North-East and Midlands Stochastic Analysis Seminar

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Organisers:

Zdzislaw Brzezniak (York), David Elworthy (Warwick), Chunrong Feng (Durham), Zhongmin Qian (Oxford), Huaizhong Zhao (Durham)

L5, Mathematical Institute, Oxford University
21 September 2022

Talks

14:00-15:00 **Sunil Chhita (Durham)**
GOE Fluctuations for the maximum of the top path in the six-vertex model with DWBC at the ice point

15:00-15:30: Break

15:30-16:30: **Anran Hu (Oxford)**
Some recent progress for continuous-time reinforcement learning and convergence rate

16:30-17:30**: Harald Oberhauser (Oxford)**
Capturing Graphs with Hypo-elliptic Diffusions

If you have any queries, please contact Zhongming Qian (zhongmin.qian@maths.ox.ac.uk).

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Sunil Chhita (Durham)

Title: GOE Fluctuations for the maximum of the top path in the six-vertex model with DWBC at the ice point

Abstract: The six-vertex model is an important toy-model in statistical mechanics for two-dimensional ice with a natural parameter Δ. When $\Delta=0$, the so-called free-fermion point, the model is in natural correspondence with domino tilings of the Aztec diamond. Although this model is integrable for all Δ, there has been very little progress in understanding its statistics in the scaling limit for other values. In this talk, we focus on the six-vertex model with domain wall boundary conditions at $\Delta=1/2$, where it corresponds to alternating sign matrices (ASMs). We consider the level lines in a height function representation of ASMs. We report that the maximum of the topmost level line for a uniformly random ASMs has the GOE Tracy-Widom distribution after appropriate rescaling. This talk is based on joint work with Arvind Ayyer and Kurt Johansson.

Anran Hu (Oxford)

Title: Some recent progress for continuous-time reinforcement learning and convergence rate

Abstract: Recently, reinforcement learning (RL) has attracted substantial research interests. Much of the attention and success, however, has been for the discrete-time setting. Continuous-time RL, despite its natural analytical connection to stochastic controls, has been largely unexplored and with limited progress. In particular, characterizing sample efficiency for continuous-time RL algorithms with convergence rate remains a challenging and open problem. This talk discusses some recent advances in the convergence rate analysis for the episodic linear-convex RL problem, and report a regret bound of the order $O(\sqrt{N\ln N})$ for the greedy least-squares algorithm, with N the number of episodes. The approach is probabilistic, involving establishing the stability of the associated forward-backward stochastic differential equation, studying the Lipschitz stability of feedback controls, and exploring the concentration properties of sub-Weibull random variables. In the special case of the linear-quadratic RL problem, the analysis reduces to the regularity and robustness of the associated Riccati equation and the sub-exponential properties of continuous-time least-squares estimators, which leads to a logarithmic regret.

Harald Oberhauser (Oxford)

Title: Capturing Graphs with Hypo-elliptic Diffusions

Abstract: A classic way to explore a graph is to use a random walk started at a random node in a graph; the macroscopic picture is described by the graph Laplacian. We revisit this motivated by the work of Gaveau from the 1970s about expected signatures. This results in a richer description of the graph structure by taking the history of the random walker into account. Formally, this amounts to replacing the graph Laplacian matrix with a "hypo-elliptic Graph Laplacian". Combined with low-rank functionals of signatures, this allows us to efficiently compute the resulting heat equation. This in turn can be leveraged with standard ML tools such as convolutional graph neural networks, attention, and sequence-to-sequence transformations to use this approach on datasets of large graph. (Joint work with Csaba Toth, Darrick Lee, Celia Hacker).