished using a commercially available finite element code ABAQUS.

Keywords: Smart Beams, Intrinsic Equations, VABS, Finite Element

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