

Workshop on stochastic analysis and applications

June 9, 2023

This event is a small workshop on

STOCHASTIC ANALYSIS AND APPLICATIONS

that will be held on **June 23rd, 2023**. Speakers will present new ideas and insights in the following directions:

Cox-Ingersoll-Ross process, SPDEs, stochastic volatility models, and BSDEs.

We hope this workshop can provide an opportunity for young researchers in stochastics from China and Norway to come together, exchange ideas, and potentially establish new collaborations.

Zoom link: <https://uio.zoom.us/j/67372697091?pwd=NWlpMnU0MExtUTgxMHd6QlJQaXBQUT09>

Conference No.: 673 7269 7091

Password: 116110

Schedule-Title-abstract

All the times refer to the *local Oslo time* in zone **GMT +1**¹:

09:45-09:50 Opening.

09:50-10:20 Speaker: Anton Yurchenko-Tytarenko (*University of Oslo*).

Title: Cox-Ingersoll-Ross process and Skorokhod problems

Abstract: In this presentation, we establish a new connection between Cox-Ingersoll-Ross (CIR) and reflected Ornstein-Uhlenbeck (ROU) models driven by either a standard Wiener process or a fractional Brownian motion with $H > 1/2$. We prove that, with probability 1, the square root of the CIR process converges uniformly on compacts to the ROU process as the mean reversion parameter tends to either $\sigma^2/4$ (in the standard case) or to 0 (in the fractional case). Additionally, we investigate the standard CIR processes of dimension less than 1, with a focus on obtaining an equation of a new type including local times for the square root of the CIR process. We utilize the fact that non-negative diffusion processes can be obtained by the transformation of time and scale of some reflected Brownian motion to derive this equation, which contains a term characterized by the local time of the corresponding reflected Brownian motion. Additionally, we establish a new connection between low-dimensional CIR processes and reflected Ornstein-Uhlenbeck (ROU) processes, providing a new representation of Skorokhod reflection functions.

10:20-10:25 Q & A.

¹Note that the China is 6 hours ahead of Oslo.

10:25-10:55 **Speaker:** Wujun Lv (*Donghua University*).

Title: Existence and Blow-up of solutions for Stochastic Two-component Camassa-Holm System.

Abstract: In this talk, we consider the two-component Camassa-Holm System with multiplicative noise. For these SPDEs, we first establish the local existence and pathwise uniqueness of the pathwise solutions in Sobolev spaces, $s > 3/2$. Then we show that strong enough noise can actually prevent blow-up with probability 1. Finally, we analyse the effects of weak noise and present conditions on the initial data that lead to the global existence and the blow-up in finite time of the solutions, and their associated probabilities are also obtained. This is joint work with Xing Huang.

10:55-11:00 **Q & A.**

11:00-11:30 **Speaker:** Oriol Zamora Font (*University of Oslo*).

Title: Heston-Hawkes stochastic volatility model: change of measure and forward variance.

Abstract: We consider the stochastic volatility model obtained by adding a compound Hawkes process to the volatility of the well-known Heston model. A Hawkes process is a self-exciting counting process with many applications in mathematical finance, insurance, epidemiology, seismology and other fields. We prove a general result on the existence of a family of equivalent (local) martingale measures. We apply this result to a particular example where the sizes of the jumps are exponentially distributed. Finally, we also give the dynamics of the forward variance which can be used to add a tradable asset in this model.

11:30-11:35 **Q & A.**

11:35-12:05 **Speaker:** Wenqiang Li (*Yantai University*).

Title: Backward stochastic differential equations with conditional reflection and related recursive optimal control problems.

Abstract: In this talk, we introduce a new type of reflected backward stochastic differential equations (BSDEs) for which the reflection constraint is imposed on its main solution component, denoted as Y by convention, but in terms of its conditional expectation $\mathbb{E}[Y_t|G_t]$ on a general sub-filtration G_t . We thus term such equation as conditionally reflected BSDE (for short, conditional RBSDE). Conditional RBSDE subsumes classical RBSDE with a pointwise reflection barrier, and the recent developed BSDE with a mean reflection constraint, as its two special and extreme cases: they exactly correspond to G_t being the full filtration to represent complete information, and the degenerated filtration to deterministic scenario, respectively. For conditional RBSDE, we obtain its existence and uniqueness under mild conditions by combining the Snell envelope method with Skorokhod lemma. We also discuss its connection, in the case of linear driver, to a class of optimal stopping problems in presence of partial information. As a by-product, a new version of comparison theorem is obtained. With the help of this connection, we study weak formulations of a class of optimal control problems with reflected recursive functionals by characterizing the related optimal solution and value. Moreover, in the special case of recursive functionals being RBSDE with pointwise reflections, we study the strong formulations of related stochastic backward recursive control and zero-sum games, both in non-Markovian framework, that are of their own interests and have not been fully explored by existing literatures yet.

12:05-12:10 **Q & A.**

12:10-12:15 **Concluding remarks.**