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PII: S0263-8223(13)00402-9
DOI: http://dx.doi.org/10.1016/j.compstruct.2013.08.005
Reference: COST 5297

To appear in: *Composite Structures*

OPTIMIZATION OF MAGNETO-ELECTRO-ELASTIC COMPOSITE STRUCTURES USING DIFFERENTIAL EVOLUTION

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Summary: Magneto-electro-elastic structures are built from materials that provide them the ability to convert in an interchangeable way, magnetic, electric and mechanical forms of energy. This characteristic can therefore provide an adaptive behaviour to a general configuration elastic structure, being commonly used in association with any type of composite material in an embedded or surface mounted mode, or by considering the usage of multiphase materials that enable achieving different magneto-electro-elastic properties.

In a first stage of this work, a few cases studies will be considered to enable the validation of the model considered and the influence of the coupling characteristics of this type of adaptive structures. After that we consider the application of a recent computational intelligence technique, the differential evolution, in a deflection profile minimization problem. Studies on the influence of optimization parameters associated to the problem considered will be performed as well as the adoption of an adaptive scheme for the perturbation factor. Results are also compared with those obtained using an enhanced particle swarm optimization technique.

Keywords: Structural optimization, differential evolution, magneto-electro-elastic materials, functionally graded structures.

1. INTRODUCTION

Magneto-electro-elastic (MEE) materials exhibit important coupling effects that in different fields of engineering, where the structures require an adaptive behaviour, can be very valuable. The recognition of this importance lead in the recent years to a great investment on the research of these materials and many papers can be found in the literature ranging from the determination of its effective properties to the studies on its magneto-electro-mechanical behaviour when subjected to mechanical, electrical or magnetic loads. Among these works one can refer the one due to [1] which derived analytical solutions for the cylindrical bending of multilayered, linear, and anisotropic magneto-electro-elastic plates under simple-supported edge conditions. Numerical examples for piezomagnetic, two layered piezoelectric/piezomagnetic, and four layered piezoelectric/piezomagnetic plates were presented on that study. A general solution for the plane problem of magneto-electro-elastic media derived in terms of four harmonic functions using strict differential operator theory for the case of distinct material eigenvalues was presented by [2]. To perform the numerical calculations, the authors developed a

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