Abstracts

Agarwal, Ankush Adam Smith Business School (Glasgow, UK)
Numerical approximations of McKean anticipative backward stochastic differential equations arising in initial margin requirements
We introduce a new class of anticipative backward stochastic differential equations with a dependence of McKean type on the law of the solution, that we name MKABSDE. We provide existence and uniqueness results in a general framework with relaxed regularity assumptions on the parameters. We show that such stochastic equations arise within the modern paradigm of derivative pricing where a central counterparty (CCP) demands each member to deposit variation and initial margins to cover their exposure. In the case when the initial margin is proportional to the Conditional Value-at-Risk (CVaR) of the contract price, we apply our general result to obtain existence and uniqueness of the price as a solution of a MKABSDE. We also provide several linear and non-linear approximations, which we solve using different numerical methods (This is a joint work with Stefano De Marco, Emmanuel Gobet, Jose-German Lopez Salas, Fanny Noubiagain and Alexandre Zhou).

dos Reis, Goncalo University of Edinburgh (Edinburgh, UK)
Importance sampling for McKean-Vlasov SDEs
This talk deals with the Monte-Carlo methods for evaluating expectations of functionals of solutions to McKean-Vlasov Stochastic Differential Equations (MV-SDE) with drifts of super-linear growth. We assume that the MV-SDE is approximated in the standard manner by means of an interacting particle system and propose two importance sampling (IS) techniques to reduce the variance of the resulting Monte Carlo estimator. In the complete measure change approach, the IS measure change is applied simultaneously in the coefficients and in the expectation to be evaluated. In the decoupling approach we first estimate the law of the solution in a first set of simulations without measure change and then perform a second set of simulations under the importance sampling measure using the approximate solution law computed in the first step. For both approaches, we use large deviations techniques to identify an optimisation problem for the candidate measure change. The decoupling approach yields a far simpler optimisation problem than the complete measure change, however, we can reduce the complexity of the complete measure change through some symmetry arguments. We implement both algorithms for two examples coming from the Kuramoto model from statistical physics and show that the variance of the importance sampling schemes is up to 3 orders of magnitude smaller than that of the standard Monte Carlo. The computational cost is approximately the same as for standard Monte Carlo for the complete measure change and only increases by a factor of 2–3 for the decoupled approach. We also estimate the propagation of chaos error and find that this is dominated by the statistical error by one order of magnitude.

Kerimkulov, Bekzhan University of Edinburgh (Edinburgh, UK)
Exponential Convergence and stability of Howard's Policy Improvement Algorithm for Controlled Diffusions
Optimal control problems are inherently hard to solve as the optimization must be performed simultaneously with updating the underlying system. Starting from an initial guess, Howard's policy improvement algorithm separates the step of updating the trajectory of the dynamical system from the optimization and iterations of this should converge to the optimal control.
In the discrete space-time setting this is often the case and even rates of convergence are known. In the continuous space-time setting of controlled diffusion the algorithm consists of solving a linear PDE followed by maximization problem. This has been shown to converge, in some situations, however no global rate of is known. The first main contribution of the work is to establish global rate of convergence for the policy improvement algorithm and a variant, called here the gradient iteration algorithm. The second main contribution is the proof of stability of the algorithms under perturbations to both the accuracy of the linear PDE solution and the accuracy of the maximizationstep. The proof technique uses the theory of backward stochastic differential equations.

Maurelli, Mario University of York (York, UK)
McKean-Vlasov SDEs with irregular drift: large deviations for particle approximation
In this talk we consider McKean-Vlasov SDEs and the associated mean field particle approximations, in the case of an additive (nondegenerate) noise and an irregular, possibly unbounded drift. Our main result is a large deviation principle for the particle system, as the
particle number tends to infinity. This implies in particular that any (weak) limit point of the particle system is a solution to the McKean-Vlasov SDE.

Joint work with Jasper Hoeksema, Thomas Holding, Mark Peletier, Oliver Tse

Anthony Réveillac, INSA de Toulouse (Toulouse, FR),
On a stochastic Hardy-Littlewood-Sobolev inequality with application to Strichartz estimates for a noisy dispersion
In this talk, we investigate a stochastic Hardy-Littlewood-Sobolev inequality. Due to the non-homogenous nature of the potential in the inequality, a constant proportional to the length of the interval appears on the right-hand-side. As a direct application, we derive local Strichartz estimates for randomly modulated dispersions and solve the Cauchy problem of the critical nonlinear Schrödinger equation.

Salkeld, William University of Edinburgh (Edinburgh, UK)
Differentiability of SDEs with drifts of super-linear growth
We close an unexpected gap in the literature of stochastic differential equations (SDEs) with drifts of super linear growth (and random coefficients), namely, we prove Malliavin and Parametric Differentiability of such SDEs. The former is shown by proving Ray Absolute Continuity and Stochastic Gateaux Differentiability. This method enables one to take limits in probability rather than mean square which bypasses the potentially non-integrable error terms from the unbounded drift. This issue is strongly linked with the difficulties of the standard methodology of [Nualart 2006, Lemma 1.2.3] for this setting. Several examples illustrating the range and scope of our results are presented.