Marcelo A. Savi
savi@mecanica.ufrj.br
Universidade Federal do Rio de Janeiro
COPPE – Department of Mechanical Engineering
P.O. Box 68.503
21.941.972 Rio de Janeiro, RJ, Brazil

Valder Steffen Jr.
vsteffen@mecanica.ufu.br
Universidade Federal de Uberlândia
School of Mechanical Engineering
Uberlândia, MG, Brazil

Special Issue on Smart Materials and Structures

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Foreword

Smart materials and structures are inspired in nature and try to mimic adaptive characteristics of natural systems. In brief, it is possible to say that smart materials have special properties that couple mechanical and non-mechanical fields, conferring adaptive characteristics.

Smart systems and structures use this kind of material as sensors and actuators. In general there are four major groups of smart materials: piezoelectric, shape memory alloys, magnetostrictive materials, electro-magneto rheological fluids.

Nowadays, several fields of science and technology are exploiting the remarkable properties of smart systems and structures including bioengineering, aerospace engineering, robotics and vibration/shape control. Therefore, several applications have been developed, giving the increasing importance to this kind of system.

In order to consolidate this new design paradigm in Brazil, several research groups from different Brazilian Universities and also international partners created the **National Institute of Science and Technology of Smart Structures in Engineering (INCT-EIE)**. Moreover, the Brazilian community created the **Committee of Smart Materials and Structures of the Brazilian Society of Mechanical Sciences and Engineering (M&EInt/ABCM)**.

In order to celebrate the consolidation of this area in Brazil, we are producing this **Special Issue on Smart Materials and Structures** of the Journal of the Brazilian Society of Mechanical Sciences and Engineering.

This special issue presents a general overview of the activities of the Brazilian community together with the international partners. Applications of piezoelectric materials and shape memory alloys are mainly discussed in the contributions.

Kalamkarov and Savi (2012) presented a review of micromechanical modeling of smart composite structures reinforced by a periodic grid that can exhibit piezoelectric behavior. The asymptotic homogenization is employed.

Trindade and Benjeddou (2012) developed a parametric analysis of effective material properties of thickness-shear piezoelectric macro-fibre composites. Finite element homogenization method is employed evaluating the influence of several parameters on material properties.

Medeiros et al. (2012) presented a procedure to evaluate effective properties on smart composite materials with piezoelectric fibers. Finite element method is applied for unidirectional periodic piezoelectric composites.

Nitzsche (2012) discussed the realization of semi-active actuators employed for application in structural control. The general idea is applied for an actuator using piezoelectric material as adaptive material.

Motter et al. (2012) discussed vibration-based energy harvesting employing piezoelectric materials. Different rectifier circuits are of concern, analyzing numerical and experimental results.

Abreu et al. (2012) presented a discussion about active vibration control of a cantilever beam using a model-based digital controller and piezoelectric sensor and actuators. The main focus of the paper is the design of the controller, showing experimental results that assure its efficacy.

Martins et al. (2012) treated the structural health monitoring for aeronautical applications by using piezoelectric materials. Electromechanical impedance measures are employed to perform nondestructive inspection. The paper discussed a case study of an aluminum aircraft window with satisfactory results.

De Paula et al. (2012) investigated the nonlinear dynamics of large-scale space structures with embedded shape memory alloy actuators. The investigation considered an archetypal model composed of a single mass connected by SMA elements. This system has a complex behavior including chaos. The paper discussed some aspects of the system dynamics giving special attention for the influence of geometrical imperfections.

Lima et al. (2012) discussed the control of a beam using shape memory alloys as actuators. A PI controller is employed to an experimental rig showing its applicability for the deformation control.

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