Osaka-UCL Workshop on Stochastics, Numerics and Risk

Date: March 29th - 30th, 2017.

Venue: International Building Seminar Room, Graduate School of Engineering Science, Osaka University (Toyonaka Campus)

Speakers: Jiro Akahori (Ritsumeikan)
Masaaki Fukasawa (Osaka)
Yuuki Ida (Ritsumeikan)
Yupeng Jiang (UCL)
Andrea Macrina (UCL)
Gareth Peters (UCL)
Benjamin Poignard (Paris, Dauphine)
Dai Taguchi (Ritsumeikan)
Tetsuya Takabatake (Osaka)
Atsushi Takeuchi (Osaka City U)
Camilo Garcia Trillos (UCL)
Toshihiro Yamada (Hitotsubashi)
Kazutoshi Yamazaki (Kansai)
Kazuhiro Yasuda (Hosei)
Rebecca Westphal (ETH Zürich & Osaka)

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Graduate School of Engineering Sciece, Osaka University
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PROGRAM:

March 29 (Wed)

9:00 - 9:50 Masaaki Fukasawa
"At-The-Money Short-Term Asymptotics under Stochastic Volatility Models."

10:00 - 10:50 Gareth Peters
"New Regression Frameworks for Dynamic Functional Regressions with Applications in Risk and Finance."

11:00-11:50 Benjamin Poignard
"Penalized M-Estimators and the Sparse Group Lasso Case: Theory and Applications."

(Lunch break)

13:30-14:10 Tetsuya Takabatake
"Statistical Inference for Fractional Volatility Model."

14:10-14:50 Rebecca Westphal
"Empirical Analysis of the Rough Fractional Stochastic Volatility Model."

(Coffee break)

15:20-16:10 Andrea Macrina
"Switching Information Flows."

16:20-17:10 Kazuhiro Yasuda
"Classical and Restricted Impulse Control for the Exchange Rate with Stochastic Trend."

17:20-18:10 Kazutoshi Yamazaki
"On Optimal Joint Reflective and Refractive Dividend Strategies in Spectrally Positive Levy Models."

March 30 (Thu)

9:30-10:20 Camilo Garcia Trillos
"Martingale Interpolation."

10:30-11:20 Jiro Akahori
"An Order-1 Markov Chain Approximation of Symmetrized Diffusion Processes."

11:30-12:20 Atsushi Takeuchi
"Joint Distributions for Stochastic Functional Differential Equations."

(Lunch Break)

14:00-14:40 Yuuki Ida
"Towards the Exact Simulation Using Hyperbolic Brownian Motion."

14:40-15:20 Yupeng Jiang
"AAD and Least-Square Monte Carlo: Fast Bermudan-Style Options and XVA Greeks."

(Coffee break)

15:50-16:40 Dai Taguchi
"Semi-Implicit Euler-Maruyama Scheme for Non-Colliding Particle Systems."

16:50-17:40 Toshihiro Yamada
"A Second Order Discretization Method for the Delta."

ABSTRACTS:

Jiro Akahori (Ritsumeikan)
"An Order-1 Markov Chain Approximation of Symmetrized Diffusion Processes."

We are interested in the convergence rate of an approximation scheme of probability distribution of hitting time of Brownian motion with drift. The scheme is based on the symmetrization of diffusion process, where the drift becomes discontinuous at a point. The Euler-Maruyama schemes are not ensured to be order 1 in such a case, but I claim that a binary tree approximation attains order 1.

Masaaki Fukasawa (Osaka)
"At-The-Money Short-Term Asymptotics under Stochastic Volatility Models."

We study the short-term asymptotics of stochastic volatility models including rough volatility one. After reviewing several approaches, we focus on an at-the-money density expansion in a general framework. The validity of the expansion is proved. As a corollary we have a limit theorem for the first and second derivatives of the at-the-money implied volatility. It validates also the Medvedev-Scaillet formula. In particular, we show that the rough Bergomi model is consistent to the power law in the term structure of the volatility skew.

Yuuki Ida (Ritsumeikan)
"Towards the Exact Simulation Using Hyperbolic Brownian Motion."

In the present paper, an expansion of the transition density of Hyperbolic Brownian motion with drift is given, which is potentially useful for pricing and hedging of options under stochastic volatility models. We work on a condition on the drift which dramatically simplies the proof.

Yupeng Jiang (UCL)
"AAD and Least-Square Monte Carlo: fast Bermudan-Style Options and XVA Greeks."

We show how Adjoint Algorithmic Differentiation (AAD) can be utilised to calculate price sensitivities in regression-based Monte Carlo methods reliably and orders of magnitude faster than with standard finite-difference approaches. We present the AAD version of the celebrated least-square algorithms of Tsitsiklis and Van Roy (2001) and Longstaff and Schwartz (2001). By discussing in detail examples of practical relevance, we demonstrate how accounting for the contributions associated with the regression functions is crucial to obtain accurate estimates of the Greeks for Bermudan-style options and XVA applications.

Andrea Macrina (UCL)
"Switching Information Flows."

We consider a partially observed system with multiple sources of information that may be active or passive at random times. We generate a switching filtration where the flow of information is modelled via a Markov chain acting on the coordinates of a multivariate Brownian bridge information process. We show that the measure-valued process and the conditional expectation process with respect to this filtration follow jump-diffusion dynamics, where the diffusion part is driven by state-dependent Wiener processes with stochastic volatilities and the jumps are due to information switches. We provide an analytic expression for the distribution of the jump sizes of the conditional expectation process. As an application in Financial Mathematics for the case where information sources never switch off once active, we make use of a sequence of Radon-Nikodym derivatives and price a European call option as the weighted sum of a series of call prices induced by different configurations of active information processes at maturity. Further, we also illustrate how the framework can be applied in modelling a dynamic competition between market agents with different Markov chains. (Co-authors: E. Hoyle & L. A. Menguturk)

Gareth Peters (UCL)
"New Regression Frameworks for Dynamic Functional Regressions with Applications in Risk and Finance."

This talk is based around dynamic functional regression models in state space formulations. These have applications in econometrics, banking and insurance stress testing applications. The work is based on a recent white paper to appear on Bank of England papers series as a guidance for multiple yield curve stress testing.

E. Karimalis, I. Kosmidis and Peters G.W. (2017) "Multi Yield Curve Stress-Testing Framework Incorporating Temporal and Cross Tenor Structural Dependencies." Bank of England Working white paper.

Benjamin Poignard (Paris, Dauphine)
"Penalized M-Estimators and the Sparse Group Lasso Case: Theory and Applications."

The key concept underlying the analysis of high-dimensional data is dimension reduction or regularization. That is the estimates must be constrained regarding the bias-variance trade-off. We will cover commonly used penalization methods and their theoretical properties. We will mainly focus on the so-called oracle property both from a finite-sample and asymptotic point of view. We will extensively study the asymptotic properties of the adaptive Sparse Group Lasso estimator within the penalized M-estimtor framework for dependent variables. We prove that this sparsity based estimator recovers the true underlying sparse model and is asymptotically normally distributed. Then we will study its asymptotic properties in a double-asymptotic framework, where the number of parameters diverges with the sample size. We show by simulations that the adaptive SGL outperforms other oracle-like methods in terms of estimation precision and variable selection.

Dai Taguchi (Ritsumeikan)
"Semi-Implicit Euler-Maruyama Scheme for Non-Colliding Particle Systems."

In this talk, we study a general class of non-colliding particle systems which include Dyson Brownian motions and Dyson-Ornstein-Uhlenbeck processes. After proving the existence and uniqueness of strong solution of these systems under certain conditions, we introduce a non-colliding semi-implicit Euler-Maruyama scheme for systems and study its convergence in strong sense.

Tetsuya Takabatake (Osaka)
"Statistical Inference for Fractional Volatility Model."

A fractional volatility model is greatly concerning with researchers in the mathematical finance because this model can represent a lot of behaviours which can not be done in existing stochastic volatility models which volatility processes are described by the Ito semimartingale. However, in order to be consistent with these feathers of data, we need a logarithmic volatility of the model is driven by the fractional Brownian motion with the Hurst parameter which is less than $1/2$, where this fact contradicts with the stylised fact that the logarithmic volatility satisfies the long memory property. Therefore, we attempt to construct a methodology to estimate the Hurst parameter in the volatility process from a market price and to test whether the long memory property of the volatility is true or not. In this talk, we report several recent research results about this problem from a theoretical point of view.

Atsushi Takeuchi (Osaka City U)
"Joint Distributions for Stochastic Functional Differential Equations."

Consider stochastic functional differential equations with the coefficients depending on the past histories. Clearly, the solution determines a non-Markovian process. In this talk, the absolute continuity for joint distributions of the solution is studied under the uniformly elliptic conditions on the noise-term coefficients, from the viewpoint of the Malliavin calculus. Moreover, some applications are introduced there.

Camilo Garcia Trillos (UCL)
"Martingale Interpolation."

In this talk we introduce a methodology, based on the randomisation of Markov bridges, to construct a martingale process conditioned to match given marginals at given times. We present some interesting properties deduced from the construction of the randomised bridge, including some structural dependence properties. These are illustrated via some simple examples. Based on some numerical studies in discrete Markov chains, we conjecture that the construction is optimal when evaluated under an appropriately defined distance in the space of measures. Joint work with A. Macrina and J. Sekine.

Rebecca Westphal (ETH, Zürich & Osaka)
"Empirical Analysis of the Rough Fractional Stochastic Volatility Model."

The rough fractional stochastic volatility is a fractional Brownian motion based process. In this framework, the Hurst parameter that determines the increments' correlation is less than one half. We propose a comparison between different methods such as an estimation procedure for the Besov smoothness and an adaptation of the Whittle method to high frequency data in order to estimate the Hurst parameter. These methods are applied to empirical stock data and verify that the Hurst parameter is only about 0.1.

Toshihiro Yamada (Hitotsubashi)
"A Second Order Discretization Method for the Delta."

We introduce a second order discretization scheme for the derivative of expectation of the form $E[f(X_T^x)]$ w.r.t. the initial value x of multidimensional diffusion process $(X_t^x)_t$, where non-smooth test functions f are considered. We apply quasi Monte Carlo (QMC) simulation method in the implementation to obtain an efficient computation scheme. The effectiveness is illustrated through examples for the Delta of the option price. This talk is based on joint work with Kenta Yamamoto (Hitotsubashi University).

Kazutoshi Yamazaki (Kansai)
"On Optimal Joint Reflective and Refractive Dividend Strategies in Spectrally Positive Lévy models."

The expected present value of dividends is one of the classical stability criteria in actuarial risk theory. In this context, numerous papers considered threshold (refractive) and barrier (reflective) dividend strategies. These were shown to be optimal in a number of different contexts for bounded and unbounded payout rates, respectively. In this paper, motivated by the behaviour of some dividend paying stock exchange companies, we determine the optimal dividend strategy when both continuous (refractive) and lump sum (reflective) dividends can be paid at any time, and if they are subject to different transaction rates. We consider the general family of spectrally positive Levy processes. Using scale functions, we obtain explicit formulas for the expected present value of dividends until ruin, with a penalty at ruin. We develop a verification lemma, and show that a two-layer (a, b) strategy is optimal. Such a strategy pays continuous dividends when the surplus exceeds level $a > 0$, and all of the excess over $b > a$ as lump sum dividend payments. Results are illustrated. Joint work with Benjamin Avanzi, Jose-Luis Perez, Bernard Wong.

Kazuhiro Yasuda (Hosei)
"Classical and Restricted Impulse Control for the Exchange Rate with Stochastic Trend."

We consider the problem faced by a Central Bank to optimally control the exchange rate, whereby the control is composed of a direct impulsive intervention and an indirect, continuously acting intervention given by the control of the domestic interest rate. We formulate the problem as a mixed classical-impulse control problem and consider a finite horizon that makes the problem time inhomogeneous. The drift in the dynamics of the exchange rate to be time varying or even unobservable so that it has to be filter-estimated from observable data. Numerical illustrations are presented as well. This is a joint work with W.J. Runggaldier in Padova university.