Groupe thématique transverse

« Activités Universitaires en Mécanique »

Annonce de thèse

Yao KOUTSAWA

Laboratoire de Physique et Mécanique des Matériaux
Université Paul Verlaine - Metz

soutiendra pour l'obtention du grade de Docteur de l'Université Paul Verlaine - Metz
Spécialité : *Mécanique*

une thèse ayant pour titre :

MODELISATION ET CONCEPTION MULTI-ECHELLES DES MATERIAUX : DE LA DESCRIPTION ATOMIQUE DISCRETE AUX MODELES DU CONTINU. APPLICATION AUX PROPRIETES AMORTISSANTES DES PARE-BRISES

le lundi 10 novembre 2008 à 14h00
salle Ferrari (ISGMP – Bât. A), UPV-M campus Saulcy

Directeur(s) de thèse : Ms. El Mostafa DAYA et Mohammed CHERKAOUI

Jury :

M. Lahcen AZRAR, Pr, Fac. S&T Tanger
M. Yves H. BERTHELOT, Pr, Georgia Inst. Tech.
M. Olivier POLIT, Pr, Univ. Paris X – Nanterre
M. El Mostafa DAYA, Pr, UPV – Metz
M. Jean-François MOLINARI, Pr, EPF Lausanne
M. Samuel FOREST, Pr, Ecole des Mines de Paris
M. Sonnou TIEM, Pr, Univ. Lomé, Togo
M. Mohammed CHERKAOUI, Pr, Georgia Inst. Tech.

Résumé :

The main objective of this thesis is to develop a multiscale modeling framework that implements hierarchical models from atomistic level modeling to structural level modeling in order to include material creation in the design of the system as a whole for damping applications. Since damping is of interest in this study, we explore some avenues for the design of high loss materials. Thus, a micromechanical model is extended to include frequency dependent material behaviour through the elastic-viscoelastic correspondence principle. The results indicate that with proper choice of viscoelastic material properties, it is possible to have a multiphase viscoelastic composite with a high loss modulus for a wide range of frequencies without substantially degrading the stiffness of the composite. A slightly weakened interface micromechanical model is also extended to investigate imperfect interface effect on damping behaviour of viscoelastic composite materials. In order to investigate the nanosize effect on damping characteristics of nanocomposite materials, we develop and validate an atomistic-continuum interphase model for effective properties of elastic composite materials containing ellipsoidal nano-inhomogeneities. This approach bridges the gap between discrete systems and continuum mechanics. An advantage of this approach is that it is developed from earlier models that consider inhomogeneities shape, thereby enabling both the nano-inhomogeneities sahape and the nano-interphase shape to be simultaneously accounted for in computing the overall composite stiffness with any case of material and surface/interface anisotropies. On structural level, we developed an analytical tool to study the static behaviour of laminated glass beams with silicone material at ends. Two sandwich finite elements have been developed and implemented in MATLAB to study the static and the modal behaviours of viscoelastic sandwich beams and plates with complex boundaries conditions. Based on the automatic differentiation techniques and the asymptotic numerical method, we developed the Diamant MATLAB toolbox which is a powerful tool to investigate many generic nonlinear problems namely the complex non linear eigenvalue problems that arise in the vibration analysis of viscoelastically damped structures. Using all theses numerical tools, we investigate the effects of the materials microstructures on the modal and acoustical properties of the automotive windshield. To finish, this work shows a simple example to conceive the automotive windshield materials microstructures to fulfil four design requirements of the whole windshield structure in service by solving a multi-objectives optimization problem. The specified design requirements for the windshield are to improve its acoustic performances while simultaneously reducing the weight and minimally reducing the in-plane stiffness.

Mots clés : viscoelastic sandwich, damping, micromechanics, nanocomposites, surface excess energy, imperfect interface, automatic differentiation, asymptotical numerical method, MATLAB.

http://www.lpmm.univ-metz.fr/