TRAG 2024

BOOK OF ABSTRACTS

Speakers

- Bruned, Yvain – Université de Loraine
- Haress, El Medhi – Centrale Supelec
- Tindel, Samy – Purdue University
- Duboscq Romain – INSA Toulouse
- Fitoussi, Mathis – Université d'Évry
- Suciu, Florin – Université Paris Dauphine
- Maurer, Paul – INRIA Université Côte d'Azur
- Richard, Alexandre – Centrale Supelec

Participants

- Agabiti Lorenzo
- Baëza Anton
- Bahrii Anna
- Bec Jérémie
- Béthencourt Loïc
- Bossy Mireille
- Bruned Yvain
- Catellier Rémi
- Considera Andre
- Duboscq Romain
- En-Nebbazi Nassim
- Fitoussi Mathis
- Gassiat Paul
- Goudenège Ludovic
- Haress El Mehdi
- Jaffard Thomas
- Lavigne Pierre
- Le Guerch Thomas
- Lejay Antoine
- Mądry Łukasz
- Maurer Paul
- Nohra Elias
- Richard Alexandre
- Shevchenko Radomyra
- Suciu Florin
- Tanré Etienne
- Tindel Samy

Organizing committee

- Catellier, Rémi – Université Côte d'Azur
- Paul Gassiat – Université Paris Dauphine
- Mireille Capvert – Université Côte d'Azur

	Mardi 2 Juillet	Mercredi 3 Juillet	Jeudi 4 Juillet
09h45 - 10h30		Samy Tindel **Some rough paths techniques in reinforcement learning**	Paul Maurer **Markovian approximation of a Volterra SDE model for intermittency**
10h30 - 11h00		PAUSE	PAUSE
11h00 - 11h45		Mini-cours: Yvain Bruned **Chain rule symmetry for singular SPDEs**	Alexandre Richard **Densities of SDEs driven by fractional Brownian motion, and application to McKean-Vlasov equations**
11h45 - 12h30			FIN DES JOURNEES TRAG 2024
12h30 - 14h00	DEJEUNER	DEJEUNER	
14h00 - 14h45	Mini-cours: Yvain Bruned **Chain rule symmetry for singular SPDEs**	Romain Duboscq **Regularization by noise, a Malliavin calculus approach**	
14h45 - 15h30		Mathis Fitoussi **Weak discretization error techniques for singular drift SDEs**	
15h30 - 16h00	PAUSE	PAUSE	
16h00 - 16h45	El Medhi Haress **Stochastic heat equation with distributional drift: numerical approximation and invariant measures**	Florin Suciu **A gradient flow on control space with rough initial condition**	
Soir		19h : Repas de conférence	

Tuesday 02/07/2024

14h00 - 15h30. Bruned, Yvain (Université de Loraine)

Title. Chain rule symmetry for singular SPDEs

Abstract. In this mini-course, we will report recent results on the characterisation of the chain rule symmetry for the geometric stochastic heat equations in the full subcritical regime for Gaussian and non-Gaussian noises. Such a result is due to a change of perspective on several levels and the use of ideas coming from operad theory and homological algebra. It has many interesting consequences such as local well-posedness for quasi-linear SPDEs and long time existence of solutions when one considers the case of space-time white noise. The course will introduce the various ideas around this result.

References :

- Y. Bruned, V. Dotsenko "Chain rule symmetry for singular SPDEs", arxiv :2403.17066.
- Y. Bruned, M. Gerencsér, U. Nadeem, "Quasi-generalised KPZ equation", arxiv :2401.13620.
- Y. Bruned, F. Gabriel, M. Hairer, L. Zambotti, "Geometric stochastic heat equations", Journal of the American Mathematical Society, 2022, Volume 35, Issue 1, pp 1-80.

16h00 - 16h45. Haress, El Medhi – Central Supelec

Title. Stochastic heat equation with distributional drift : numerical approximation and invariant measures

Abstract. We study the numerical approximation of the stochastic heat equation with a distributional reaction term. We construct a tamed Euler finite-difference scheme and obtain a rate of convergence, which depends on the Besov regularity of the drift. Then we add a Lipschitz reaction term with negative sign to the equation and study it's long-time behaviour. We prove uniform-in-time bounds on the moments of the solutions. This is in part motivated by the Stochastic Allen-Cahn equation and opens up questions on the existence of invariant measures and numerical schemes for such equations.

Wednesday 03/07/2024

9h45 - 10h30. Tindel, Samy – Purdue University

Title. Some rough paths techniques in reinforcement learning

Abstract. In this talk I will start by reviewing some classical results relating machine learning problems with control theory. I will mainly discuss some very basic notions of supervised learning as well as reinforcement learning. Then I will show how noisy environments lead to very natural equations involving rough paths. This will include a couple of motivating examples. In a second part of the talk I will try to explain the techniques used to solve reinforcement learning problems with a minimal amount of technicality. In particular, I will focus on rough HJB type equations and their respective viscosity solutions. If time allows it, I will give an overview of our current research program in this direction.

This talk is based on a joint work with Prakash Chakraborty (Penn State) and Harsha Honnappa (Purdue, Industrial Engineering).

11h00 - 12h30. Bruned, Yvain (Université de Loraine)

Title. Chain rule symmetry for singular SPDEs

Abstract. In this mini-course, we will report recent results on the characterisation of the chain rule symmetry for the geometric stochastic heat equations in the full subcritical regime for Gaussian and non-Gaussian noises. Such a result is due to a change of perspective on several levels and the use of ideas coming from operad theory and homological algebra. It has many interesting consequences such as local well-posedness for quasi-linear SPDEs and long time existence of solutions when one considers the case of space-time white noise. The course will introduce the various ideas around this result. **References :**

- Y. Bruned, V. Dotsenko "Chain rule symmetry for singular SPDEs", arxiv :2403.17066.
- Y. Bruned, M. Gerencsér, U. Nadeem, "Quasi-generalised KPZ equation", arxiv :2401.13620.
- Y. Bruned, F. Gabriel, M. Hairer, L. Zambotti, "Geometric stochastic heat equations", Journal of the American Mathematical Society, 2022, Volume 35, Issue 1, pp 1-80.

14h00 - 14h45. Duboscq, Romain (INSA Toulouse)

Title. Regularization by noise : a Malliavin calculus approach

Abstract. In this talk, we investigate the Cauchy problem of a rough differential equation (RDE) driven by a gaussian rough path and with a singular drift. This question is tackled by considering a type of mild formulation of the RDE through the flow associated to the equation without the drift. It turns out that we can prove a regularization by noise phenomenon thanks to this flow despite the fact that it implicitly depend on the noise. We will develop our idea which is based on to use Malliavin calculus, a martingale decomposition and some interpolations in Besov spaces.

This is a joint work with Rémi Catellier.

14h45 - 15h30. Fitoussi, Mathis (Université d'Évry)

Title. Weak discretization error techniques for singular drift SDEs.

Abstract. Take a stable-driven SDE $dX_t = b(t, X_t)dt + dZ_t(E)$, where b is a singular drift (Hölder, Lebesgue or distributional). In this talk, I will introduce the Euler discretization of (E) and the metrics used to study its convergence. I will then discuss how we can forego the usual regularity assumptions on b by relying instead on the regularity of the law of (E) and on estimates of this law in the dual space of b, as well as the associated results for the weak error. I will also present a few unpolished ideas on how one might try to improve on those techniques.

16h00 - 16h45. Florin Suciu – Université Paris Dauphine

Title. A gradient flow on control space with rough initial condition

Abstract. We consider the (sub-Riemannian type) control problem of finding a path going from an initial point x to a target point y, by only moving in certain admissible directions. We assume that the corresponding vector fields satisfy the Hormander condition, so that the classical Chow-Rashevskii theorem guarantees the existence of such a path. One natural way to try to solve this problem is via a gradient flow on control space. However, since the corresponding dynamics may have saddle points, any convergence result must rely on suitable (e.g. random) initialization. We consider the case when this initialization is irregular, which is conveniently formulated via Lyons' rough path theory. We show that one advantage of this initialization is that the saddle points are moved to infinity, while minima remain at a finite distance from the starting point. In the step2-nilpotent case, we further manage to prove that the gradient flow converges to a solution, if the initial condition is the path of a Brownian motion (or rougher). The proof is based on combining ideas from Malliavin calculus with Lojasiewicz inequalities. A possible motivation for our study comes from the training of deep Residual Neural Nets, in the regime when the number of trainable parameters per layer is smaller than the dimension of the data vector.

Thursday 04/07/2024

9h45 - 10h30. Paul Maurer – INRIA Université Côte d'Azur

Title. Markovian approximation of a Volterra SDE model for intermittency

Abstract.

11h00 - 11h45. Richard, Alexandre (Centrale Supelec)

Title. Densities of SDEs driven by fractional Brownian motion, and application to McKean-Vlasov equations

Abstract. First, we will consider the SDE $dX_t = b(t, X_t)dt + dB_t$, where b is singular (e.g. a distribution) and B is a fractional Brownian motion. We review well-posedness results about this equation, giving criteria that relate the regularity of b and the parameter H. Then we study the time-space regularity of the density of the solution in Lebesgue-Besov spaces. Exploiting this regularity, we prove the existence of solutions for McKean-Vlasov equations of the form $dY_t = \mu_t * b(t, Y_t) + dB_t$, where μ_t is the law of the solution Y_t, for a drift b which is allowed to be more singular than in the linear case. Finally we briefly discuss uniqueness for this McKean-Vlasov equation.

Joint work with L. Anzeletti, L. Galeati and E. Tanré.