Centre for Doctoral Training
Mathematics of Random Systems

Andrew Wiles Building
Mathematical Institute
Woodstock Road
Oxford OX2 6GG
United Kingdom

info@randomsystems-cdt.ac.uk
www.randomsystems-cdt.ac.uk

University of Oxford
Mathematical Institute

2022 Spring Retreat Draft Timetable

Missenden Abbey, London Road, Great Missenden, Buckinghamshire, HP16 0BD

Monday 4th April

12:00	Welcome & Lunch	
2:00	**Faculty Talk: Christoph Reisinger** **Analysis and implementation of policy gradient methods for continuous-time stochastic control**	
3:00	Break	
3:30	Lorenzo Lucchese	Deep Learning Techniques for High Frequency Limit Order Book Predictions
4:00	Milena Vuletic	Financial time series forecasting via generative adversarial networks
4:30	Mark Jennings	Graph-based methods for multivariate time series forecasting
5:00	Break	
5:30	Martin Peev	Renormalising Fermionic SPDE's
6:00	Min Chul Lee	A rigorous computation of the abelian anomaly based on fermionic functional measure
6:30	Break	
7:30	Dinner	

Faculty Talk: Christoph Reisinger

Analysis and implementation of policy gradient methods for continuous-time stochastic control

We begin this talk by surveying recent advances in solving stochastic control problems using machine learning techniques that optimise a target by gradient steps of parameterized controls. Despite its popularity in the reinforcement learning community, a provably convergent policy gradient method for general continuous space-time stochastic control problems has been elusive. We close the gap by proposing a proximal gradient algorithm for feedback controls of finite time horizon stochastic control problems with controlled drift and possibly degenerate noise, where the objectives are nonconvex in the state and nonsmooth in the control. We prove under suitable conditions that the algorithm converges linearly to a stationary point of the control problem. Next, we discuss a PDE-based, momentum accelerated implementation that exploits a forward-backward splitting approach. Time permitting, we present numerical tests which reveal that our algorithm captures important structures of the optimal feedback control and achieves a robust performance with respect to parameter perturbation.

This is joint work with Wolfgang Stockinger and Yufei Zhang.

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Tuesday 5th April

9:30	Hugo Chu	Conditioned random dynamics: Multiplicative ergodic theorem and Q-process
10:00	Connor Tracy	Transformer Networks for Limit Order Book Prediction
10:30	Giuseppe Tenaglia	Chaos theory in random systems
11:00	Break	
11:30	Rivka Mitchell	Cover Times of Random Trees
12:00	Francesco Pedulla	An approximation scheme for the random evolution of loops on manifolds
12:30	Lunch	
2:00	Joseph Mulligan	Robust Portfolio Optimisation for Systematic Strategies
2:30	Slava Cherepanov	Itô integrals for fractional Brownian motion and applications
3:00	Break	
3:30	William Turner	Signature Kernels and Stratonovich Brownian Motion
4:00	Shyam Popat	The Dean-Kawasaki equation with correlated noise
4:30	Break	
5:00	**Faculty Talk: Johannes Muhle-Karbe** **A Leland Model for Delta Hedging in Central Risk Books**	
6:00	Break	
7:30	Dinner	

Faculty Talk: Johannes Muhle-Karbe:

A Leland Model for Delta Hedging in Central Risk Books

Using a tractable extension of the Leland (1985) model, we study how a delta-hedging strategy can realistically be implemented using market and limit orders in a centralized, automated market-making desk that integrates trading and liquidity provision for both options and their underlyings. In the continuous-time limit, the optimal limit-order exposure can be computed explicitly by a pointwise maximization. It is determined by the relative magnitudes of adverse selection, bid-ask spreads, and volatilities. The corresponding option price (from which the option can be replicated using market and limit orders) is characterized via a nonlinear PDE.

Our results highlight the benefit of tactical liquidity provision for contrarian trading strategies, even for a trading desk that is not a competitive market maker. More generally, the paper also showcases how reduced-form models are competitive with "brute force" numerical approaches to market microstructure. Both the estimation of microstructure parameters, and the simulation of the optimal trading strategy are made concrete and reconciled with real-life high frequency data.

(Joint work with Kevin Webster (on garden leave from Citadel) and Zexin Wang (Imperial))

Preprint: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4049864

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Wednesday 6th April

9:30	Owen Futter	Generative Adversarial Learning for Robust Optimisation
10:00	Jason Rader	Satisfying No-arbitrage Constraints in Swaption Pricing with Machine Learning
10:30	Break	
11:00	Akshunna S. Dogra	Some effective theories and mathe-physical perspectives on deep learning
11:30	Yifan Jiang	Robustness analysis via optimal transport methods
12:00	Lunch	
1:30	Faculty Talk: Pietro Siorpaes Title: A personal journey on robust pricing	
2:30	Break	
3:00	Local walk for 2-3 hours at leisurely pace.	
6:00	Break	
7:30	Dinner	

Faculty Talk: Pietro Siorpaes

A personal journey on robust pricing

An important problem in finance is how to determine prices at which illiquid derivatives should be traded. In this talk I will discuss variants of the standard pricing mechanism, the no-arbitrage paradigm, which are less sensitive to the choice of the underlying model.

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Thursday 7th April

9:30	Karolina Bassa	Climate risk in the financial system - introduction
10:00	Nikkita Ngalande	Mathematical modelling of climate risk
10:30	Break	
11:00	Ziyu Li	Random substitution dynamical systems and random dynamical systems with bounded noise
11:30	Bassols Cornudella Bernat	Stochastic n-point bifurcations on finite spaces
12:00	Roan Talbut	A Statistical Analysis of Phylogenetic Trees
12:30	Closing remarks	
12:45	Lunch	
2:00	Depart	