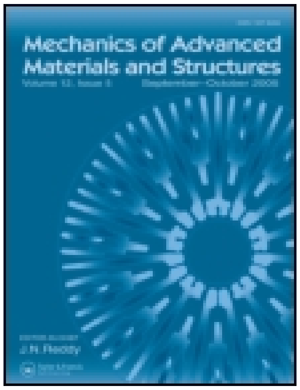

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Modeling and Analysis of Functionally Graded Beams, Plates and Shells: Part II

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[a] This Special Issue is dedicated to the memory of Ettore Antona, Professor of Aircraft Design at the Politecnico di Torino
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GUEST EDITORIAL

Modeling and Analysis of Functionally Graded Beams, Plates and Shells: Part II

Guest Editors
Erasmo Carrera and Salvatore Brischetto

This Special Issue is dedicated to the memory of Ettore Antona, Professor of Aircraft Design at the Politecnico di Torino

This special issue of MAMS collects selected papers on modeling aspects and the analysis of beams, plates and shells embedding functionally graded materials (FGMs). It has been split in two parts, the present volume is related to Part II.

The first paper is devoted to the free vibration analysis of FGM plates; another three papers consider the thermo-mechanical investigation of FGM structures; the last three articles are devoted to static and dynamic analysis of functionally graded piezoelectric and multiferroic material structures subjected to mechanical and electrical loads. A short description of the paper contents follows.

Cinefra and Soave have analyzed the free vibration problem of functionally graded plates. The importance of refined and advanced models is pointed out to obtain a quasi-3D response of the dynamic behaviour of such structures in terms of frequencies. The results are given in closed-form for simply supported plates.

In the paper by Vel, an exact solution has been developed for the thermoelastic analysis of functionally graded, long, hollow cylinders. The functionally graded material is assumed to have temperature-dependent, cylindrical, monoclinic material properties that vary as a function of the radial coordinate. The thermal and mechanical boundary conditions are specified on the inner and outer surfaces of the cylinder. The generality of the analytical solution makes it a useful tool that will enable engineers to develop functionally graded cylinders with superior thermomechanical properties. The behaviour of functionally graded materials under mechanical, thermal and coupled thermo-mechanical stimulation has been investigated in the paper by Leutz and Wallmersperger, where the thermo-mechanical balance equations are discretized and simulated using the finite element method. In the thermal field, the convergence ratio is only dependent on the thermal shape functions and is not influenced by the mechanical ones. In the mechanical field, the maximum possible convergence ratio is only obtained when the thermal shape functions are of the same polynomial order as the mechanical ones. Cavalcante et al. have explored a graded cylinder subjected to transient thermal cyclic loading, which simulates a thermal shock durability test, using the parametric finite-volume theory for functionally graded materials. A major failure mechanism of thermal barrier coatings involves delamination of the ceramic top coat from the substrate; techniques to mitigate this failure mode include grading the transition region between the ceramic top coat and the metallic bond coat by gradually varying the contents of the two phases. The importance of accurately modeling transient effects in thermal shock testing as well as crack-growth management through grading is mentioned.

A three-dimensional finite-element-method formulation has been developed by Wang and Pan to investigate the response of functionally graded material multiferroic composites under different types of loads. Different grading functions correspond to different field responses. Under a mechanical load, the electric displacements and magnetic inductions are more sensitive than the stresses to material grading; under an electric load, on the other hand, material grading affects all field responses. Qian et al. have considered an analytical approach to investigate the existence and propagation behaviour of surface electro-elastic Love waves in an ideally layered structure consisting of a functionally graded piezoelectric substrate and a dielectric layer. The main conclusions are: the effect of the gradient coefficient on the fundamental mode; the gradient coefficient has a strong influence on the electromechanical coupling factor; negative gradient coefficients can change the dispersion state of the fundamental mode. The wave propagation in a functionally graded piezoelectric cylindrical transducer submerged in an infinite fluid medium has been considered by Chen and Bian. In addition to the material anisotropy and electromechanical coupling, the transducer material is also assumed to be functionally graded along the thickness direction. A state-space formulation is developed for the transducer, while the separation of variables method is used to obtain the solution for the ambient fluid. Unlike the fluid-filled case, the existence of an outer fluid provides a medium for scattering wave energy to infinity, causing energy dissipation. The proposed numerical results show that the outer fluid has a certain effect on the dispersion relation of wave propagation in the transducer, especially in the range of low wave numbers.

The papers published in this Special Issue only discuss some of the most significant topics about the modeling and analysis of functionally graded beams, plates and shells. However, the included articles present significant contributions and promising methods.

The Guest Editors would like to take this opportunity to thank all the authors for their valuable contributions as well as the anonymous reviewers for their comments and suggestions.

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