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Education

2004-2007 **Ph.D. thesis** in Applied Mathematics at Rennes 1 University.
Adviser : Marc Briane.
Title : *Some problems of low and high contrast homogenization.*
(see details in the section Research)
The jury of the thesis :
Doina Cioranescu (Referee), Gilles Francfort (Referee), François Murat, Éric Bonnetier, François Castella, Pierre Seppecher, Nicoletta Tchou.

2003-2004 **Master's Degree** in Analysis and Numerical Analysis at Rennes 1 University.
Post-graduate Dissertation : "Introduction to H-measures theory and application to small amplitude homogenization formulas", from a paper of Luc Tartar.
Adviser : Marc Briane.

2002-2003 **Master's Degree** in Mathematics at Rennes 1 University.
Master's Degree Dissertation : "Introduction to differential Galois theory".

2001-2002 **First Degree** in Mathematics at Université du Maine.

1999-2001 **D.E.U.G.** (Mathematics, Physics and Computer science), at the Université du Maine.

Professional experience

2007-2008 Temporary Teaching and Research Associate at Rennes 2 University.

2004-2007 Allocataire Moniteur at the INSA of Rennes.

Publications

- M. Briane, D. Manceau & G.W. Milton, "Homogenization of the two-dimensional Hall effect", *J.* Math. Ana. App. 339 (2008), pp. 1468-1484.
- M. Briane & D. Manceau, "Duality results in the homogenization of two-dimensional high-contrast conductivities", accepted and to appear on NHM.
- D. Manceau, "Small amplitude homogenization applied to models of non-periodic fibered materials", *M2AN Math. Model. Numer. Anal.* 41 (2007), no. 6, pp. 1061-1087.

Conferences, seminars and summer schools

- *Homogénéisation à faible contraste de matériaux fibrés non périodiques.* Groupe de Travail Numérique du Laboratoire de Mathématique d'Orsay, Université Paris-Sud 11, February 13, 2008.
- *Homogénéisation à faible contraste de matériaux fibrés non périodiques.* Groupe de travail "Homogénéisation et échelles multiples", Laboratoire Jacques-Louis Lions, Université Paris 6, January 07, 2008.
- *Introduction à la théorie de l'homogénéisation et applications.* Rencontres Doctorales de Mathématiques, Rennes, May 11-12, 2006.
- *Comparison of two models of non-periodic fibrous materials in small amplitude homogenization.* Workshop INDAM "Recent Advances in Homogenization" Rome, Italie, May 23-27, 2005.

Computer skills

- Use of computer operating systems : Unix, Linux, Windows.
- Programming languages : Fortran, Java, C++ , HTML.
- Mathematical software : Maple.
- Word processors : Word, LaTeX.

Research

In the mechanical study of a composite, the determination of the behaviour law can be too complex for a numerical treatment due to the high heterogeneities of the medium. The goal of homogenization is to give an equivalent homogeneous behaviour law when the size of the heterogeneities tends to zero. Then we seek to determine if the homogenized problem obtained is of the same type than the initial one. In others words, we seek if

we have compacity of the sequence of behaviour laws at the microscopic scale. In the case of conduction and linear elasticity equations, Murat and Tartar have shown, through the H-convergence theory, that we have a compacity result when the sequence of initial behaviour laws is uniformly bounded from below and above.

In my thesis, we study homogenization problems of conduction and linearized elasticity in dimensions two and three.

In dimension 2, we consider problems of low and high contrast. The contrast corresponding to the amplitude between the minimal value and the maximal value of the behaviour law (conductivity or Hooke's law). On the one hand, we treat of the homogenization of the Hall effect which is a perturbation problem of a conductor medium by a low magnetic field and so can be interpreted as a low contrast problem. We extend Bergman's approach of the periodic case in the framework of H-convergence. Moreover, we obtain a positivity property for the effective Hall coefficient, *i.e.* the sign of the Hall coefficient is conserved by homogenization. On the other hand, we study the inverse case of high contrast problems. Following the recent works of Briane and Casado-Díaz in high conduction, we obtain an original extension of Keller-Dykhne's duality, *i.e.* if a conductivity A_ε has for effective conductivity A_* then $A_\varepsilon^t/\det A_\varepsilon$ has for effective conductivity $A_*^t/\det A_*$, where A^t denotes the transposed matrix of A. As a consequence, we obtain a compacity result for sequences of conductivities which are not necessarily symmetric and not uniformly bounded from below. We also obtain an extension to linearized elasticity of a L^2 compacity result establish by Briane and Casado-Díaz in the conduction case. This result contain additional difficulties due to the fact that Korn's inequality does not hold, in general, for the L^1 norm.

In dimension 3, we consider two non-periodic fibered microstructures modeling cardiac fibers. These models have been obtained by biomechanicians like Peskin and extended by Briane in the rigorous framework of H-convergence. The object of this second part of my thesis is to derive simplified models of those obtained by Briane under some assumptions and which could validate the biomechanics empirical model. On the one hand, we consider the homogenization of the two materials in the case where the behaviour laws of the fiber and the external medium are close. Using Tartar's works on small amplitude homogenization, we obtain simplified homogenized models in conduction and in isotropic linearized elasticity. Moreover, we extend the result of Tartar to anisotropic linearized elasticity, which allows us to obtain a third simplified model which validate the biomechanics one. On the other hand, in conduction, we study the inverse case where the conductivities of the fibers and of the external medium are highly contrasted. We obtain a non-local limit problem in the case of reinforcement by fibers, for which the external medium has a low conductivity. This result extends to non-periodic structures some non-local results obtained for fibered periodic structures by Bellieud and Bouchitté.