Description du mini-symposium : Simulation numérique aléatoire et applications aux mathématiques financières

Organisateur : Noufel Frikha

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Ce mini-symposium contient trois exposés sur la thématique "Simulation numérique aléatoire de systèmes ayant des liens étroits avec des problématiques issues des mathématiques financières". Les sujets abordés sont notamment la simulation d'évènements rares, la quantification optimale comme alternative à la méthode de Monte Carlo pour la simulation de schéma de discrétisation d'équations différentielles stochastiques et des méthodes de simulation de Monte Carlo, dites sans biais. L'accent sera mis sur les applications en mathématiques financières. Ce mini-symposium s'articule autour des trois orateurs suivants :

— Ankush Agarwal, CMAP Ecole Polytechnique ,
— Abass Sagna, ENSIEE, Université d'Evry Val d'Essonne,
— Noufel Frikha, LPMA, Université Paris Diderot.

Rare Event Simulation Related to Financial Risks : Efficient Estimation and Sensitivity Analysis, by Ankush Agarwal.

In this paper, we develop the reversible shaking transformation methods on path space to estimate the rare event statistics arising in different financial risk settings which are embedded within a unified framework of isonormal Gaussian process. Namely, we combine splitting methods with both Interacting Particle System (IPS) technique and ergodic transformations using Parallel-One-Path (POP) estimators. We also propose an adaptive version for the POP method and prove its convergence. We demonstrate the application of our methods in various examples which cover usual semi-martingale stochastic models (not necessarily Markovian) driven by Brownian motion and, also, models driven by fractional Brownian motion (non semi-martingale) to address various financial risks. Interestingly, owing to the Gaussian process framework, our methods are also able to efficiently handle the important problem of sensitivities of rare event statistics with respect to the model parameters (joint work with Stefano De Marco, Emmanuel Gobet and Gang Liu).

Recursive quantization of the Euler scheme of diffusion process and its applications pour quantitative finance, by Abass Sagna.

The recursive quantization method is a new approach which allows us to speak of fast quantization of the Euler scheme of diffusion processes. The fast quantization meaning that we are able to quantize the whole discrete Euler scheme process and to compute the associated

weights and transition probabilities instantaneously. We will describe first the method, then, we will give the approximation error induced by the recursive quantization of the marginals of the Euler scheme process and finaly, we will give some applications to quantitative finance as the pricing of European or American options in local volatility models, the pricing of European options in the Heston model.

First hitting times of one dimensional elliptic diffusions and Monte Carlo simulation, by Noufel Frikha

In this presentation, we obtain properties of the law associated to the first hitting time of a threshold by a one-dimensional uniformly elliptic diffusion process and to the associated process stopped at the threshold. Our methodology relies on the parametrix method that we apply to the associated Markov semigroup. It allows to obtain explicit expressions for the corresponding transition densities and to study its regularity properties up to the boundary under mild assumptions on the coefficients. As a by product, we also provide a probabilistic representation that may be useful for the construction of an unbiased Monte Carlo path simulation method, among other applications.