Les organisateurs remercient les institutions suivantes pour leur soutien financier à ce colloque :

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  Ministère de l'Enseignement supérieur et de la Recherche
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Conférences plénières

HEAT SEMIGROUP, HARMONIC FUNCTIONS AND HEAT FLOWS ON MANIFOLDS BY STOCHASTIC ANALYSIS

Marc Arnaudon
Université de Poitiers

We will present some stochastic analysis and stochastic calculus methods which can be efficiently used to establish results concerning heat semigroups, harmonic functions and heat flows on manifolds. Gradient estimates, Harnack and Li-Yau inequalities for heat semigroups and harmonic functions will be investigated with the help of coupling methods for stochastic processes, changes of probability, analysis on the path space, estimation of quadratic variation of martingales, and the optional stopping theorem for submartingales. We will deduce heat kernel estimates, existence results for Harmonic functions or Harmonic maps between manifolds, characterization of blow-up times for some heat flows. Time reversal of stochastic processes will be an essential tool for determining all bounded harmonic functions in a manifold.

$\rightarrow \infty \diamond \infty \leftarrow$

ON BLOW-UP PHENOMENA FOR NLS ON SURFACES

Valeria Banica
Université d'Evry Val d'Essonne

We will discuss the question of existence of blow-up solutions for the nonlinear Schrodinger equations on surfaces. Part of this is joint work with Remi Carles and Thomas Duyckaerts.

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STABILIZATION BY NOISE OF NAVIER STOKES EQUATION

Viorel Barbu
Université d'Iasi

The Navier-Stokes equations are stabilizable in probability by noise concentrated on arbitrary open subsets of the domain or under certain conditions on discrete subsets or on the boundary. In the latter case, that is of actuation on boundary or on a discrete set of points the stabilization is in distributional sense. The noise controller is robust

$\rightarrow \infty \diamond \infty \leftarrow$

WEYL-PEDERSEN CALCULUS ON COADJOINT ORBITS OF NILPOTENT LIE GROUPS

Ingrid Beltiţă
Institute of Mathematics "Simion Stoilow" of the Romanian Academy

Daniel Beltiţă
Institute of Mathematics "Simion Stoilow" of the Romanian Academy

The talk presents new results on the Weyl correspondence constructed by N.V. Pedersen (Inventiones Mathematicae (1994)) for arbitrary irreducible representations of nilpotent Lie groups. This is a mapping from functions defined on a coadjoint orbit to operators in the space of the corresponding representation. We present the construction of modulation spaces of symbols for this calculus and show some of their basic properties. In the special case of the Schrödinger representation of the Heisenberg group we recover the usual Weyl pseudo-differential calculus, and the classical modulation spaces used in time-frequency analysis.

$\rightarrow \infty \diamond \infty \leftarrow$

NON-LINEAR ELLIPTIC DIFFERENTIAL- FUNCTIONAL EQUATIONS : THE REGULARITY PROBLEM

Pierre Bousquet
Université de Provence Aix-Marseille 1

We present continuity results for non-linear elliptic differential-functional equations of the form div $a(\nabla u) + F[u](x) = 0$, over the functions u $\in W^{1,1}(\Omega)$ that assume given boundary values ϕ on $\partial\Omega$. The vector field $a : \mathbb{R}^n \to \mathbb{R}^n$ satisfies an ellipticity condition and for a fixed x, $F[u](x)$ denotes a non-linear functional of u. In considering the same problem, Hartman and Stampacchia have obtained existence results in the space of uniformly Lipschitz continuous functions when ϕ satisfies the classical bounded slope condition. This last assumption requires in particular that ϕ be linear on the faces of $\partial\Omega$. One may weaken this condition on ϕ and still obtain the existence of a solution in $W^{1,2}(\Omega)$ which is now *locally* Lipschitz in Ω. Moreover such a solution is continuous up to the boundary and satisfies the Dirichlet condition in a classical sense.

$$\rightarrow \infty \diamond \infty \leftarrow$$

ON THE PULLBACK EQUATION

Bernard Dacorogna
Ecole Polytechnique Fédérale de Lausanne

We discuss the existence of a diffeomorphism $\varphi : \mathbb{R}^n \to \mathbb{R}^n$ verifying

$$\varphi^* (g) = f$$

where $f, g \in \Lambda^k (\mathbb{R}^n)$, $2 \leq k \leq n$, are closed differential forms. Componentwise the equation reads as

$$\sum g_{i_1 \cdots i_k} (\varphi (x))\, d\varphi^{i_1} \wedge \cdots \wedge d\varphi^{i_k} = \sum f_{i_1 \cdots i_k} (x)\, dx^{i_1} \wedge \cdots \wedge dx^{i_k} .$$

1) Our main result concerns the case $k = 2$. It generalizes the celebrated Darboux theorem in two directions. First we obtain optimal regularity in Hölder spaces for the local problem and then, under some necessary additional hypotheses, we get global existence as well as regularity. We thus extend to 2−forms the results of Moser and Dacorogna-Moser obtained for the case of volume forms $k = n$.

2) We also obtain local existence for the case $k = n - 1$.

3) Finally we obtain some partial results for the more difficult case $3 \leq k \leq n-2$.

[1] Bandyopadhyay S. and Dacorogna B., On the pullback equation $\varphi^*(g) = f$, *Ann. Inst. Henri Poincaré, Analyse Non Linéaire*, **26** (2009), 1717-1741.

[2] Bandyopadhyay S., Dacorogna B. and Kneuss O., The pullback equation for degenerate forms, *Disc. Cont. Dyn. Syst. Series A*, **27** (2010), 657-691.

[3] Dacorogna B. and Kneuss O., Divisibility in Grassmann algebra, to appear in *Linear and Multilinear Algebra*.

$\rightarrow \infty \diamond \infty \leftarrow$

GÉOMÉTRIE DES ESPACES DE SOBOLEV À COEFFICIENTS VARIABLES: LISSITUDE ET CONVEXITÉ UNIFORME

George Dinca
Université de Bucarest

Soit $\Omega \subset \mathbf{R}^N, N \geq 2$, un domain borné et régulier. On demontre que: (a) si $p \in L^\infty(\Omega)$ et $ess\inf_{x\in\Omega} p(x) > 1$, alors l'espace de Lebesgue généralisé $\left(L^{p(\cdot)}(\Omega), \| \ \|_{p(\cdot)}\right)$ est lisse; (b) si $p \in \mathcal{C}(\bar{\Omega})$ et $p(x) > 1$, pour tout $x \in \bar{\Omega}$, alors l'espace de Sobolev généralisé $\left(W_0^{1,p(\cdot)}(\Omega), \| \ \|_{1,p(\cdot)}\right)$ est lisse. Dans les deux cas, les formules de la dérivée au sens de Gâteaux de chaque norme des espaces ci-dessus sont données; (c) si $p \in \mathcal{C}(\bar{\Omega})$ et $p(x) \geq 2$, pour tout $x \in \bar{\Omega}$, alors $\left(W_0^{1,p(\cdot)}(\Omega), \| \ \|_{1,p(\cdot)}\right)$ est uniformément convexe et lisse.

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CONVERGENCE RATES FOR DISPERSIVE APPROXIMATION SCHEMES TO NONLINEAR SCHRÖDINGER EQUATIONS

Liviu Ignat
Institute of Mathematics "Simion Stoilow" of the Romanian Academy

This talk is devoted to the analysis of the convergence rates of several numerical approximation schemes for linear and nonlinear Schrödinger equations on the real line. Recently, we have introduced viscous and two-grid numerical approximation

schemes that mimic at the discrete level the so-called Strichartz dispersive estimates of the continuous Schrödinger equation. This allows to guarantee the convergence of numerical approximations for initial data in $L^2(\mathbb{R})$, a fact that can not be proved in the nonlinear setting for standard conservative schemes unless more regularity of the initial data is assumed. In a recent joint work we obtain explicit convergence rates and prove that dispersive schemes fulfilling the Strichartz estimates are better behaved for $H^s(\mathbb{R})$ data if $0 < s < 1/2$. Indeed, while dispersive schemes ensure a polynomial convergence rate, non-dispersive ones only yield logarithmic decay rates.

This is a joint work with Enrique Zuazua, Basque Center for Applied Mathematics, Spain.

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HYSTÉRÉSIS EN MAGNÉTOHYDRODYNAMIQUE

Pavel Krejčí
Institut de Mathématiques, Académie Tchèque des Sciences, Prague, République Tchèque

Michela Eleuteri
Università di Trento, Italie

Jana Kopfová
Université de Silésie, Opava, République Tchèque

On se propose de décrire l'écoulement plan d'un fluide conducteur entre deux plaques ferromagnétiques. Le modèle se ramène à un système d'équations aux dérivées partielles en dimension deux, où l'équation de Maxwell pour le champ magnétique aussi bien que l'équation de Navier-Stokes pour la vitesse du fluide contiennent des termes hystérétiques dûs à la réaction ferromagnétique du milieu ambiant. Pour assurer la compatibilité thermodynamique du système, le modèle d'hystérésis utilisé est celui de Preisach. Le résultat principal comporte l'existence et l'unicité des solutions fortes à condition que le champ magnétique ne quitte pas le domaine de convexité de l'opérateur de Preisach.

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MEASURE CONCENTRATION, FUNCTIONAL INEQUALITIES, AND CURVATURE OF METRIC MEASURE SPACES

Michel Ledoux
University of Toulouse

We present a circle of ideas between analysis, geometry and probability theory, around the concentration of measure phenomenon, geometric, information theoretic and functional inequalities, and evolution equations, that led recently to notions of curvature in metric measure spaces

$\rightarrow \infty \diamond \infty \leftarrow$

A DUALITY VARIATIONAL APPROACH TO TIME-DEPENDENT NONLINEAR DIFFUSION EQUATIONS

Gabriela Marinoschi
Institute of Mathematical Statistics and Applied Mathematics, Bucharest, Romania

We formulate a variational principle for time-dependent equations of parabolic type in terms of the Fenchel duality relations. This approach allows us to reduce the parabolic equation to an optimization problem which can be solved via the Ekeland principle.

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WEAK MAJORIZATION PROPERTIES OF STOCHASTIC COMPARISONS

Eugen Păltănea
Transilvania University of Braşov, Romania

Stochastic orderings and their applications, especially in reliability theory, have been treated by numerous researchers in the field of Statistics and Applied Probabilities. Many classical works have established the importance of *Schur majorization* in this area. But, in the last years, has been proved that more refined descriptions of some stochastic ordering properties can be often formulated in the language of adequate weak majorization type orders. Firstly, we refer here to *weak majorization order*,

p-larger order and *reciprocal majorization order*. We review some of these recent characterizations, regarding various well-known stochastic orders. Also, we point out some new ordering properties. Our presentation focuses on the comparison of convolutions and order statistics, with direct applications to the stochastic comparisons of Markov models in reliability theory.

$$\rightarrow \infty \diamond \infty \leftarrow$$

NON-CONVEX VARIATIONAL INEQUALITIES WITH SINGULAR INPUTS AND APPLICATIONS TO STOCHASTIC INCLUSIONS

Aurel Rascanu
"Alexandru Ioan Cuza" University and "Octav Mayer" Mathematics Institute, Iaşi, Romania

An existence and uniqueness result is given for the multivalued differential equation

$$dx(t) + \partial^{-}\varphi(x(t))(dt) \ni dm(t),$$

where $m : \mathbb{R}_+ \to \mathbb{R}^d$ is a continuous function and $\partial^{-}\varphi$ is the Fréchet subdifferential of a semiconvex function φ; the domain of φ can be non-convex, but with some regularity of the boundary. The compactness of the map $m \longmapsto x : C\left([0,T];\mathbb{R}^d\right) \to C\left([0,T];\mathbb{R}^d\right)$ and tightness criteria permit to pass from the deterministic case to a stochastic variational inequality of Ito's type: for all $0 \leq s \leq t$ and $y \in C\left(\mathbb{R}^d;\mathbb{R}^d\right)$,

$$\begin{cases} X_t + K_t = x + \displaystyle\int_0^t b(s, X_s)\, ds + \int_0^t \sigma(s, X_s)\, dB_s, \\ \displaystyle\int_s^t \langle y(r) - X_r, dK_r\rangle + \int_s^t \varphi(X_r)\, dr \leq \int_s^t \varphi(y(r))\, dr \\ \qquad\qquad + \displaystyle\int_s^t |y(r) - X_r|^2 \left(\beta dr + \gamma d\updownarrow K\uparrow_r\right). \end{cases}$$

$$\rightarrow \infty \diamond \infty \leftarrow$$

THE BAROTROPIC MODE FOR THE PRIMITIVE EQUATIONS OF THE ATMOSPHERE AND THE OCEANS

Roger Temam
Indiana University, Bloomington

In this lecture we will derive the equations of the barotropic mode of the primitive equations that are the central equations governing the motion of the atmosphere and the oceans. We will discuss the existence of solutions of the linearized equations which leads to an unusual boundary value problem. We will discuss also numerical simulations of the full nonlinear barotropic mode.

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Sessions spéciales

ROBUSTNESS TO CONTAGION IN FINANCIAL NETWORKS

Hamed Amini
Ecole Normale Supérieure de Paris, INRIA Rocquencourt

Rama Cont
Laboratoire de Probabilités et Modèles Aléatoires, CNRS - Université de Paris, IEOR Department, Columbia University, New York

Andreea Minca
INRIA Rocquencourt, Laboratoire de Probabilités et Modèles Aléatoires, CNRS - Université de Paris

We perform an asymptotic analysis of the magnitude of default contagion, using analytical methods, and derive an expression for the fraction of defaulted nodes in the limit where the number of nodes is large, in terms of the empirical distribution of the in and out-degrees and the proportion of dangerous links in the network. We show that the size of the default cascade generated by a macroeconomic shock may exhibit a phase transition when the minimal capital ratio imposed across financial institutions falls under a certain threshold. This result is used obtain a criterion for the resilience of a large network to macro-economic shocks. Given a macroeconomic stress scenario defined in terms of the magnitude of common shocks across balance sheet, our criterion yields a minimal capital ratio which guarantees stability of the system in the given stress scenario. The asymptotic results are shown to be in good agreement with simulations for networks whose sizes are realistic, showing the relevance of the large network limit for macro-prudential regulation.
Keywords: systemic risk, default contagion, random graphs, stress test, macro-prudential regulation.

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SOME PROPERTIES OF NONLOCAL REACTION-DIFFUSION EQUATIONS FROM POPULATION DYNAMICS

Narcisa Apreutesei
Technical University “Gh. Asachi” Iasi, Romania

Vitaly Volpert
Institute of Mathematics, University Lyon 1, France

We present some results concerning travelling waves for integro-differential equations and systems arising in population dynamics. The integral term describes the nonlocal consumption of resources. Fredholm property of the corresponding linear operators can help to prove the existence of travelling wave solutions. Depending on how the integral appears in the nonlinear term, one can apply different methods to prove the existence of waves. For some models, one studies separately the case when the support of the integral is sufficiently small and carry out numerical simulations if its support is not small. If the support of the integral is small, the integro-differential operator is close to the differential operator and one can make use of the implicit function theorem. For some other models, Leray-Schauder method can be applied. This implies the construction of a topological degree for the corresponding operators and the setting of a priori estimates for the solution. Some biological interpretations follow from these results.

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PITFALLS IN USING WEIBULL TAILED DISTRIBUTIONS

Alexandru V. Asimit
School of Mathematics, The University of Manchester, UK

Deyuan Li
School of Management, Fudan University, China

Liang Peng
School of Mathematics, Georgia Institute of Technology, USA

By assuming that the underlying distribution belongs to the domain of attraction of an extreme value distribution, one can extrapolate the data to a far tail region so that a rare event can be predicted. However, when the distribution is in the domain of attraction of a Gumbel distribution, the extrapolation is quite limited generally in comparison with a heavy tailed distribution. In view of this drawback, a Weibull tailed distribution has been studied recently. Some methods for choosing the sample fraction in estimating the Weibull tail coefficient and some bias reduction estimators have been proposed in the literature. In this paper, we show that the theoretical optimal sample fraction does not exist and a bias reduction estimator does not always

produce a smaller mean squared error than a biased estimator. These are different from using a heavy tailed distribution. Further we propose a refined class of Weibull tailed distributions which are more useful in estimating high quantiles and extreme tail probabilities.

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MULTIGRID METHODS FOR VARIATIONAL INEQUALITIES

Lori Badea
Institut de Mathématiques de l'Académie Roumaine

Nous proposons quatre algorithmes multi-grille pour résoudre les inégalités variationnelles. Le premier algorithme est une itération multi-grille standard du type V-Cycle. Cet algorithme peut être regardé comme une itération multiplicative à chaque niveau de discrétisation et, aussi, une itération multiplicative entre les niveaux. Les trois autres algorithmes proposés sont combinaisons d'itérations additives ou multiplicatives sur les niveaux de discrétisation avec itérations additives ou multiplicatives entre les niveaux. Les algorithmes ont une complexité de calcul optimale et sont donnés pour la minimisation avec contraintes de fonctionnelles non-quadratiques où l'ensemble convexe est du type à deux obstacles. Nous estimons le taux de convergence globale en fonction du nombre de niveaux. Nous avons trouvé, par exemple, que, dans $\mathbf{R}^2$, pour la minimisation de fonctionnelles quadratiques, le premier algorithme a un taux de convergence global de $1 - 1/(1 + CJ^3)$, comme le taux de convergence asymptotique qui existe dans la littérature pour les problèmes complémentaires. Les méthodes sont décrites comme V-Cycles, mais les résultats sont aussi valables pour les itérations plus complexes, du type W-Cycle, par exemple.

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COORDINATE TRANSFORMATIONS AND STABILIZATION OF SOME SWITCHED CONTROL SYSTEMS WITH APPLICATION TO HYDROSTATIC ELECTROHYDRAULIC SERVOACTUATORS

Silvia Balea
University Politehnica of Bucharest

Andrei Halanay
University Politehnica of Bucharest

Ioan Ursu
Elie Carafoli National Institute for Aerospace Research

The main result of the paper is a sufficient condition for existence of controllers that stabilize the zero solution for some switched non-linear control systems in the critical case of a zero eigenvalue in the spectrum of the Jacobian matrix calculated in zero.

In the situation when the relative degree in the equilibrium point is one unit less the order of the system, coordinate transformations allow control synthesis that gives a canonical form of the system to which a Malkin type theorem for switched system can be applied.

An application to a pump controlled electrohydraulic servoactuator is given.

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TUBE ESTIMATES FOR LOCALLY ELLIPTIC ITÔ PROCESSES

Vlad Bally
Université Paris Est Marne la Vallée

We consider Itô processes for which the diffusion matrix is non degenerated in a tube along a differentiable curve. And we derive lower bound for the probability that the process remains in the tube up to a finite time T. Such estimates have a variety of applications, but we focus on the lower bounds for the desnity of a locally elliptic diffusion process - and more generaly, a diffusion process which verifies a certain weak Hörmander condition.

$\rightarrow \infty \diamond \infty \leftarrow$

ON SAINT VENANT'S PRINCIPLE

Cristian Barbarosie
CMAF, Faculdade de Ciências, Universidade de Lisboa

Anca-Maria Toader
CMAF, Faculdade de Ciências, Universidade de Lisboa

A version of Saint-Venant's principle is stated and proven for a scalar elliptic equation in a domain of arbitrary shape, loaded only in a small ball. When the loads are self-equilibrated (that is, having zero integral), the energy stored at a certain distance of the ball is shown to decay (as a function of the radius of the ball) at the rate of a certain power of the radius. An important tool for proving the result is the Poincaré-Wirtinger inequality for functions defined on a sphere; results from spectral geometry are used to determine the constant therein. Some links are pointed out to the bubble method in topology optimization: when a small hole is introduced in a given shape, the difference between the perturbed solution and the unperturbed one satisfies the hypotheses of Saint-Venant's principle.

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UNE MÉTHODE DE CONTRÔLE OPTIMAL POUR LE CONTACT DES POUTRES ÉLASTIQUES

Mikael Barboteu
Université de Perpignan

Mircea Sofonea
Université de Perpignan

Dan Tiba
Institut de Mathématiques de l'Académie Roumaine, Bucarest

Nous considérons un modéle mathématique décrivant l'équilibre d'une poutre élastique en contact avec deux obstacles. Le contact est modélisé à l'aide d'une condition de compliance normale avec pénétration finie. Nous présentons un résultat d'existence et d'unicité de la solution faible en utilisant des arguments de monotonie. Puis, nous retrouvons ce résultat en utilisant des arguments de contrôle optimal. Nous présentons aussi des conditions nécessaires et suffisantes d'optimalité, ainsi qu'un résultat de convergence. Nous adaptons ensuite ces résultats dans l'étude du contact d'une poutre avec un seul obstacle. Pour ce type de problèmes nous présentons deux algorithmes de résolution numériques, dont l'un est basé sur la méthode itérative du contrôle optimal. Ensuite, dans le cadre d'un exemple académique, nous présentons des simulations numériques permettant de comparer les deux méthodes en termes de coût de calcul.

→ ∞ ⋄ ∞ ←

TRANSFERT DE CHAMPS EN MÉCANIQUE NON LINÉAIRE DES STRUCTURES

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Valérie Cano
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Sébastien Meunier
EDF Recherche et Développement

En mécanique des milieux continus, les occasions de transférer des données d'un maillage sur un autre sont nombreuses : études chaînées lors de problèmes multi-physiques, adaptation de maillages lors du suivi de propagation de fissures ou lors des mesures de qualité d'un résultat, approche multi-modèles. Lors d'un calcul par la méthode des éléments finis, en mécanique des structures, deux types de champs sont concernés : ceux connus aux nœuds, comme les déplacements, et ceux connus aux points de Gauss, comme les déformations, les contraintes ou les variables internes (endommagement, déformation plastique cumulée, etc.). Chaque type possède une nature particulière et réclame ainsi un traitement qui lui est propre.

Le transfert de champs soulève deux types de problèmes. Un champ étant connu, aux nœuds ou aux points de Gauss, sur un maillage initial, comment calculer le champ sur le maillage final ? Autrement dit, quel opérateur de transfert utiliser? D'autre part, outre la manière de transférer les champs, se pose la question des propriétés que doivent vérifier ces champs.

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PERIODIC SOLUTIONS FOR BOUNDED PERTURBATIONS OF THE P-LAPLACIAN

Cristian Bereanu
Institute of Mathematics "Simion Stoilow" of the Romanian Academy

In this talk we present some results concerning periodic solutions for bounded perturbations of the p-Laplacian.

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APPLICATIONS OF COMPACT SUPERHARMONIC FUNCTIONS: PATH REGULARITY AND TIGHTNESS OF CAPACITIES

Lucian Beznea
"Simion Stoilow" Institute of Mathematics of the Romanian Academy

We discuss the relations between the existence of the $\mathcal{L}$-superharmonic functions that have compact level sets ($\mathcal{L}$ being the generator of a right Markov process), the path regularity of the process, and the tightness of the induced capacities. We present several examples, mainly in infinite dimensional situations, like the case when $\mathcal{L}$ is the Gross-Laplace operator on an abstract Wiener space. We deduce the càdlàg property of the paths of a class of measure-valued branching process associated with nonlinear operators of the form $\mathcal{L}u+\Phi(u)$, where Φ is a "branching mechanism". The talk includes results from joint works with **Nicu Boboc** and **Michael Röckner**.

$\rightarrow \infty \diamond \infty \leftarrow$

ON A COSSERAT MODEL FOR THIN RODS MADE OF THERMOELASTIC MATERIALS WITH VOIDS

Mircea Bîrsan
University "A.I. Cuza" of Iaşi, Department of Mathematics, Iaşi, Romania

Holm Altenbach
Martin–Luther University, Department of Engineering Sciences, Halle (Saale), Germany

We investigate the mechanics of thin rods modelled by the direct approach. Following an idea initially proposed by the Cosserat brothers, the rod–like body is regarded as a one–dimensional continuum (i.e. a deformable curve) with a triad of rigidly rotating orthonormal vectors (usually called directors) attached to each material point. In this context, we present a model for porous thermoelastic curved rods, having natural twisting and arbitrary shape of cross–section. To describe the porosity, we employ the theory of elastic materials with voids. The basic laws of thermodynamics are applied directly to the one–dimensional continuum and the nonlinear

governing equations are established. We formulate the general constitutive equations and determine the structure of constitutive tensors. We prove the uniqueness of solution to the boundary–initial–value problem associated to the deformation of porous thermoelastic rods, in the framework of linear theory. Also, we establish an inequality of Korn type for this one–dimensional model and we use it to derive existence results. Finally, we consider the case of orthotropic materials and determine the constitutive coefficients for deformable curves in terms of three–dimensional constitutive constants, by means of comparison between exact solutions obtained in the two approaches, for porous thermoelastic rods.

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THE STRUCTURE OF ALPINE PLANT COMMUNITIES: A DATA MINING APPROACH

Voicu Boscaiu
Institute of Mathematical Statistics and Applied Mathematics "Gheorghe Mihoc-Caius Iacob"

Vascular plant species presence/absence data were obtained from 64 plots of $1m^2$ located in Rodna Mountains. The plots were designed as it follows. Four neighbor similar summits were selected; for each summit, in each cardinal compass direction, 4 permanent plots of $1m^2$ were established (at 5m below the peak), giving a total of 16 sample plots on each summit. Each plot was subdivided into 100 10cm $\times$ 10cm cells and the presence of plant species was recorded for each cell. Data were twofold registered in July, years 2000 and 2008. This small-scale spatial design offers useful information on site biodiversity, species clustering, interactions/association/competition among plants (i.e. species), species richness and abundance, etc. The main issues were the study of plant community dynamics, namely testing some hypotheses concerning the effect of climate change on alpine plant biodiversity. We highlighted statistical-significant modification in the cover of alpine-subalpine plant species, the expansion of new species from neighboring sites and the occupation of void niches between the years 2000 and 2008.

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EXACT ASYMPTOTIC BIAS FOR ESTIMATORS OF THE ORNSTEIN-UHLENBECK PROCESS

Denis Bosq
LSTA, Université Pierre et Marie Curie, Paris 6

We study the bias and the bias derivative for a family $\mathcal{F}$ of asymptotically efficient estimators of the Ornstein-Uhlenbeck process. That family contains the maximum likelihood, the conditional maximum likelihood and the empirical estimators.

We show that, if $g(\theta_T)$ is an estimator of $g(\theta)$, where θ is the parameter and $\theta_T \in \mathcal{F}$, then, under mild conditions,

$$T\,E\,[g(\theta_T) - g(\theta)] \longrightarrow_{T\to\infty} c_\theta g'(\theta) + \theta g''(\theta),$$

where c_θ is an explicit constant that only depends on the choice of θ_T.

In particular, if θ_T is one of the three previous estimators, one has

$$T\,E_\theta(\theta_T - \theta) \longrightarrow_{T\to\infty} 2.$$

$$\rightarrow \infty \diamond \infty \leftarrow$$

FORMULATIONS VARIATIONNELLES UTILISANT LES BIPOTENTIELS

Marius Buliga
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Pour mieux comprendre le fonctionnement des méthodes variationnelles proposés dans la littérature des bipotentiels, en partant du travail de Berga et de Saxcé sur le problème d'évolution d'un matériau satisfaisant la loi de Drücker-Prager non associée, nous presentons un algorithme général de résolution du problème discrétisé par rapport au temps, ainsi qu'un principe variationnel fort intéressant.

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HOMOGENIZATION RESULTS FOR ELLIPTIC PROBLEMS IN PERIODICALLY PERFORATED DOMAINS WITH MIXED-TYPE BOUNDARY CONDITIONS

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The asymptotic behaviour of a class of elliptic second-order equations with highly oscillating coefficients, in a perforated domain, is analyzed. We address here the case of an ε periodic perforated structure, with two different types of holes in each period. Depending on the boundary interaction that take place at their surfaces, two distinct conditions, one of Signorini's type and another one of Dirichlet type, are imposed on the corresponding boundaries of the holes. On the exterior fixed boundary of the perforated domain, an homogeneous Dirichlet condition is prescribed.

The main feature of this kind of problems is the existence of a critical size of the perforations that separates different emerging phenomena as the small parameter ε tends to zero. In this critical case, it is shown that the solution of our problem is governed by a new operator, which is the sum of a standard homogenized one and extra terms coming from the particular geometry. The limit problem, expressed in a form a variational inequality, captures the two sources of oscillations involved in this problem, i.e. those arising from the special size of the holes and those due to the periodic heterogeneity of the medium.

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WEYL TRANSFORMS AND THE GENERALIZED HERMITE OPERATOR. THE ABSTRACT CAUCHY PROBLEM FOR THE ABSTRACT HERMITE OPERATOR

Viorel Catana
University Politechnica of Bucharest

We give a formula for the heat kernel of the generalized Hermite operator L^{λ}, on $\mathbb{R}^2$, $\lambda \in \mathbb{R} - \{0\}$. This formula is derived by means of pseudo-differential operators of theWeyl type, i.e.Weyl transforms, Fourier-Wigner transforms and Wigner transforms of generalized Hermite functions, which are the eigenfunctions of the generalized Hermite operators and form an orthonormal basis of $L^2(\mathbb{R}^2)$. By means of the heat kernel, we give a formula for the Green function of $L^{\lambda}, \lambda \in \mathbb{R} - \{0\}$. Using the Green function and the heat kernel we give some applications concerning the global hypoellipticity of L^{λ} in the sense of Schwartz distributions, the ultracontractivity and the hypercontractivity of the strongly continuous one-parameter semigroup $\exp\left(-tL^{\lambda}\right), t > 0, \lambda \in \mathbb{R} - \{0\}$.Using the same technique of the Weyl transforms we give a formula for the inverse of the generalized Hermite operator. By means of this formula we give an estimate for the L^p norm of the solution u of the partial differential equations $L^{\lambda}u = f$ on $\mathbb{R}^2$ in terms of L^2 norm of f , $2 \leq p \leq \infty$.

We also give a formula for the one-parameter strongly continuous semigroup $\exp(-tA)$ generated by the abstract Hermite operator A. The formula is derived by means of the abstract Weyl operators, the abstract Fourier-Wigner operator and the abstract Wigner operators.

$$\rightarrow \infty \diamond \infty \leftarrow$$

COMBINING MIXTURE COMPONENTS FOR CLUSTERING

Gilles Celeux
Inria

Jean-Patrick Baudry
Université Paris 6

Adrian Raftey
Washington University

Model-based clustering consists of fitting a mixture model to data and identifying each cluster with one of its components. Multivariate normal distributions are typically used. The number of clusters is usually determined from the data, often using BIC. In practice, however, individual clusters can be poorly fitted by Gaussian distributions, and in that case model-based clustering tends to represent one non-Gaussian cluster by a mixture of two or more Gaussian distributions. If the number of mixture components is interpreted as the number of clusters, this can lead to overestimation of the number of clusters. This is because BIC selects the

number of mixture components needed to provide a good approximation to the density, rather than the number of clusters as such. We propose first selecting the total number of Gaussian mixture components, K, using BIC and then combining them hierarchically according to an entropy criterion. This yields a unique soft clustering for each number of clusters less than or equal to K; these clusterings can be compared on substantive grounds. We illustrate the method with simulated data and real datasets.

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DERIVED CONES TO REACHABLE SETS OF SEMILINEAR SECOND-ORDER DIFFERENTIAL INCLUSIONS

Aurelian Cernea
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We consider second-order differential inclusions of the form

$$x'' \in Ax + F(t,x), \quad x(0) \in X_0, \quad x'(0) \in X_1,$$

where $F : [0,T] \times X \to \mathcal{P}(X)$ is a set valued map, A is the infinitesimal generator of a strongly continuous cosine family of operators $\{C(t);\ t \in R\}$ on a separable Banach space X and $X_0, X_1 \subset X$ are closed sets and we prove that the reachable set of a certain second-order variational inclusion is a derived cone in the sense of Hestenes to the reachable set of the initial differential inclusion. This result allows to obtain a sufficient condition for local controllability along a reference trajectory.

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ON SPATIAL BEHAVIOR IN A POROELASTIC MATERIAL

Stan Chiriţă
Al. I. Cuza University of Iaşi, Romania

In this paper we consider the state of plane strain in an elastic material with voids occupying a right or curvilinear strip that is maintained in equilibrium under self–equilibrated traction and equilibrated force applied on one of the edges, while the other three edges are traction free and subjected to zero volumetric fraction or zero equilibrated force. Our aim is to derive some explicit spatial estimates describing

how some appropriate measures of a specific Airy stress function and volume fraction evolve with respect to the distance to the loaded edge. The results of the present paper prove how the spatial decay rate varies with the constitutive profile. For the problem corresponding to a right strip or a curvilinear strip loaded on a right edge we are able to establish an exponential spatial decay estimate. While for the problem corresponding to a loaded curved edge we establish an algebraical spatial decay with respect to the polar distance r, provided the angle ω is lower than the critical value $\pi\sqrt{2}$.

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CONVERGENCE OF THE INVARIANT MEASURE FOR NONLINEAR STOCHASTIC EQUATIONS IN VARIATIONAL FORMULATION

Ioana Ciotir

The aim of this work is to investigate the behavior of the invariant measure corresponding to the transition semigroup P_t^α, for nonlinear partial differential equation in variational formulation, perturbed by noise $dX^\alpha(t) + A^\alpha(X^\alpha)\,dt = \sqrt{Q}dW(t)$. We prove that, if we assume to have graph convergence of the sequence of nonlinear operators $\{A^\alpha\}_\alpha$, we get convergence of the corresponding sequence of invariant measures.

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CONTINUUM MODEL OF LATTICE DEFECTS IN FINITE ELASTO-PLASTICITY

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In the paper the models, which describe the behaviour of elasto-plastic bodies with structural inhomogeneities (lattice defects), are developed based on the existence on the second order plastic deformation. The second order plastic deformation is defined as a pair of plastic distortion and plastic connection. The decomposition rule of the second order deformation allow us to introduce the second order elastic deformation associated with the motion and plastic second order deformation.

Lattice defects (see Kröner 1990, 1992), the so-called dislocation, disclination and point defects (extra-matter, vacancies) are mathematically identified in continuum theory as the torsion, curvature and non-metricity of the plastic connection, for the linear approximation see R de Wit (1981). Two types of forces, like micro and micro forces, are introduced as being power conjugated with the rate of elastic and plastic second order deformations. Constitutive and evolution equations are restricted to satisfy the free energy imbalance and balance equations for macro and micro forces, following the procedure developed by Cleja-Ţigoiu (2007).

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NON-LOCAL ELASTO-VISCOPLASTIC MODELS WITH DISLOCATIONS

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Raisa Tichisan
University of Bucharest, Romania

In the paper elasto-viscoplastic models, with non-local evolution equations for the scalar dislocation densities given by Bortoloni and Cermelli (2004), are developed within the constitutive framework of crystal plasticity at large deformations. The behaviour of material is elastic with respect to plastically deformed configuration, the evolution equation for plastic rate are associated with the Schmid activation condition, as in Teodosiu and Sidoroff (1976). The material hardens , with scalar hardening parameters which are dependent on the the scalar dislocation densities. A complet analysis of the elasto-plastic behaviour is performed in a stress controled test for given slip systems. The numerical scheme for non local solutions of the initial and boundary value problems are implemented using Matlab programs. The comparison with approache to local models with dislocations in crystal plasticity, by Teodosiu and Raphanel (1993), are also performed.

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ANALYSE D'UNE CLASSE D'INÉQUATIONS D'ÉVOLUTION IMPLICITES ET APPLICATIONS À DES PROBLÈMES QUASI-STATIQUES DE CONTACT

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Institut de Mathématiques de l'Académie Roumaine, Bucarest, Roumanie

Ce travail concerne l'analyse mathématique et numérique d'un système composé de deux inéquations d'évolution. Cette formulation, qui peut s'écrire également sous la forme d'une inéquation d'évolution variationnelle implicite avec un opérateur non linéaire, permet une approche unifiée de plusieurs problèmes quasi-statiques de contact en élasticité.

En utilisant un schéma implicite de discrétisation en temps, des résultats de convergence et d'existence sont démontrés et des algorithmes de correction par sous-espaces sont introduits et étudiés.

Les résultats précédents sont ensuite appliqués à la résolution d'un problème quasi-statique de contact unilatéral avec frottement non local par des méthodes de Schwarz.

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CONVOLUTION EQUATIONS WITH ALMOST PERIODIC SOLUTIONS

Silvia-Otilia Corduneanu
Gh. Asachi Technical University of Iaşi

Consider a locally compact abelian group G, the space of all almost periodic complex-valued functions defined on G denoted by $AP(G)$ and the space of all almost periodic measures denoted by $ap(G)$. We are looking for almost periodic solutions in the case of equation

$$f(x) = g(x) + \nu * f(x) + M_y[(\varphi \circ f)(xy^{-1})\mu(y)], \quad x \in G.$$

In this context $g \in AP(G)$, $\mu \in ap(G)$, ν is a bounded complex measure and $\varphi : \mathbb{C} \to \mathbb{C}$ is a continuous function.

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MEAN-RISK PORTFOLIO OPTIMIZATION WITH PRINCIPAL COMPONENT ANALYSIS BASED STOCK SELECTION

Silvia Dedu
Academy of Economic Studies, Bucharest

We consider the problem of a decision maker, who is concerned with the management of a single-period portfolio that consists of holdings in N risky assets and is adjusted at the beginning of the time-period. We propose to solve the portfolio optimization problem in two steps: first, for the stock selection phase and second, the asset allocation phase. For the stock selection, we use the principal component analysis to reduce the number of characteristics that will be taken into account. Once the stock selection completed, the optimal portfolio is obtained using an algorithm based on a mean-risk model. We use the Limited Value-at-Risk (LVaR) risk measure, which takes into consideration the values superior to a certain fixed threshold in the extreme tail of the loss distribution. We consider the mean-LVaR model for portfolio selection, which evaluates risk using LVaR. We provide properties of the new mean-risk model and compare it with the classical mean-VaR model. We derive the analytical form of LVaR risk measure in the case of normal distribution.

Acknowledgment. This work was supported by CNCSIS-UEFISCSU, project number 844 PNII - IDEI, code 1778/2008.

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STRUCTURE DE L'ESPACE DES TENSEURS D'ÉLASTICITÉ EN 2D

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Claude Vallée
Laboratoire de Mécanique des Solides, UMR 6610, Université de Poitiers, France

Pour révéler la structure géométrique sous-jacente de l'espace des tenseurs d'élasticité en 2D, on étudie les orbites dans l'espace des composantes du tenseur d'élasticité pour l'action du groupe des rotations planes suivant la règle tensorielle. On identifie un système de paramètres faisant apparaître la décomposition en sous-espaces irréductibles, puis on détermine les invariants de l'orbite. L'espace des orbites est la réunion de 4 variétés de dimensions respectives 5, 3, 3 et 2.

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MINIMISATION LOCALE DE LA FONCTIONNELLE DE GINZBURG-LANDAU AVEC DEGRÉS PRESCRITS

Mickaël Dos Santos
Université Lyon 1

On s'intéresse à la minimisation de la fonctionnelle de Ginzburg-Landau (sans champ magnétique) définie sur un ouvert régulier borné non simplement connexe du plan avec des conditions au bord du type degré.

Contrairement au cas des conditions du type Dirichlet, l'existence des minimiseurs ne peut être obtenue par minimisation directe, car les conditions aux limites sont instables pour la convergence faible dans H^1.

On présente un moyen de rendre le problème compact, obtenant ainsi l'existence de points critiques de la fonctionnelle. Ceci se fait en considérant un outil ad hoc, le degré approché.

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MESURES DE YOUNG EN TANT DE MINIMISEURS RELAXÉS DANS LE CALCUL DES VARIATIONS

Liviu Constantin Florescu
Université "Al. I. Cuza", Iaşi

Le problème standard du calcul des variations est de trouver minimiseurs pour la fonctionnelle $I(u) = \int_\Omega F(t, u(t), \nabla u(t))dt$, où Ω est un domaine borné et ouvert, F est un intégrand de Carathéodory lorsque $u \in W^{1,p}(\Omega)$ satisfait des conditions au bord.

Dans des nombreuses situations (voir, par exemple, des problèmes de type Bolza), le problème n'admet pas de solutions classiques; cela est dû au comportement oscillatoire rapide des suites minimisantes. Ce type de comportement est bien contrôlé en utilisant la technique des mesures de Young, une technique développée par L. C. Young, J. Warga, et, plus récemment, par E. J. Balder, M. Valadier, P. Pedregal, D. Kinderlehrer, T. Roubicek etc.

Dans cette communication, nous présentons des extensions au cas non borné des résultats connu dans le cas borné, dans des conditions où nous disposons d'une bonne maîtrise sur la suite de gradients d'une suite minimisante; un tel contrôle sera assuré en exigeant que la suite de gradients soit Jordan finiment tendue. La solution relaxée de ce problème sera une fonction $u \in L^p(\Omega)$ qui admet comme gradient généralisé une mesure de Young.

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MODÉLISATION DES LOIS NON ASSOCIÉES - APPLICATION AUX LOIS LINÉAIRES COAXIALES

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Camélia Lerintiu
Université de Poitiers, France

Jamal Chaoufi
Université d'Agadir, Maroc

Claude Vallée
Université de Poitiers, France

Kossi E. Atchonouglo
Université de Lomé, Togo

Le comportement des matériaux régis par une loi non associée peut être décrit par un bipotentiel. Les exemples d'application sont variés, de la loi de Coulomb, en passant par les lois de Plasticité des sols (telles que celles de Drücker-Prager et du Cam-Clay) ou la Plasticité et la Viscoplasticité cyclique des métaux à écrouissage cinématique non linéaire, jusqu'à la loi d'Endommagement de Lemaître. Dans le cadre des lois monotones, l'analyse convexe propose de construire une suite de fonctions dites de Fitzpatrick. Chacune de ces fonctions se révèle être un bipotentiel au sens de Géry de Saxcé. Nous construisons cette suite dans le cas des lois de comportement linéaires coaxiales pour lesquelles le tenseur des contraintes et le tenseur des déformations (ou des vitesses de déformation) ont mêmes directions principales. Cette construction met en jeu, d'une manière surprenante, les polynômes de Tchebychev de seconde espèce.

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SPATIAL BEHAVIOR IN VISCOELASTIC MATERIALS

Catalin Gales
Al. I. Cuza University of Iasi

This work deals with the study of the amplitude of the steady-state vibrations in a right finite cylinder made of an viscoelestic material. Some exponential decay estimates, similar to those of Saint-Venant type, are obtained for appropriate cross-sectional area measures associated with the amplitude of the steady-state vibrations. It is proved that due to dissipative effects, the estimates in question hold for every value of the frequency of vibrations and for arbitrary values of the elastic coefficients. The results are extended to a semi-infinite cylinder and some alternatives of Phragmén-Lindelöf type are established.

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ON THE RELAXED SAINT-VENANT'S PROBLEM FOR TRANSVERSELY ISOTROPIC POROUS ELASTIC CIRCULAR CYLINDER

Ionel–Dumitrel Ghiba
"Octav Mayer" Mathematics Institute,
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In this talk we present a solution of the relaxed Saint-Venant's problem for right circular cylinders made of a transversely isotropic homogeneous elastic material with voids. We consider the theory of porous materials introduced by Cowin and Nunziato (1983).

For the treatment of the deformation of right circular cylinder filled with a transversely isotropic porous material, we use the results established by Ghiba (2008). These results are established using the method described by Ieşan (1987). This method gives a possibility to reduce the Saint-Venant's problem to some generalized plane strain problems. In fact, in the paper (2008), two classes of semi-inverse solutions were described in the set of solutions of Saint-Venant's problem that may be expressed in terms of solutions of some generalized plane strain problems. We use these classes obtained in the anisotropic case to solve the extension, bending, torsion and flexure problems of transversely isotropic porous elastic circular cylinders.

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CONTROL OF THE MOTION OF A BOAT

Olivier Glass
Université Paris-Dauphine

Lionel Rosier
Université Henri Poincaré Nancy 1

In this talk we investigate the control of the motion of a boat, viewed as a rigid body with one axis of symmetry, and which is surrounded by an incompressible perfect fluid filling an exterior domain in $\mathbb{R}^2$. We take as control input the flow of the fluid through a part of the boundary of the boat. We prove that the position, orientation, and velocity of the boat are controllable.

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ESTIMATION DE PARAMÈTRES NON LINÉAIRES PAR DES MÉTHODES NON-PARAMÉTRIQUES EN POPULATION FINIE

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Anne Ruiz-Gazen
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Nous considérons dans cet article l'estimation de paramétres non-linéaires de totaux en population finie quand une variable auxiliaire est disponible pour chaque individu de la population. Une nouvelle classe d'estimateurs par substitution est obtenue en remplaçant chaque total par un estimateur assisté par un modéle et basé sur une régression non-paramétrique. Pour obtenir la variance asymptotique, la statistique complexe obtenue est ensuite linéarisée par la technique de la fonction d'influence proposée par Deville (1999).

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A LINEAR PROGRAMMING APPROACH TO DISCONTINUOUS CONTROL PROBLEMS

Dan Goreac
Université Paris-Est Marne-la-Vallée

O.-S. Serea
Université de Perpignan and CMAP

The aim of this talk is to present some results concerning the value function for the Mayer control problem in discontinuous deterministic and stochastic setting. No convexity assumption is made on the dynamics. Occupational measures are employed and the value function is given by some (equivalent) linearized formulation and the associated dual problem. For semicontinuous cost functions, this value is characterized as a (generalized) solution of the associated Hamilton-Jacobi-Bellman system. Weak control formulations are provided. In the u.s.c. case and in the l.s.c. case with convex dynamics, the two formulations are equivalent.

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GRAIN DE SABLE ET BARCHANES

Olivier Goubet
LAMFA CNRS UMR 6140 Université de Picardie Jules Verne

L'objet de cet exposé est de présenter différents aspects mathématiques de la modélisation du comportement d'un matériau granulaire (par exemple le sable) à l'échelle macroscopique. Nous nous interesserons plus particulièrement aux modèles dits de Prigozhin et à leurs adaptations pour modéliser par exemple la formation et le déplacement de champs de dunes de grande taille dans le désert (barchanes). Cet exposé décrira une partie des résultats obtenus par le projet "Grain de Sable" soutenu par l'ANR JC05-41831. Ce projet associe des chercheurs de l'Université de Picardie Jules Verne notamment J. Fortin, S. Dumont, L. Dupaigne, O. Goubet, N. Igbida, V. Martin.

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OPTIMALITY AND DUALITY FOR MULTIOBJECTIVE VARIATIONAL PROBLEMS INVOLVING (B, F, ρ)-TYPE I FUNCTIONS

Sorina Gramatovici
Academy of Economic Studies, Bucharest, Romania

The convexity assumptions for a multiobjective variational problem are relaxed to those of (B, F, ρ)-type I and generalized (B, F, ρ)-type I situation. Sufficient

optimality conditions are established under some specific assumptions. Several duality theorems concerning weak, strong and strict converse duality are proved under (B, F, ρ)-type I assumptions on the objective functions and on the constraints. The results concerning the Mond-Weir duality and the Wolfe duality generalize some of the results of D. Bhatia and A. Sharma (2000), D.S. Kim and J.S. Jung (2009).

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HOMOGÉNÉISATION D'UN MILIEU CONTENANT UNE SOUS-STRUCTURE EN NID D'ABEILLES TRÈS FORTEMENT CONDUCTRICE.

Isabelle Gruais
I.R.M.A.R, Université de Rennes 1

Dan Polisevski
I.M.A.R., Bucarest

The present paper deals with the homogenization of the heat conduction which takes place in a binary three-dimensional medium consisting of an ambiental phase having conductivity of unity order and a rectangular honeycomb structure formed by a set of thin layers crossing orthogonally and periodically. We consider the case when the conductivity of the thin layers is in inverse proportion to the vanishing volume of the rectangular honeycomb structure. We find the system that governs the asymptotic behaviour of the temperature distribution of this binary medium. The dependence with respect to the thicknesses of the layers is also emphasized. We use an energetic method associated to a natural control-zone of the vanishing domain.

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APPROCHE MULTI-ÉCHELLE POUR MODÉLISER LE COMPORTEMENT DES INTERFACES DE CONTACT

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Serge Dumont
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Mohamed Guessasma
LTI CNRS-EA 3899, Université de Picardie

Jérôme Fortin
LTI CNRS-EA 3899, Université de Picardie

L'objectif de cette étude consiste à identifier numériquement des lois d'interface entre deux corps déformables lorsque cette interface est constituée de grains supposés rigides et frottants. Ce problème comporte clairement deux échelles spatiales qui nécessite un traitement numérique approprié. Les corps déformables représentent l'échelle macroscopique et les grains l'échelle microscopique. Nous nous proposons dans cette étude d'analyser et de comparer différentes approches pour traiter ce problème. La première approche est fondée sur les méthodes de décomposition de domaine avec recouvrement. La seconde consiste à généraliser les travaux déjà existant sur les éléments finis FE^2, où la loi de comportement de l'interface au point de Gauss de l'échelle macroscopique est déterminée à partir d'un calcul à l'échelle microscopique (granulaire).

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CELL DYNAMICS IN SOME BLOOD DISEASES UNDER TREATMENT

Andrei Halanay
University Politehnica of Bucharest

Treatment's action in some blood diseases are modelled on the lines in the papers of Mackey and co-workers, as nonlinear control systems of differential equations with time-lag.

Two classes of such systems are considered. One of them is aimed to the study of chemotherapy action on the stem cells' cycle. The other one corresponds to drugs that are active only on one of the mature cells line as Imatinib treatment in Chronic Myelogenous Leukemia. Existence and stability of periodic solutions will be investigated.

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A SPLITTING METHOD FOR NONLINEAR SCHRÖDINGER EQUATION

Liviu Ignat
Institute of Mathematics "Simion Stoilow" of the Romanian Academy

We introduce a splitting method for the semilinear Schrödinger equation and prove its convergence for those nonlinearities which can be handled by the classical well-posedness $L^2(\mathbb{R}^d)$-theory. The scheme we analyse is based on an approximation $S_\tau(t)$ of the linear semigroup $S(t)$ which admits Strichartz-like estimates in some time discrete spaces. We make use of these new estimates to establish uniform bounds on the numerical solution in the auxiliary spaces $l^q_{loc}(\tau\mathbb{Z}, L^r(\mathbb{R}^d))$ without assuming more than $L^2(\mathbb{R}^d)$-regularity on the initial data. Once these bounds are obtained we assume the $H^2(\mathbb{R}^d)$ regularity of the initial data and prove a first order error in the $L^2(\mathbb{R}^d)$-norm.

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SMALL-AMPLITUDE CAPILLARY-GRAVITY WATER WAVES: EXACT SOLUTIONS AND PARTICLE MOTION BENEATH SUCH WAVES

Delia Ionescu-Kruse
Institute of Mathematics "Simion Stoilow" of the Romanian Academy

Two-dimensional periodic surface waves propagating under the combined influence of gravity and surface tension on water of finite depth are considered. Within the framework of small-amplitude waves, we find the exact solutions of the nonlinear differential equation system which describes the particle motion in the considered case, and we describe the possible particle trajectories. The required computations involve elliptic integrals of the first kind, the Legendre normal form and a solvable Abel differential equation of the second kind. Some graphs of the results are included.

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RECENT ADVANCES IN THE LEVEL SET METHOD FOR SHAPE AND TOPOLOGY OPTIMIZATION

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Grégoire Allaire
CMAP, Ecole Polytechnique

Since the seminal papers in the early 2000's, there has been a burst of publications on the application of the level set method to shape and topology optimization of structures. Most of the recent papers focus on numerical issues for improving the level set method but do not extend so much its range of applicability. Let us mention, for example, works on its coupling with the topological gradient for holes nucleation or velocity/derivative regularization. Most of these recent works consider only compliance optimization and linear elasticity which is a notably simpler problem than optimization of a general objective function and nonlinear direct problems.

We propose to extend the range of objective functions which are successfully treated by the level set method, and more specifically to treat the case of objective functions depending on the stress tensor. Together with our previous works (eigenvalue and multiple loads optimization, nonlinear elasticity problems, robust or worst-case optimization) it clearly demonstrates that the level set method is a versatile tool for structural optimization which can tackle industrial, and not merely academic, problems.

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ANALYSE ASYMPTOTIQUE D'UNE INTERFACE MINCE : CAS DE RIGIDITÉS COMPARABLES

Frédéric Lebon
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Raffaella Rizzoni
Université de Ferrara, Italie

Dans ce travail on s'intéresse à un corps élastique linéaire constitué de deux solides liés par une interphase mince d'épaisseur ε. Les trois parties ont des modules élastiques du même ordre. On se propose d'étudier le comportement limite de cette interphase quand ε tend vers zéro. Il a été établi précédemment, en utilisant des développements asymptotiques, qu'à l'ordre zéro, l'interphase se réduisait à une interface parfaite, alors qu'à l'ordre un, l'interphase se comportait comme une interface imparfaite, modélisée par une condition de transmission faisant intervenir les vecteurs déplacements et contraintes obtenus à l'ordre zéro. Dans ce travail, on montre tout d'abord, en utilisant des arguments de Γ-convergence, qu'à l'ordre zéro on retrouve l'interface parfaite. A l'ordre supérieur, un nouveau modèle est obtenu en étudiant les propriétés d'une suite faiblement convergente de solutions d'équilibre.

Ce travail est complété par une méthode de développements formels de l'énergie du système qui permet de retrouver les résultats précédents et par quelques exemples analytiques.

$\rightarrow \infty \diamond \infty \leftarrow$

UNE MÉTHODE PAR ÉLÉMENTS FINIS MIXTE STABILISÉE APPLIQUÉE AU PROBLÈME DE CONTACT APPROCHÉ PAR LA MÉTHODE XFEM

Vanessa Lleras
Université de Franche-Comté

Patrick Hild
Université de Franche-Comté

Yves Renard
INSA de Lyon

La méthode des éléments finis étendus (XFEM) a été introduite en 1999 par Moës, Dolbow et Belytschko afin de traiter des problèmes de fissuration. Cette méthode consiste à enrichir la base de la méthode classique des éléments finis par des fonctions singulières en pointe de fissure et des fonctions discontinues localisées le long de la fissure. Peu de travaux ont été effectués sur le traitement du contact dans le cadre de la méthode des éléments finis étendus XFEM. Afin de formuler les conditions de contact, on combine l'approche XFEM avec une formulation stabilisée de type Barbosa-Hughes pour obtenir une méthode de type domaine fictif. On décrira donc la méthode stabilisée utilisée qui permet de contourner la condition inf-sup de Babuška-Brezzi et de formuler le contact sur la fissure. Ensuite on donnera le résultat de convergence obtenu. Les simulations numériques sont en cours.

$\rightarrow \infty \diamond \infty \leftarrow$

RÉSULTATS À DISTANCE FINIE POUR LA DÉTECTION DE RUPTURE DANS UN MODÈLE EXPONENTIEL

Olivier Lopez
LSTA Université Paris VI

Vladimir Spokoiny
WIAS, Humboldt Universität Berlin

Nous considérons un modèle de rupture sur le paramètre d'un modèle exponentiel. Les observations sont constituées de réalisations indépendantes $(Y_i)_{1\le i\le n}$ où $Y_i \sim \mathcal{P}(f_i)$, f_i étant le paramètre du modèle exponentiel considéré, où l'on a $f_i = f_0 + a_0\mathbf{1}_{i\le n_0}$, avec f_0 connu, a_0 et n_0 inconnus, estimés par maximum de vraisemblance. Grâce à de nouvelles bornes exponentielles, nous obtenons des résultats à distance finie sur la qualité d'estimation de l'instant de rupture ainsi que de son amplitude. Nous considérons également le cas où le modèle est mal spécifié.

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EXISTENCE OF POSITIVE SOLUTIONS FOR A CLASS OF HIGHER-ORDER M-POINT BOUNDARY VALUE PROBLEMS

Rodica Luca-Tudorache
Gh. Asachi Technical University of Iasi, Romania

We investigate the existence of positive solutions of the higher-order nonlinear differential system

$$(S)\qquad \begin{cases} u^{(n)}(t) + \lambda b(t) f(v(t)) = 0, & t \in (0,T) \\ v^{(n)}(t) + \mu c(t) g(u(t)) = 0, & t \in (0,T), \quad n \ge 2, \end{cases}$$

with the m-point boundary conditions

$$(BC)\qquad \begin{cases} u(0) = u'(0) = \cdots = u^{(n-2)}(0) = 0, \quad u(T) = \displaystyle\sum_{i=1}^{m-2} a_i u(\xi_i) \\ v(0) = v'(0) = \cdots = v^{(n-2)}(0) = 0, \quad v(T) = \displaystyle\sum_{i=1}^{m-2} a_i v(\xi_i), \quad m \ge 3, \end{cases}$$

where $0 < \xi_1 < \cdots < \xi_{m-2} < T$, $a_i > 0$, $i = 1, \ldots, m-2$. The proofs of the main results are based on the Guo-Krasnoselskii fixed point theorem for compression-expansion operators.

$\rightarrow \infty \diamond \infty \leftarrow$

GRADIENT REPRESENTATION AND POSITIVE CAD-LAG SOLUTIONS FOR JUMP DIFFERENTIAL EQUATIONS

Marinela Marinescu
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Piecewise continuous (cad-lag) solutions of s.d.e driven by nonlinear vector fields and containing witchings and jumps are studied involving Lyapunov exponents, weak asymptotic behaviour (in probability), selffinancing (admissible) strategies and gradient representation of (cad-lag) solutions. In the first part, the analysis reveals a strong connection between the existence of Lyapunov exponents and solving second order differentialinequalities when weak asymptotic behaviour and admissible strategies are concerned. In addition, as far as the (cad-lag) solution is a sum of two components, one continuous and the second a piecewise constant one (including jumps), sufficient conditions for asymptotic stability for the continuous component are given. All these results are presented into the three theorems as solutions for the problems (P1), (P2) and (P3). The second part is meaningfull by itself and contains a detailed investigation of (cad-lag) solutions when admitting nonlinear vector fields in the jumping (impulsive) part of s.d.e and a separation into two components (one continuous and another piecewise constant) is possible.

$\rightarrow \infty \diamond \infty \leftarrow$

SUR UNE CLASSE D'INÉQUATIONS QUASIVARIATIONNELLES EN MÉCANIQUE DU CONTACT

Andaluzia Matei
Université de Craiova

Mircea Sofonea
Université de Perpignan

Nous considérons une classe d'inéquations quasivariationnelles gouvernées pas deux fonctionnelles non-différentiables, pour laquelle nous présentons un résultat d'existence, d'unicité et de régularité de la solution. Les preuves sont basées sur des arguments de monotonie, de convexité et de point fixe. Par ailleurs, nous considérons plusieurs problèmes quasistatiques de contact pour des matériaux élastiques et viscoélastiques, dans lesquels le contact est modelisé à l'aide d'une condition de compliance normale ou de réponse normale instantanée, associée à une loi de frottement de type Coulomb. Nous montrons que ces problèmes conduisent à des

inéquations quasivariationnelles dont l'inconnue est le champ des déplacements ou le champ des vitesses. Nous utilisons ensuite les résultats abstraits présentés dans la première partie de l'exposé afin d'obtenir l'existence et l'unicité de la solution faible pour les problèmes de contact considérés.

$$\rightarrow \infty \diamond \infty \leftarrow$$

APPROXIMATION METHODS FOR BACKWARD STOCHASTIC VARIATIONAL INEQUALITIES

Lucian Maticiuc
"Al. I. Cuza" University of Iasi, Faculty of Mathematics

Eduard Rotenstein
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Adrian Zălinescu
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We consider a mixed approximation scheme for the following backward variational inequality:

$$dY_t + F(t, X_t, Y_t, Z_t)dt + G(t, X_t, Y_t)dA_t \in \partial\varphi(Y_t)dt + Z_t dW_t,$$

where $(X_t, A_t)_{t\in[0,T]}$ is the unique solution of the reflected forward stochastic differential equation

$$\begin{cases} dX_t = b(t, X_t)dt + \sigma(t, X_t)dW_t - \nabla\alpha(X_t)dA_t, \\ A_t = \displaystyle\int_0^t \mathbf{1}_{\{X_s\in Bd(D)\}}dA_s,\ t \mapsto A_t \text{ is increasing.} \end{cases}$$

More precisely, we use an Euler scheme for the above system of decoupled forward-backward variational inequality combined with Yosida penalization techniques. The connection with variational PDEs is also envisaged.

$$\rightarrow \infty \diamond \infty \leftarrow$$

PROLEGOMENA TO STUDIES ON DYNAMIC MATERIALS

Gérard A. Maugin
Université Pierre et Marie Curie

Martine Rousseau
Université Pierre et Marie Curie

Mikhail Berezovski
Tallinn University of Technology Center for Nonlinear Science, Estonia

As a preliminary study to more complex situations of interest in small-scale technology, this paper envisages the elementary propagation properties of elastic waves in one-spatial dimension when some of the properties (mass density, elasticity) may vary smoothly or suddenly in space or in time, the second case being of course more original. Combination of the two may be of even greater interest. Towards this goal a critical examination of what happens to solutions at the crossing of pure space-like and time-like material discontinuities is given together with simple solutions for smooth transitions and numerical simulations in the discontinuous case. The role played by canonical conservation laws of energy and momentum which reflect the inhomogeneity in time and space is emphasized. The effects on amplitude, speed of propagation, frequency changes and the appearance of a Doppler like effect are demonstrated although the whole physical system remains linear.

$\rightarrow \infty \diamond \infty \leftarrow$

LINE ENERGIES IN MICROMAGNETISM

Benoît Merlet
CMAP, Ecole Polytechnique

Radu Ignat
Université Paris 11

We analyze energy functionals concentrated on the discontinuity lines of unit-length, divergence-free vector fields $m : \omega \subset \mathbf{R}^2 \to S^1$:

$$I_f(m) := \int_J f(|m^+ - m^-|)\, d\mathcal{H}^1(x).$$

The motivation comes from thin-film micromagnetics where these line energies occur as Γ-limits of the 3D micromagnetic energy in different asymptotic regimes.

We use entropies adapted to the constraints to establish a representation formula which is valid for a large class of line energies $\mathcal{C}$. In this class, we prove lower semi-continuity and existence of minimizers. Finally, we show that $\mathcal{C}$ contains some physically relevant cases.

$\rightarrow \infty \diamond \infty \leftarrow$

CONTROLLABILITY OF THE 3D COMPRESSIBLE EULER SYSTEM

Hayk Nersisyan
Université de Cergy-Pontoise

The talk is devoted to the controllability problem for 3D compressible Euler system. The control is a finite-dimensional external force acting only on the velocity equation. We show that the velocity and density of the fluid are simultaneously controllable. In particular, the system is approximately controllable and exactly controllable in projections. The proof is based on a development of the approach introduced by Agrachev and Sarychev.

$\rightarrow \infty \diamond \infty \leftarrow$

SUR LE MOUVEMENT CAVITANTE D'UN FLUIDE LUBRIFIANT

Bogdan N. Nicolescu
Université de Piteşti

Tudor C. Petrescu-Ivan
Université de Piteşti

On s'intéresse au mouvement d'un fluide visqueux incompressible entre deux surfaces nonpareilles, note S_1 (le rotor) et S_2 (le stator), qui définissent un système tribologique à symétrie axiale. Le caractère non parallèle des deux surfaces est induit par l'action des perturbations extérieures (la plus fréquente étant celles du type vibration). A cause de ces perturbations on aura un mouvement supplémentaire du rotor, comme le mouvement d'un rigide à point fixe.

A cause du non-parallélisme des deux surfaces on voit apparaitre des modifications dans le champ de la pression sur la surface du stator et par conséquence la coupure du film de lubrification sur différent portion de la surface.

Pour étudier ces phénomène on obtient une nouvelle forme de l'équation de Reynolds et on construit des solutions self-similaires qui nous permettent de décrire la rupture du film, considère comme un type de cavitation du lubrifiant.

$\rightarrow \infty \diamond \infty \leftarrow$

DISCRETE BRANCHING TYPE PROCESSES AND NONLINEAR OPERATORS

Andrei-George Oprina
"Simion Stoilow" Institute of Mathematics of the Romanian Academy

The talk is based on joint works with **Lucian Beznea**.

We present several probabilistic aspects for a nonlinear operator of the form $\Delta u + \sum_{k=1}^{\infty} q_k u^k$, in connection with the classical works of M. Nagasawa, N. Ikeda, S. Watanabe, and M.L. Silverstein on the discrete branching processes. Our approach uses probabilistic and analytic potential theoretical tools, like the potential kernel of a continuous additive functional and the subordination operators.

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SUR L'ANALYTICITÉ DES FLUIDES DE GRADE DEUX

Marius Paicu
Université Paris Sud, Orsay

Le but de cet exposé est de donner quelques résultats qualitatifs sur des équations provenant de la mécanique des fluides non-newtoniens. Dans la première partie de l'exposé, nous présentons les équations des fluides de grade deux qui sont un cas de fluides de type différentiels. Nous commençons par étudier les propriétés de régularisation asymptotique de ce système en montrant l'existence d'un attracteur compact global qui est plus régulier que l'espace ambiant. Ensuite on discute l'existence globale de solutions analytiques en espace en donnant un contrôle précis sur la bande d'analyticité de la solution. Dans la deuxième partie de l'exposé nous présentons quelques résultats récents d'existence globale de solutions pour le système des cristaux liquides nématiques. Il s'agit ici d'un système couplé entre les équations de Navier-Stokes et une équation parabolique qui décrit l'évolution des cristaux liquides dans le fluide. Nous montrons l'existence d'une fonctionnelle d'énergie qui

permette de construire des solutions faibles globales. En dimension deux d'espace, nous montrons que cette fonctionnelle permet de contrôler aussi les dérivées d'ordre supérieur et nous construisons des solutions globales régulières.

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ASYMPTOTIC ANALYSIS FOR THE STOKES FLOW IN A THIN CYLINDRICAL RIGID ELASTIC PIPE

Grigory Panasenko
LaMUSE EA 3989, University of Lyon/University of Saint Etienne

Ruxandra Stavre
Institute of Mathematics of the Romanian Academy, Bucharest, Romania

The non-steady Stokes equations are considered in a thin cylinder with the Koiter shell boundary condition on the lateral boundary of the cylinder. The pressure from the Stokes equation enters into the right hand side of the Koiter's equation, so the Stokes equation in the cylinder is coupled with the Koiter's equation on the boundary. The problem contains two parameters: the small ratio epsilon of the diameter of the cylinder to its length and the great relative rigidity of the wall which is some negative power of epsilon . The complete asymptotic expansion is constructed and the error estimates are justified.

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A VELOCITY-BASED TIME-STEPPING SCHEME FOR MULTIBODY DYNAMICS WITH UNILATERAL CONSTRAINTS

Laetitia Paoli
LaMUSE, Université de Saint-Etienne, FRANCE

We consider a discrete mechanical system subjected to perfect unilateral constraints characterized by some geometrical inequalities $f_\alpha(q) \geq 0$, $\alpha \in \{1, \ldots, \nu\}$, with $\nu \geq 1$. We assume that the transmission of the velocities at impacts is governed by a Newton's impact law with a restitution coefficient $e \in [0, 1]$, allowing for conservation of kinetic energy if $e = 1$, or loss of kinetic energy if $e \in [0, 1)$, when the constraints are saturated. Starting from a formulation of the dynamics as

a first order measure-differential inclusion for the unknown velocities, time-stepping schemes inspired by the proximal methods can be proposed. Convergence results in the single-constraint case ($\nu = 1$) are recalled and extended to the multi-constraint case ($\nu > 1$), leading to new existence results for this kind of problems.

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FELLER'S DIFFUSION WITH LOGISTIC GROWTH: RAY-KNIGHT THEOREM AND GENEALOGIES

Etienne Pardoux
Université de Provence

We prove a generalization of one of the well known Ray-Knight theorems. Namely we show that the local time of the solution of a specific SDE, considered at a specified random time, as a function of the levels, solves the Feller diffusion equation with logistic growth. This result, obtained jointly with A. Wakolbinger, gives an insight into the genealogy in a population following the Feller diffusion equation with logistic growth.

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COUPLINGS OF REFLECTING BROWNIAN MOTIONS AND APPLICATIONS

Mihai N. Pascu
Transilvania University of Braşov, Faculty of Mathematics and Computer Science

The method of coupling of reflecting Brownian motion is a useful technique for proving results on various functionals associated to the reflecting Brownian motion.

In this talk, we will present two such couplings of reflecting Brownian motions: the scaling coupling and the mirror coupling of reflecting Brownian motions.

As an application of the scaling coupling, we will prove a monotonicity of the lifetime of reflecting Brownian motion with killing, which implies the validity of the Hot Spots conjecture of J. Rauch for a certain class of domains.

As applications of the mirror coupling, we will present a proof of the Laugesen-Morpurgo conjecture on the radial monotonicity of the trace of the Neumann heat kernel of the unit ball in $\mathbb{R}^n$ ($n \geq 1$), and a unifying proof of the results of I. Chavel and W. Kendall on the domain monotonicity of the Neumann heat kernel.

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A UNIFORM BERRY-ESSEEN THEOREM ON $M-$ESTIMATORS FOR GEOMETRICALLY ERGODIC MARKOV CHAINS

Valentin Patilea
IRMAR-INSA Rennes

Loïc Hervé
IRMAR-INSA Rennes

James Ledoux
IRMAR-INSA Rennes

Let $\{X_n\}_{n\geq 0}$ be a V-geometrically ergodic Markov chain with $V \geq 1$ some fixed unbounded real-valued function and consider $M_n(\alpha) = n^{-1}\sum_{k=1}^{n} F(\alpha, X_{k-1}, X_k)$, $\alpha \in \mathcal{A} \subset \mathbb{R}$ for some real-valued functional $F(\cdot,\cdot,\cdot)$. Define the $M-$estimator $\widehat{\alpha}_n$ such that $M_n(\widehat{\alpha}_n) \leq \min_{\alpha\in\mathcal{A}} M_n(\alpha)+c_n$ with c_n, $n \geq 1$ some sequence of real numbers decreasing to zero. Under some standard regularity assumptions, close to that of the i.i.d case, and under the moment assumption

$$\left(\left|\frac{\partial F}{\partial \alpha}(\alpha, x, y)\right| + \left|\frac{\partial^2 F}{\partial \alpha^2}(\alpha, x, y)\right|\right)^{3+\varepsilon} \leq C\,(V(x) + V(y))$$

for some constants $\varepsilon > 0$ and $C > 0$, the estimator $\widehat{\alpha}_n$ satisfies a Berry-Esseen theorem uniformly with respect to the underlying probability distribution of the Markov chain.

$\rightarrow \infty \diamond \infty \leftarrow$

NONLINEAR DUAL AND PRIMAL DOMAIN DECOMPOSITION METHODS

Julien Pebrel
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This contribution presents two nonlinear domain decomposition methods (DDM) for the resolution of nonlinear stationnary problems. It's based on the condensation of the continuous problem on the interface and the resolution of the interface problem by a Newton-Raphson algorithm. Then, we obtain a two stages strategy implying a linear DDM and a set of nonlinear problems on each subdomain. Understanding the behaviour of this method involves a mount of questions: the properties of the local Steklov-Poincaré operator, of the interface problem, the convergence of the Newton-Raphson algorithm and the influence of the local iterations on the interface iterations. In the case of solid mechanics the study is quite complex as it involves properties of the global problem that are sometimes not clear. Fluid mechanics offers the advantage of an "easier" theoretical formulation. Indeed, questions of existence and uniqueness can be solved with relatively simple mathematical tools. We'll introduce quickly nonlinear DDM in an abstract framework before presenting some applications to nonlinear solid mechanics and mentioning some theoretical properties obtained in the case of fluid mechanics and that remain observable in the case of solid.

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A NEW RESULT OF EXACT CONTROLLABILITY FOR THE MAGNETOHYDRODYNAMIC EQUATIONS

Cătălin Popa
Universitatea "Al. I. Cuza"

The local exact internal controllability for the three-dimensional magnetohy- drodynamic equations is established in the case of target weak solutions. Specifi- cally, we prove that one can find a control function acting on an arbitrarily small subdomain of the region where the flow takes place and a corresponding solution of the controlled magnetohydrodynamic equations which equals the target solu- tion at the final time. This happens provided that the solution we drive starts from an initial configuuration which is sufficiently close to the initial configura- tion of the taget solution (with respect to a suitable norm). Some additional regularity for the target weak solution is however needed. This result improves a previous one obtained for strong solutions as targets. The main tool we use to derive the controllability result is a new global Carleman estimate for the adjoint linearized system, which we also establish here.

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A MATHEMATICAL MODEL FOR ALLOGENEIC BONE MARROW TRANSPLANTATION

Radu Precup
University Babeş–Bolyai of Cluj-Napoca, Romania

We present a basic mathematical model for understanding dynamics of three cell lines after allogeneic bone marrow transplantation: normal host cells, leukemic host cells and donor cells. The evolution is one of competitive type, depends upon kinetic and cell-cell interaction parameters and can ultimately lead either to the normal hematopoietic state achieved by the expansion of the donor cells and the elimination of the host cells, or to the leukemic hematopoietic state characterized by the proliferation of the cancer line and the suppression of the other cell lines. One state or the other is reached depending on cell-cell interactions and initial cell concentrations at transplantation. The model also provides a theoretical basis for the control of post-transplant evolution aimed at the achievement of normal hematopoiesis.

$$\rightarrow \infty \diamond \infty \leftarrow$$

A NEW METHOD OF APPROXIMATING THE PROBABILITY OF MATCHING COMMON WORDS IN MULTIPLE RANDOM SEQUENCES

Cristian Preda
Université des Sciences et Technologies de Lille, France

George Haiman
Université des Sciences et Technologies de Lille, France

We consider R independent sequences of length T formed by independent, not necessarily uniformly distributed letters drawn from a finite alphabet. We first develop a new and efficient method of calculating the expectation

$$\mathbb{E}(N_R) = \mathbb{E}(N_R(m,T))$$

of the number of distinct words of length m, $N_R(m,T)$, which are common to R such sequences. We then consider the case of four uniformly distributed letters. We determine a $b_R = b_R(m,T) \geq 0$ such that the interval $[\mathbb{E}(N_R) - b_R; \mathbb{E}(N_R)]$ contains the probability $p_R = \mathbb{P}(N_R \geq 1)$ that there exists a word of length m common to the R sequences. We show that $b_R \approx 0.07\mathbb{E}(N_R)$ if $R = 3$ and $b_R \leq 0.05\mathbb{E}(N_R)$ if

$R \geq 4$. Thus, for unusual common words, i.e. such that p_R is small, $E(N_R)$ provides a very accurate approximation of this probability. We then compare numerically the intervals $[\mathbb{E}(N_R) - b_R, \mathbb{E}(N_R)]$ with former approximations of p_R provided by Karlin and Ost (1988) and Naus and Sheng (1997).

$\rightarrow \infty \diamond \infty \leftarrow$

COMPARISON OF BAYESIAN AND NON-BAYESIAN ESTIMATES USING RECORD STATISTICS FROM MODIFIED-INVERSE WEIBULL MODEL

Vasile Preda
University of Bucharest, Faculty of Mathematics and Computer Sciences, Bucharest, Romania
Eugenia Panaitescu
"Carol Davila" University of Medicine and Pharmacy, Faculty o Medicine, Department of Medical Informatics and Bistatistics, Bucharest, Romania

In this paper, we consider the modified-inverse Weibull distribution as an important model of life time models and derive Bayesian and non-Bayesian estimators based on record values of the scale and shape parameters, reliability and hazard functions. The Bayes estimates are obtained based on a conjugate prior for the scale parameter and a discrete prior for the shape parameter of the distribution. Also the conditions for existence of MLE are given. Comparisons are made between these estimators using a Monte-Carlo simulation study. Finally, Bayesian predictive density function is derived and discussed.

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DISCRETE PROGRAMMING MODELS FOR CROP PLANNING UNDER RISK

Constanta Zoie Radulescu
Institute for Research in Informatics

Marius Radulescu
Institute of Mathematical Statistics and Applied Mathematics

In the paper is presented a multiple objective programming model for crop planning which includes climate risk and market risk. The decision variable is a rectangular matrix whose entries are equal to 0 or 1. This matrix describes the land allocation to crops. The model is based on portfolio theory and considers several classes of land quality and historical data of land productivity and crop market prices. The risk of a production plan is defined as the variance of the return. Consequently the financial risk is a quadratic function of the decision variables. Starting from the multi-criteria binary programming model are defined several single objective models. It is shown that these models are equivalent to linear binary programming models.

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ALGEBRAIC CRITERIA FOR ERGODICITY OF ARBITRARY MATRICES APPLICATIONS TO FINITE MARKOV CHAINS

Marius Radulescu
Institute of Mathematical Statistics and Applied Mathematics

Sorin Radulescu
National College of Advanced Studies A. Vlaicu

The purpose of this paper is to study the behavior of powers of matrices when the exponent tends to infinity. This problem is of considerable importance in various fields of mathematics and has many applications. Several conditions that imply the convergence of powers of arbitrary square matrices or of sequences of matrices that are built from powers of matrices to a square matrix are given. The description of the limiting matrix is also presented. Applications to finite Markov chains are discussed also. Our results extend known results for the convergence of powers of stochastic matrices since it considers the case when the Markov chain has several recurrent classes.

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STOCHASTIC CALCULUS VIA REGULARIZATIONS IN BANACH SPACES WITH MATHEMATICAL FINANCE PERSPECTIVES

Francesco Russo
INRIA Rocquencourt and ENSTA ParisTech

This talk develops some aspects of stochastic calculus via regularization to Banach valued processes. An original concept of χ-quadratic variation is introduced, where χ is a subspace of the dual of a tensor product $B \otimes B$ where B is the values space of some process X process. Particular interest is devoted to the case when B is the space of real continuous functions defined on $[-\tau, 0]$, $\tau > 0$. Itô formulae and stability of finite χ-quadratic variation processes are established. Attention is deserved to a finite real quadratic variation (for instance Dirichlet, weak Dirichlet) process X. The $C([-\tau, 0])$-valued process $X(\cdot)$ defined by $X_t(y) = X_{t+y}$, where $y \in [-\tau, 0]$, is called *window* process. Let $T > 0$. If X is a finite quadratic variation process such that $[X]_t = t$ and $h = H(X_T(\cdot))$ where $H : C([-T, 0]) \longrightarrow \mathbb{R}$ is $L^2([-T, 0])$-smooth or H non smooth but finitely based it is possible to represent h as a sum of a real H_0 plus a forward integral of type $\int_0^T \xi d^- X$ where H_0 and ξ are explicitly given. This representation result will be strictly linked with a function $u : [0, T] \times C([-T, 0]) \longrightarrow \mathbb{R}$ which in general solves an infinite dimensional partial differential equation with the property $H_0 = u(0, X_0(\cdot))$, $\xi_t = D^{\delta_0} u(t, X_t(\cdot)) := Du(t, X_t(\cdot))(\{0\})$. This decomposition generalizes the Clark-Ocone formula which is true when X is the standard Brownian motion W. The financial perspective of this work is related to hedging theory of path dependent options without semimartingales.

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ETUDE D'UN MODÈLE D'ÉQUATION DE KDV FORCÉE ET AMORTIE

Georges Sadaka
Université de Picardie Jules Vernes

Jean-Paul Chehab
Université de Picardie Jules Vernes

On s' intéresse sur l'étude d'un modèle d'équation de KdV forcée et amortie

$$u_t + L_\gamma u + u_{xxx} + uu_x = f, x \in T([0, L]), t > 0$$

Ici $T([0, L])$ désigne le tore $(0, L)$ et l'opérateur d'amortissement généralisé L_γ est défini par

$$L_\gamma u = \sum_{k \in Z} \gamma_k \hat{u}_k e^{\frac{2ik\pi x}{L}}$$

avec $\gamma_k \geq 0$ et $\hat{u}_k$ est le k-ième coefficient de Fourier de u. On se concentre sur le comportement pour les grands temps des solutions pour différents types de suites

γ_k ; on aborde en particulier les questions de régularité, de vitesse d'amortissement, d'amortissement à bande limitée et on présente des simulations numériques.

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ELECTROMECHANICS OF SOLID CONTINUA SUBJECT TO A BIAS

Olivian Simionescu
Bucharest University

In this work we review various aspects concerning the electromechanical behavior of solid continua subject to a bias, which we published last decade. After deriving the fundamental equations on the dynamics of piezoelectric crystals subject to initial electromechanical fields, we analyze the following particular problems:

1. Homogeneous plane wave propagation in isotropic solids, cubic and 6-mm type crystals.
2. Attenuated plane wave propagation in isotropic solids and cubic crystals.
3. Guided wave propagation in monoclinic crystals and isotropic solids (SAEW).
4. Inhomogeneous plane wave propagation in monoclinic crystals (IPW).

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OPTIMAL BOUNDS ON DISPERSION COEFFICIENT IN PERIODIC MEDIA

Loredana Smaranda
Department of Mathematics, University of Piteşti, Romania

In this talk, we consider a periodic media and we study the dependence of the dispersion tensor in terms of the microstructure. We treat one-dimensional and laminated structures, and also we give some perspectives on other cases in higher dimension.

Considering the one dimensional and laminated periodic medium, we completely describe the set in which the dispersion coefficient lies, as the microstructure varies preserving the volume proportion. In higher dimension, we study properties on the dispersion tensor for Hashin structures and we characterize the bounds of this tensor in terms of some geometric properties on the reference cell.

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HOMOGENIZATION WITH ITERATED FUNCTION SYSTEM

Anna Soos
Babes Bolyai University, Faculty of Mathematics and Computer Science

The homogenization theory is devoted to analysis of partial differential equations with rapidly oscillating coefficients. Let $\mathcal{A}^k$ be a given partial differential operator and we consider the equation

$$\mathcal{A}^k u^k = f,$$

together with the appropriate boundary initial conditions. Here $k \in \mathbb{N}$ and $f \in H^1(\mathbb{R}^n)$. We are interested in studying the solutions of this system in the limit as $k \to \infty$. The homogenization theory study the convergence of u^k, as $k \to \infty$, characterize the limiting process and construct the limiting equation. In the classical homogenization theory the structure are periodic. This implies that the coefficients of the corresponding PDE which model the phisical phenomenon under investigation are periodic.

In this article we will quit the periodicity assumption. The coefficients are generated by an iterated function system.

$\rightarrow \infty \diamond \infty \leftarrow$

LE PROBLÈME D'OBSTACLE POUR LES EDPS PARABOLIQUES QUASILINÉAIRES

Lucretiu Stoica
Université de Bucarest

Anis Matoussi
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Le but de cette exposé est de discuter un resultat récent d'existence et unicité pour le problème d'obstacle pour les EDP stochastiques (voir l'article publié par les auteurs dans Annals of Probability 2010, Vol. 38, No. 3, p. 1143 - 1179). Une partie de l'exposé sera dédié à la description de la notion de mesure régulière

pour les équations paraboliques déterministes. C'est cette notion qui fait possible le traitement du cas des EDP paraboliques stochastiques.

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CONTACT AVEC ADHÉSION ENTRE UN CORPS ÉLASTIQUE ET UNE FONDATION RIGIDE

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Le but de ce travail est l'étude variationnelle du contact avec adhésion entre un matériau élastique et une fondation rigide dans le processus quasi-statique et avec l'hypothèse des petites déformations. La loi de comportement de ce matériau élastique est non-linéaire, le contact est avec adhésion et modélisé par les conditions de Signorini. L'évolution du champ d'adhésion est décrite par une équation différentielle non-linéaire d'ordre un. Après la modélisation mathématique de ce problème mécanique de contact nous déduisons sa formulation variationnelle ensuite nous prouvons l'existence et l'unicité de sa solution faible, en plusieurs étapes, en utilisant un théorème sur les inéquations variationnelles, le théorème de Cauchy-Lipschitz, un lemme de Gronwall ainsi que le point fixe de Banach.

Mots clés : matériau élastique, contact, adhésion, équation différentielle, conditions de Signorini, solution faible, inéquation variationnelle, point fixe de Banach.

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CONSTRUCTION DE SUITES MINIMISANTES EN OPTIMISATION DE FORME

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Dans la plupart des problèmes d'optimisation de forme, la solution n'appartient pas à l'ensemble des vraies formes car elle est composite. La méthode d'homogénéisation relaxe le problème originel en étendant l'ensemble des structures admissibles à celui des formes composites. D'un point de vue numérique, un atout considérable de cette méthode par rapport aux méthodes géométriques traditionnelles réside dans le fait que la forme finale est indépendante de la forme initiale (même dans le cas d'une relaxation partielle).

Cependant, la forme optimale étant un composite, un post-traitement est nécessaire afin d'obtenir une forme presque optimale non composite (i.e. constructible). Pour ce faire, l'approche classique consiste à pénaliser les densités de matériel intermédiaires, mais le résultat ainsi obtenu dépend de manière fondamentale du maillage sous-jacent, et le degré de détails n'est pas controllable.

Nous proposons un nouvel algorithme de post-traitement pour la minimisation de la compliance d'une structure élastique. L'idée principale est d'approximer la forme composite optimale par un solide composite localement périodique, et de construire une suite de vraies formes convergeant vers la structure composite.

Cette méthode nous permet de régler le niveau de détail de la forme optimale. Enfin, la détermination des paramètres d'homogénéisation est totalement non linéaire dans l'algorithme; la construction des suites minimisantes à partir des paramètres définissant le composite est linéaire.

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HSU-ROBBINS THEOREM FOR THE CORRELATED SEQUENCES

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A famous result by Hsu and Robbins says that if $X_1, X_2, ...$ is a sequence of independent identically distributed random variables with zero mean and finite variance and $S_n := X_1 + ... + X_n$, then $\sum_{n=1} P(|S_n| > \varepsilon n) < \infty$ for every $\varepsilon > 0$. We will analyze this result in the case when the random varibles X_i are correlated (they are related to the increments of the fractional Brownian motion). Our techniques are based on multiple stochastic integrals, Malliavin calculus and Stein's method.

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MANIPULATION OF QUANTUM DYNAMICS: CONTROLLABILITY AND BEYOND

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Manipulating the quantum dynamics of atomic and molecules with laser pulses is now experimentally feasable with molecules ranging from di-atomics to organic molecules and to proteins.

In the mathematical formalization the evolution is determined by the Schrodinger equation that involves the Hamiltonian of the system; a different formalism describes the situation where the state is described by a density matrix operator and evolves according to the master equation. A first and crucial question concerning the manipulation of the quantum evolution by an external field (e.g., a laser) is whether this is possible at all i.e. whether any possible state can be reached with a well-chosen control field; in technical terms this question is called the 'controllability of the equation'. The mere positive conclusion that a control exists does not indicate how to find it in practice. Therefore one needs to formulate numerical algorithms. The presentation will cover both controllability and numerics.

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UNE APPLICATION DE LA STATISTIQUE DANS L'OPTIMISATION DES BASES DE DONNÉES

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Dans cet article, nous étudions des cas particuliers de bases de données aléatoires, dans lesquelles les colonnes suivent des certaines répartitions différentes, aussi bien discrètes que continues. Ce cas correspond à la notion de base de données aléatoires hétérogènes, que nous avons introduit avant. Le problème d'approximer le cardinal de l'ensemble résultat est important dans le traitement des requêtes. Nous proposons une solution pour ce problème dans le cadre des bases de données hétérogènes.

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A PARTITIONED NEWTON METHOD FOR THE INTERACTION OF A FLUID AND A 3D SHELL STRUCTURE

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The problem of interest is the interaction between an incompressible fluid and an elastic structure. As the target application is blood flows through large arteries, a strongly coupled method which ensures a well-balanced energy transfer between the fluid and the structure is required. It is well-known that a heterogeneous domain-decomposition approach is well suited to solve such problems.

The purpose of this paper is to propose a new algorithm based on a domain decomposition paradigm well suited for this kind of problems. The proposed method is based on the principle "linearize first, then decompose" whereas the usual schemes are generally "nonlinear in subdomains". Numerical experiments show that the proposed approach attractiveness increases with the complexity of the structures. This is the case for our target problems, blood flow problems. In this situation the artery walls are thin, multilayer, nonlinear solids. These complex structures can be conveniently approximated using 3D shell finite elements. This kind of model typically increases the complexity of the solid resolution in fluid-structure simulations.

As far as the implementation is concerned, a domain decomposition method allows the use of different solvers for the fluid and the structure problem, each with its own schemes. The use of two different solvers has several established benefits such as re-usability of existing codes and flexible choice of the numerical methods adapted to each sub-problem. In addition, this approach allows to design scalable approaches for large, memory- and time-intensive problems by using multi-level state of the art algorithms for both fluid and solid solvers.

We will focus on the solution of the solid problem. For the blood flow simulations as the wall arteries are thin it is convenient to use shell elements; they accurately describe the geometry. For simple models of the wall arteries MITC4 general shell elements are used. When considering more realistic models of the wall with several layers (the intima, media and adventitia) then general 3D shell elements are more convenient, but the computation cost of the solid problem increases. A Newmark algorithm is used for the time integration. As the local tangent problems for the structure are very ill-conditioned, direct methods are preferred to solve them, but this dramatically increases the memory requirements. To overcome this difficulty, when dealing with large problems, in our simulations we introduce a second level of domain decomposition by using a balanced Neumann-Neumann method inside the structure. Numerical examples will show the flexibility of the method.

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STOCHASTIC VARIATIONAL INEQUALITIES WITH JUMPS

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We prove existence and uniqueness for solutions of jump-difussion variational inequalities of the following type:

$$dX_t + \partial\varphi\left(X_t\right) dt \ni b\left(t, X_t\right) dt + \sigma\left(t, X_t\right) dW_t + \int_{\mathbb{R}^d \setminus \{0\}} \gamma\left(t, X_{t-}, z\right) \tilde{N}_t\left(dz\right) dt.$$

Here, $\partial\varphi$ is the subdifferential of a proper, l.s.c., convex function $\varphi : \mathbb{R}^n \to \overline{\mathbb{R}}$, W is a Brownian motion in $\mathbb{R}^d$, and $\tilde{N}$ is the compensated measure of a Poisson random measure N. Under certain conditions, N can be regarded as the jump counting measure of a Lévy process.

The existence of a strong solution is shown via a penalization method, by considering the Yosida regularization of φ; uniqueness is a consequence of the Lipschitz continuity assumptions on the coefficients and of the monotonicity of the subdifferential operator.

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ON ITERATED INTEGRATED TAIL

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Let F be a distribution function on $[0, \infty)$ with finite moments. Its integrated tail is defined by $F_I\left(x\right) = \frac{\int_0^x (1-F(y))\mathrm{d}y}{\int_0^\infty (1-F(y))\mathrm{d}y}$. This distribution plays a crucial role both in renewal and ruin theories. Tzvetan Ignatov conjectured that the sequence of iterated tails $F, F_I, F_{II}, F_{III}, ...$ must have an exponential limit $F_\lambda\left(x\right) = 1 - e^{-\lambda x}$ for some $0 \leq \lambda \leq \infty$. We know that this is not true (we give a counterexample) but we conjecture that his assertion holds in a particular case.

CONJECTURE. Let F be an absolutely continuous distribution function on $[0,\infty)$ with finite moments. Let λ_F be the hazard ratio of F, defined by $\lambda_F\left(x\right) := \frac{F'(x)}{F(x)}$. Suppose that the Cesaro limit $\lambda_F^* = \lim_{x\to\infty} \frac{\int_0^x \lambda_F(y)\mathrm{d}y}{x}$ does exist, finite or not. Then Ignatov's conjectute holds with $\lambda = \lambda_F^*$.

We prove this conjecture in two cases:
1. $\lim_{x\to\infty} \lambda_F(x) = \lambda_F^*$ does exist itself;
2. λ_F is periodic.

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