SEPTIEMES JOURNEES DES EQUATIONS AUX DERIVEES PARTIELLES
LILLE - LITTORAL - VALENCIENNES
OCTOBER 12–13, 2009:
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PROGRAMME

MONDAY OCTOBER 12, 2009

Chairman: Serge Nicaise (UVHC, Valenciennes, France)

14:00 **BONHEURE Denis**, (ULB, Bruxelles, Belgique)
Ground state and non ground state solutions of some strongly coupled elliptic systems
We discuss two reduction methods for elliptic systems of hamiltonian type. We then use these reductions to deal with existence and multiplicity of solutions and qualitative results such as positivity and symmetry of the ground state solutions. We consider both bounded domains and $\mathbb{R}^N$.
This talk is based on some collaborations with E. dos Santos (Unicamp) and M. Ramos (Lisboa).

14:50 **PIGNOTTI Cristina**, (Università degli Studi di L'Aquila, L'Aquila, Italie)
Existence and exponential estimate for positive solutions of a class of semilinear elliptic equations
We consider the semilinear elliptic problem

$$\begin{cases} \Delta u = W'(u) & \Omega \\ u = 0 & \partial\Omega \end{cases}$$

where $\Omega \subset \mathbb{R}^n$ is a Lipschitz, possibly unbounded, domain and the potential $W \in C^2$ satisfies suitable assumptions.
Under a condition on the *size* of the domain, we deduce the existence of a positive solution satisfying a uniform pointwise estimate. We also extend the analysis to the case of mixed Dirichlet–Neumann boundary conditions.
Joint work with G. Fusco and F. Leonetti.

15:40 **Coffee break**

16:10 **REGNIER Virginie**, (UVHC, Valenciennes)
The Klein-Gordon equation with multiple tunnel effect on a star-shaped network: Expansions in generalized eigenfunctions
We consider the Klein-Gordon equation on a star-shaped network composed of n half-axes connected at their origins. We add a potential which is constant but different on each branch. The corresponding spatial operator is self-adjoint and we state explicit expressions for its resolvent and its resolution of the identity in terms of generalized eigenfunctions. This leads to a generalized Fourier type inversion formula in terms of an expansion in generalized eigenfunctions.

17:00 **MUGNOLO Delio**, (University of Ulm, Allemagne)
Symmetries in evolution equations
The investigation of conserved quantities of differential equations dates back to Emmy Noether's theorem of 1918. Her fundamental result motivates the investigation of continuous symmetries. In the context of evolution equations on infinite-dimensional Hilbert spaces, continuous symmetries often take the form of Lie groups of unitary, bounded linear operators. We will present a class of such symmetries arising in elliptic systems as well as in parabolic network equations.

17:50 **DUJARDIN Guillaume**, (USTL, Lille)
Title to be announced

TUESDAY OCTOBER 13, 2009

Chairman: Thierry Goudon (USTL, Lille, France)

8:45 **XENOPHONTOS Christos**, (University of Cyprus, Nicosie, Chypre)
Finite element methods for a singularly perturbed transmission problem
We consider a one-dimensional singularly perturbed transmission problem with two different diffusion coefficients. The solution will contain boundary layers only in the part of the domain where the diffusion coefficient is high. We derive and analyze various finite element approaches for the approximation of the solution and conduct numerical computations that show the robustness (or lack thereof) of each approach.

9:35 **VENEL Juliette**, (UVHC, Valenciennes)
Mathematical and numerical modelling of crowd motion
We are interested in modelling crowd motion in emergency evacuation. The aim is to propose a mathematical model and a numerical method to handle contacts, in order to deal with local interactions between people and to describe the whole dynamics of the pedestrian traffic. We propose a microscopic model for crowd motion which rests on two principles. On the one hand, each individual has a spontaneous velocity that he would like to have in the absence of other people. On the other hand, the actual velocity must take into account congestion. By specifying the link between these two velocities, the evolution problem takes the form of a first order differential inclusion. Its well-posedness is proved with the help of results concerning sweeping processes by uniformly prox-regular sets. Then we present a numerical scheme and prove its convergence. In order to compute a specific spontaneous velocity (the one directed by the shortest path avoiding the obstacles), we present an object oriented programming to simulate the evacuation of any building consisting of several floors. Furthermore, we describe other choices of spontaneous velocity (for example, by including individual strategies) and we present associated numerical results. These numerical simulations allow us to recover some characteristics of pedestrian traffic.

10:25 **Coffee break**

10:50 **SIRE Yannick**, (Université Aix-Marseille 3, Marseille)
Some topics in harmonic analysis, geometry and PDEs involving fractional order operators
I will describe several contextes in which fractional order operators play an interesting role. In harmonic analysis, fractional powers of Ornstein-Uhlenbeck operators allow to get improved non local Poincare inequalities. In conformal geometry, some non local operators allow to get bounds on the Hausdorff dimension of the singular set of Riemannian metrics. Finally, in PDE theory, fractional operators describe anomalous diffusion. I will describe for these three areas some recent results.

11:40 **RAULT Jean-François**, (ULCO, Calais)
The Fujita phenomenon under dynamical boundary conditions in exterior domains
The Fujita phenomenon for nonlinear parabolic problems $\partial_t u = \Delta u + u^p$ in an exterior domain of $\mathbb{R}^N$ under dissipative dynamical boundary conditions $\sigma\partial_t u + \partial_\nu u = 0$ is investigated in the superlinear case. As in the case of Dirichlet or Neumann boundary conditions, it turns out that there exists a critical exponent $p = 1 + \frac{2}{N}$ such that blow-up of positive solutions always occurs for subcritical exponents, whereas in the supercritical case global existence can occur for small non-negative initial data. The main results concern the case of global existence of

classical solution of the problem

$$\begin{cases} \partial_t u = \Delta u + u^p & \text{in } \overline{\Omega} \times (0,\infty), \\ \sigma \partial_t u + \partial_\nu u = 0 & \text{on } \partial\Omega \times (0,\infty), \\ u(\cdot,0) = \varphi & \text{in } \overline{\Omega}\ . \end{cases}$$

A full answer is given for dimension $N \neq 2$, by using comparison methods and the solution of the Neumann Problem.

12:30 **Lunch**

Chairman: Joachim von Below (ULCO, Calais, France)

14:30 **ROUSSET Mathias**, (USTL, Lille)
Implicit mass-matrix penalization of Hamiltonian dynamics and exact sampling of stiff systems
Dans cet exposé, on rappelera d'abord les méthodes stochastiques (et leurs motivations) utilisées en Dynamique Moléculaire (MD) pour simuler une dynamique ou échantillonner un système Hamiltonien couplé à un thermostat. Les applications les plus importantes pour la pratique seront évoquées. Ensuite on présentera une méthode originale fondée sur une modification implicite de la matrice de masse du système, permettant de traiter efficacement le problème des hautes fréquences des systèmes moléculaires usuels.

15:20 **CUESTA Mabel**, (ULCO, Calais)
Problèmes aux valeurs propres non linéaires pour une classe de systèmes elliptiques dégénérés
Nous étudions le problème aux valeurs propres d'un système non linéaire de paramètres (λ, μ):

$$\begin{cases} -\Delta_p u = \lambda\, a(x)\, |u|^{\alpha_1} |v|^{\beta_1 - 1} v & \text{dans } \Omega\,; \\ -\Delta_q v = \mu\, b(x)\, |v|^{\alpha_2} |u|^{\beta_2 - 1} u & \text{dans } \Omega\,; \\ u = v = 0 & \text{sur } \partial\Omega\,. \end{cases}$$

Ici, $p, q \in (1,\infty)$, Ω est un domaine borné de $\mathbb{R}^N$ avec un bord connexe de classe C^2, $a, b \in L^\infty(\Omega)$, strictement positives dans Ω, et les coefficients α_i, β_i sont des nombres positifs satisfaisant soit $\alpha_1 + \beta_1 = p - 1$ et $\alpha_2 + \beta_2 = q - 1$, ou

$$(p - 1 - \alpha_1)(q - 1 - \alpha_2) = \beta_1 \beta_2\,.$$

Nous montrons l'existence d'une courbe (λ, μ) dans $(0,\infty) \times (0,\infty)$ pour laquelle le système quasilinéaire elliptique possède une solution (u, v) non négative.
Travail en collaboration avec Peter Takáč, Université de Rostock (Allemagne)

16:10 **Coffee break**

16:30 **VAN DER HOUT Rein**, (VU University Amsterdam, Pays-Bas)
Precise results concerning energy concentration events in the radially symmetric harmonic map heat flow from the disk to the 2 - sphere
A harmonic map $u : D^2 \to S^2$ from the two-dimensional unit disk D^2 into the unit sphere S^2 is a stationary point for the energy $\int_{D^2} |\nabla u|^2 dx$, where $|\nabla u|^2 = \sum |\frac{\partial u_i}{\partial x_j}|^2$. In the radially symmetric case, the corresponding gradient flow ("heat flow") is known to exhibit blow-up in finite time, given appropriate initial/boundary conditions. At blow-up, a strictly positive amount ($\geq 4\pi$) of energy is concentrated in the origin. It has been widely believed that the amount of concentrated energy reads precisely 4π. We sketch a proof that this is indeed the case.
This is joint work with M. Bertsch (Roma II) and J. Hulshof (VU Amsterdam).