Analysis, Probability, and their Applications

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Quy Nhon (Vietnam)

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Geometry of BiLipschitz mappings

Summary:

By definition, BiLipschitz mappings distort distances of points by at most a fixed constant.
Therefore a'priori they are the simplest geometric deformations.
On the other hand, it turns out that even in two dimensions these maps provide a surprisingly rich geometric structure. In particular, in this talk I wish to discuss the multifractal and deformation properties of BiLipschitz mappings.

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Stabilization and control of PDEs: seminal results and recent extension

Auteur correspondant jlr@univ-orleans.fr

Control of PDEs is about the action that one can have on the solution of a PDE through, for example, a source term in the interior of the domain or at the boundary. The goal is then to drive the solution to a prescribed state or close to it at a given time. Stabilization shares the same goal, yet for an infinite time horizon and in the case of a closed-loop: the action one has on the PDE is through a function of the solution itself. One could think for instance of a damping term for the wave equation. In this talk, we shall review some seminal results and methods used to address these issues. Such methods vary from one equation type to the other: waves, Schrödinger,heat, etc… We shall also present some recent results that exploit these techniques.

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Rigidity, nonlinear flows and optimal symmetry for extremals of functional inequalities

The analysis of optimality and symmetry properties of extremals in functional inequalities has been performed recently by introducing nonlinear flows into the picture. These results solve conjectures about symmetry and symmetry breaking in functional inequalities which play an important role in various areas of analysis. Also, as a consequence we have obtained optimal estimates for the principal eigenvalues of linear operators and rigidity results of solutions of nonlinear elliptic PDEs for compact and noncompact in Riemaniann manifolds.

This work has been done in collaboration with J. Dolbeault and M. Loss

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Generalized Multifractality of Whole-Plane SLE

Summary:

We introduce a generalized notion of integral means spectrum for unbounded conformal maps, depending on two moments, giving access to logarithmic coefficients. We study this (averaged) generalized integral means spectrum for unbounded whole-plane SLE. The usual SLE multifractal spectrum, predicted by the speaker in 2000 and proved in expectation by Beliaev and Smirnov in 2005 and almost surely by Gwynne, Miller and Sun in 2014, crosses over to a novel spectrum along phase transition lines in the plane of moment orders. A conjecture is also proposed for the universal generalized multifractal spectrum, which is proved for a certain range of moments.

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To be announced

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Domain decomposition methods for heterogeneous diffusion problems discretized by the finite ele- ment cell-centered scheme

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to be announced

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Big Data and Data Science: Engineering Approach

Summary:

The presentation will focus on an introduction of a Big Data project, engineering approach. The four significant steps therein consist of the acquisition, organization, analyses, and restitution. An evolution of the open source software supporting distributed processing of large data sets is playing an essential role in Big Data projects. Then, classical analytic methods of machine learning and data mining are essential to take into account very large data sets in distributed mode. Finally, some use cases of data science projects are introduced.

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Stabilization to trajectories for parabolic equations

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Questions

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The survival probability of a critical multi-type branching process in i.i.d. random environment

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On spectral collocation methods for solving differential and integral equations

Summary:

Node distributions for computing spectral differentiation matrices and integration matrices are proposed and studied.
A fast algorithm for computing integration matrices for an arbitrary node distribution is developed. Numerical experiments have shown that the proposed node distributions can yield results of higher accuracy than those obtained by the most commonly used Chebyshev-Gauss-Lobatto node distribution.

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Some new results on dynamic inequalities and dynamic systems on time scales

Summary:

In this talk, we present some weighted inequalities for delta derivatives acting on products and compositions of functions on time scales and apply them
to obtain generalized dynamic Opial-type inequalities.
We also give some Picone-type identities and inequalities for a class of first-order nonlinear dynamic systems and derive various weighted inequalities of Wirtinger type and Hardy type on time scales. We apply these results to obtain some
related properties of these systems including Reid's roundabout theorem on disconjugacy, Sturm's separation and comparison theorems, as well as a variational method in the oscillation theory.

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Regime Switching Hidden Markov Models applied to Commodity Term Structure

Summary:

This article analyzes the Commodity Term Structure by using a two-factor model based on the spot price and a convenience yield in a regime switching framework. We use an extension of the Gibson-Schwartz model that may run through different regimes illustrating several equilibrium behaviors of the spot price and the convenience yield. It is assumed that noisy observations of future contracts are available in such a way that commodity markets dynamics
is represented by a regime switching Conditional Linear and Gaussian state space model. We propose first a new algorithm to approximate the conditional distributions of the states (spot, convenience yield and regime indicator) given a set of observations. These approximations are obtained by combining Sequential Monte Carlo methods and Kalman smoothing techniques.
Then, model parameters are estimated with an Expectation Maximization based algorithm.
The performance of the proposed procedure is assessed with Chicago Mercantile Exchange crude oil data.

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A Numerical Scheme for Solutions of Stochastic Differential Equations with Markovian Switching

Summary:

This talk introduces a numerical scheme for approximating solutions of stochastic differential equations with Markovian switching. Our effort is devoted to designing approximation algorithms with faster convergence rates than the commonly used Euler-Maruyama scheme. In contrast to the existing literature of numerical solutions for stochastic differential equations and Markovian switching stochastic differential equations, a new approach incorporating martingale methods, quadratic variations, and Markvian stopping times is developed. Under suitable conditions, the convergence of the algorithms is established. The rate of convergence is also ascertained. In addition, numerical examples are provided to show the agreement with the theoretical convergence order.