Modelling Piezoelectric Energy Harvesters by a Finite Integration Technique Formulation for Electro-Mechanical Coupled Problems

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ABSTRACT

Piezoelectric energy harvesters are nowadays an attractive technology for powering sensors. Their industrial application to intelligent tires, i.e. tires equipped with a large number of wireless sensors, is a current research topic. Analytical models are well assessed and important tools for designing and optimizing harvesters [1]. Non-ideal conditions like clamping setup, local variations in geometry and material properties, and residual stress may significantly affect, however, the harvester performance, and in particular its resonance frequency. Therefore, accurate numerical analyses are required.

The Finite Integration Technique (FIT) with piecewise uniform bases leads to consistent and stable schemes [2]. By splitting topological and constitutive relationships FIT formulations are well-suited for analysing coupled problems [3]-[5]. For electro-mechanical coupled problems this splitting can be obtained by reformulating local constitutive relationships in terms of the displacement gradient [6]. In this work a novel FIT formulation for coupled electro–mechanical steady-state or dynamic problems is used for analysing piezo-electric bimorph cantilevers, with a realistic 3-D multi-layered geometry.

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