7th ECCOMAS Thematic Conference on Smart Structures and Materials
SMART 2015
A.L. Araújo, C.A. Mota Soares, et al. (Editors)

Abstract ID-162

PIEZOELASTIC COMPOSITE PLATE MODELING

Matija Hustić, A.L. Araújo

IDMEC, Instituto Superior Técnico, Universidade de Lisboa, Portugal
aurelio.araujo@ist.utl.pt ; matija.hustic@ist.utl.pt

Keywords: Piezoelasticity, Composite Materials, Finite Element Method

Summary: With the goal of design optimization of vibration attenuators, pressure sensors and various other devices using smart structures based on piezoelastic materials, a working finite element model of such structures is a prerequisite. In this work, which is an extension of a 2005 paper by Vasques, Rodrigues [1] on piezoelectric beams, a composite plate with up to three layers has been modeled by 4-node rectangular shell elements. First order shear deformation kinematics have been assumed and linear elasticity and piezoelasticity theories have been used to model the material behavior. The materials are characterized by their respective stiffness, piezoelectric and dielectric matrices which are then reduced according to the plane stress assumption and the assumption of either vanishing in-plane electrical field or in-plane electrical displacement. Static analysis and modal analyses are performed with various structural and electrical loads. The developed software handles general body and surface loads as well as general electric potential and surface charge distributions. It has also been coded modularly to allow for different types of elements in the same model as well as more complex geometries. The results of analyses of different test cases have then been compared to those obtained using other software tools and results available in the literature. Certain additional steps are undertaken in the direction of incorporating nonlinear elasticity and piezoelasticity as well as curved geometries.

References:

[1] C.M.A. Vasques, J.D. Rodrigues, Coupled Three-Layered Analysis of Smart Piezoelectric Beams With Different Electric Boundary Conditions, Int. J. Numer. Meth. Engng 2005; 62:1488–1518