

On a Model of Layered Piezoelectric Beams Including Transverse Interactions Between Different Layers

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In this paper, models of layered piezoelectric beams are discussed. The influence of hypotheses on three-dimensional sectional deformations and stress distributions on the estimate of the beam electromechanical properties is analysed. By exploiting a mixed variational formulation and Lagrange multipliers method, an Euler-Bernoulli-like beam model which accounts for transverse interactions between different is presented. The fully coupled electromechanical nature of the system is described by including both mechanical and electrical kinematical descriptors and both direct and inverse piezoelectric effects. For a sandwich piezoelectric beam and for a two-layers beam, expressions of the beam constitutive coefficients are provided and the main features of the proposed model are highlighted. Comparisons with experimental data and results from standard modelling approaches are presented. As main peculiarity, the proposed beam model coherently estimates the equivalent piezoelectric capacitance and transverse normal stress distribution also for beam composed by elastic and piezoelectric layers of comparable thickness.

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