Problèmes inverses et domaines associés

Workshop GOMS

Jeudi 27 Novembre - Vendredi 28 Novembre 2014
Marseille

Présentation

Dans le cadre du groupe de travail GOMS deux journées tournant autour des problèmes inverses sont organisées à Marseille du Jeudi 27 Novembre au Vendredi 28 Novembre 2014 dans les locaux de la FRUMAM de l'Université d'Aix-Marseille. Ces journées sont organisées par Michel Cristofol et Eric Soccorsi.

Les journées présenteront des communications sur des avancées récentes dans des domaines aux interfaces entre les problèmes inverses, le contrôle et l'analyse des EDP. Elles s'adressent à tous les chercheurs intéressés ou curieux et aux jeunes chercheurs en formation (doctorants et postdoctorants).

Conférenciers

Mourad BELLASSOUED (Université de Bizerte, Tunisie)
Mourad CHOULLI (Université de LORRAINE, METZ)
Eric BONNETIER (Université Joseph Fourier, Grenoble)
Jimmy GARNIER (Université de Savoie, Chambéry)
Hiroshi ISOZAKI (Université de Tsukuba, Japon)
David DOS SANTOS FERREIRA (Université de Lorraine, Nancy)
Morgan MORANCEY (Université d'Aix-Marseille, I2M)
Arnaud MUNCH (Université Blaise Pascal, Clermont-Ferrand)
Masahiro YAMAMOTO (Université de Tokyo, Japon)

Programme

Jeudi 27 Novembre

12h00 – 14h00	**Accueil des participants.**
14h00 – 15h00	**Morgan MORANCEY (Marseille I2M)**
	Simultaneous controllability of 1D bilinear Schrödinger equations .
15h00 – 16h00	**Jimmy GARNIER (Chambery)**
	Inside dynamics of solutions of reaction-dispersion equations.
16h00 – 16h20	**Pause Café- Discussions**
16h20 – 17h20	**David DOS SANTOS FERREIRA (Nançy)**
	Stability estimates for the Calderón problem with partial data.
17h20 ——	**Discussions**
20h00	**Diner au Pavillon flottant : "La Nautique"**

Vendredi 28 Novembre

9h00 – 10h00	**Mourad CHOULLI (Metz)** Stable determination of two coefficients in a dissipative wave equation from boundary measurements
10h – 10h20	**Pause Café**
10h20 – 11h20	**Arnaud MUNCH (Clermont-Ferrand)** Inverse problem for the wave equation via a mixed formulation.
11h20 – 12h20	**Eric BONNETIER (Grenoble)** Electrical impedance tomography under elastic perturbation : a stability result.
12h20 – 14h00	**Déjeuner sur place**
14h00 – 15h00	**Hiroshi ISOZAKI (Tsukuba)** Inverse scattering on non-compact manifold with general metric.
15h00 – 16h00	**Masahiro YAMAMOTO (Tokyo)** TBA.
16h00 – 16h20	**Pause Café- Discussions**
16h20 – 17h20	**Mourad BELLASSOUED (Bizerte)** Stable determination of coefficient in the dynamical Schrödinger equation in a magnetic field.
16h00 – 16h20	**Café- Discussions**

Résumés des exposés

Mourad BELLASSOUED

Title : Stable determination of coefficient in the dynamical Schrödinger equation in a magnetic field.

Abstract : This talk is devoted to the study of the following inverse boundary value problem : given a Riemannian manifold with boundary determine the magnetic potential in a dynamical Schrödinger equation in a magnetic field from the observations made at the boundary.

Mourad CHOULLI

Title : Stable determination of two coefficients in a dissipative wave equation from boundary measurements.

Abstract : I'm interested in the inverse problem of determining both the potential and the damping coefficient in a dissipative wave equation from boundary measurements. I will present some stability estimates of logarithmic type when the measurements are given by the operator who maps the initial conditions to Neumann boundary trace of the solution of the corresponding initial-boundary value problem. The results of my talk were obtained jointly with Kaïs Ammari.

Eric BONNETIER

Title : Electrical impedance tomography under elastic perturbation : a stability result.

Abstract : Perturbing Electrical Impedance Tomography (EIT) measurements by focused ultrasound waves has been proposed as a method to obtain additional information in electrical impedance tomography [1]. Assuming that the local variation of the conductivity is proportional to the amplitude of the elastic perturbation, one asymptotically recovers the pointwise values of the energy density at the center of the perturbation. The inverse problem becomes then one of reconstructing the conductivity from internal measurements. We will discuss how knowledge of such internal data allows for the reconstruction of the conductivity in a stable manner [2].

[1] H. Ammari, E. Bonnetier, Y. Capdeboscq, M. Tanter, and M. Fink. *Electrical impedance tomography by elastic deformation.* SIAM J. APPL. MATH. Vol. 68, No. 6 (2008) 1557-1573.

[2] G. Bal, E. Bonnetier, F. Monard, and F. Triki. *Inverse diffusion from knowledge of power densities.* Inverse Probl. Imag. , Vol. 7, No. 2 (2013) 353-375.

Jimmy GARNIER

Title : Inside dynamics of solutions of reaction-dispersion equations.

Abstract : Solutions of reaction-dispersion equations are commonly used in population dynamics to represent biological invasion or range expansion phenomena which are known to deeply modifies the inside structure of the invading or colonizing species. In this talk, I will present some reaction-dispersion equations with local and nonlocal dispersion terms and either monostable or bistable reaction terms. The goal of the talk is to present a new approach to study the inside dynamics of solutions which propagate in space. I will first focus on the reaction-diffusion traveling wave to present the notion of pulled and pushed traveling waves. Then, I will investigate the integro-diffrential traveling waves and the accelerating solutions of integro-differential equations. We will see that this approach gives some insights on the consequences of range expansion of population on their diversity.

Hiroshi ISOZAKI

Title : Inverse scattering on non-compact manifold with general metric.

Abstract : We consider the scattering theory on a non-compact Riemannian manifold (or orbifold) $\mathcal{M}$ with the following structure :

$$\mathcal{M} = \mathcal{K} \cup \mathcal{M}_1 \cup \cdots \mathcal{M}_{N+N'},$$

where $\overline{\mathcal{K}}$ is compact, $\mathcal{M}_i$ is diffeomorphic to $(1,\infty)\times M_i$, M_i being a compact $n-1$ dimensional manifold (or orbifold) endowed with the metric h_{M_i}. On each end $\mathcal{M}_i$, the metric of $\mathcal{M}$ is assumed to behave like

$$ds^2 \sim (dr)^2 + \rho_i(r)^2 h_{M_i}, \quad r \to \infty,$$

and $\rho_i(r)$ has the form either $A\exp(c_0 r + \beta r^\alpha/\alpha)$, $0 < \alpha < 1$, or Ar^β. Moreover, for $1 \le i \le N$, we assume that $c_0 \ge 0$ and if $c_0 = 0$, then $\beta > 0$, and for $N+1 \le i \le N+N'$, we assume $c_0 \le 0$ and if $c_0 = 0$, then $\beta < 0$. This means that the ends $\mathcal{M}_i$ have regular infinities for $1 \le i \le N$, while they have cusps for $N+1 \le i \le N+N'$. By observing the asymptotic behavior of generalized eigenfunctions at infinity, we introduce the S-matrix, and then solve the inverse scattering problem, i.e. the recovery of the manifold $\mathcal{M}$ from one component of the S-matrix (for all energies) associated with the Laplace operator on $\mathcal{M}$. This is a joint work with Y. Kurylev and M. Lassas.

David DOS SANTOS FERREIRA

Title : Stability estimates for the Calderón problem with partial data.

Abstract : This talk willl present the results that we obtained on the stability of Calderon's inverse conductivity problem with partial data in the context of the uniqueness result obtained by Kenig, Sjöstrand and Uhlmann. These authors proved that the Dirichlet-to-Neumann map measured on the illuminated part of the boundary of an open bounded set Ω in dimension $n \ge 3$ from a source point outside the convex hull of the set suffices to determine the potential q in a Schrödinger equation $-\Delta u + qu = 0$. The aim of our work is to transform this result into a quantitative stability statement. The proof is based on the construction of complex geometrical optics solutions with logarithmic weights introduced by Kenig, Sjöstrand and Uhlmann, but viewed from the recent attempts (of Kenig, Salo, Uhlmann and myself) to tackle the anisotropic Calderón problem. The last part of the argument is based on classical stability estimates on the geodesic ray transform.
This is a joint work with Pedro Caro (Instituto de Ciencias Matematics, Madrid) and ALberto Ruiz (Universidad Autonoma de Madrid).

Morgan MORANCEY

Title : Simultaneous controllability of 1D bilinear Schrödinger equations.

Abstract : In this talk I will consider simultaneous exact controllability of the following bilinear Schrödinger equations

$$\begin{cases} i\partial_t \psi^j(t,x) = (-\partial_{xx}^2 + V(x))\psi^j(t,x) - u(t)\mu(x)\psi^j(t,x), x \in (0,1), \\ \psi^j(t,0) = \psi^j(t,1) = 0, \\ \psi^j(0,x) = \psi_0^j(x), \end{cases} \tag{1}$$

for an arbitrary number of equations i.e. $j \in \{1, \dots, N\}$ for any $N \in \mathbb{N}$. A particular feature of this model is that the control u multiplies the state ψ^j and thus the control problem is nonlinear. After recalling several results and strategies concerning controllability in the case of a single equation ([1], [2]) I will focus on global exact controllability for an arbitrary number of equations. The proof relies on two main steps. First, using a Lyapunov strategy, I will prove a global approximate property. Then, I will prove a local exact controllability property based on Coron's return method and the resolution of an appropriate moment problem. The framework extends previous results even for the case of a single equation. This is a joint work with V. Nersesyan [3].

[1] K. Beauchard and C. Laurent, *Local controllability of 1D linear and nonlinear Schrödinger equations with bilinear control*, J. Math. Pures Appl. (9), **94** (2010), no. 5.

[2] V. Nersesyan, *Global approximate controllability for Schrödinger equation in higher Sobolev norms and applications*, Ann. Inst. H. Poincaré Anal. Non Linéaire, **27** (2010), no. 3.

[3] M. Morancey and V. Nersesyan, *Simultaneous global exact controllability of an arbitrary number of 1D bilinear Schrödinger equations*, J. Math. Pures Appl. (9), *to appear*.

Arnaud MUNCH

Title : Inverse problem for the wave equation via a mixed formulation.

Abstract : We explore a direct method allowing to solve numerically inverse type problems for the wave equation. We first consider the reconstruction of the full solution of the wave equation posed in $\Omega \times (0,T)$ - Ω a bounded subset of $\mathbb{R}^N$ - from a partial distributed observation. We employ a least-squares technic and minimize the L^2-norm of the distance from the observation to any solution. Taking the wave equation as the main constraint of the problem, the optimality conditions are reduced to a mixed formulation involving both the state to reconstruct and a Lagrange multiplier. Under usual geometric optic conditions, we show the well-posedness of this mixed formulation (in particular the inf-sup condition) and then introduce a numerical approximation based on space-time finite elements discretization. We show the strong convergence of the approximation and then discussed several example for $N = 1$ and $N = 2$. The reconstruction of both the state and the source term is also discussed, as well as the boundary case as well as the parabolic case. Joint work in progress with Nicolae Cîndea.

Masahiro YAMAMOTO

Titre : TBA .

Résumé : TBA

Emails des orateurs et organisateurs

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