Southern California Probability Symposium 2019

Confirmed speakers

Bambad Hosseini (Caltech)

Title: Function Space Metropolis-Hastings for Bayesian Inverse Problems with Non-Gaussian Priors

Abstract: Bayesian inverse problems (BIPs) on infinite-dimensional Banach spaces have attracted a lot attention in the context of uncertainty quantification and non-parametric inference with applications in engineering, data science, and physics. However, the theoretical analysis and development of algorithms for solving BIPs has been largely focused on Gaussian priors that are not always adequate. In this talk we give an overview of BIPs with non-Gaussian priors, briefly discussing their well-posedness and perturbation properties as well as some applications. Afterwards, we introduce a new class of Metropolis-Hastings algorithms for interesting non-Gaussian priors and show that the algorithm is reversible in infinite dimensions with a uniform spectral gap, making it discretization invariant.

Mark Huber (Claremont McKenna)

Title: Bernoulli factories, local correctness, and the Fundamental Theorem of Perfect Simulation

Abstract: A *Bernoulli factory* takes a sequence of iid Bernoulli random variables (so either 0 or 1) with unknown mean p, and returns a Bernoulli random variable with mean $f(p)$. For some functions f, such as $p(1 - p)$, this is easy to do. For other functions, like $2p$, this is surprisingly difficult. In fact, Nacu and Peres showed that the ability to generate a $2p$ Bernoulli gave Bernoulli factories for almost all analytic f. In this talk I'll present a new Bernoulli factory for $2p$ that is faster in expected number of variables used than previous methods. Along the way we will use *local correctness* and the Fundamental Theorem of Perfect Simulation, which gives a way to prove the final distribution of the output of general algorithms that make random choices and utilize recursion.

Hanbaek Lyu (UCLA)

Title: Scaling limit of soliton statistics of a multicolor box-ball system

Abstract: The box-ball systems (BBS) are integrable cellular automata whose long-time behavior is characterized by the soliton solutions, and have rich connections to other integrable systems such as Korteweg-de Veris equation. Probabilistic analysis of BBS is an emerging topic in the field of integrable probability, which often reveals novel connection between the rich integrable structure of BBS and probabilistic phenomena such as phase transition and invariant measures. In this talk, we give an overview on the recent development in scaling limit theory of multicolor BBS with random initial configurations. Our analysis uses various methods such as modified Greene-Kleitman invariants for BBS, circular exclusion processes, Kerov–Kirillov–Reshetikhin bijection, combinatorial R, and Thermodynamic Bethe Ansatz.

Mohamed Ndaoud (USC)

Title: Improved clustering algorithms for the Bipartite Stochastic Block Model

Abstract: We consider a Bipartite Stochastic Block Model (BSBM) on vertex sets V1 and V2, and investigate asymptotic sufficient conditions of exact and almost full recovery for polynomial-time algorithms of clustering over V1, in the regime where the cardinalities satisfy |V1| ≪ |V2|. We improve upon the known conditions of almost full recovery for spectral clustering algorithms in BSBM. Furthermore, we propose a new computationally simple procedure achieving exact recovery under milder conditions than the state of the art. This procedure is a variant of Lloyd's iterations initialized with a well-chosen spectral algorithm leading to what we expect to be optimal conditions for exact recovery in this model. The key elements of the proof techniques are different from classical community detection tools on random graphs. In particular, we develop a heavy-tailed variant of matrix Bernstein inequality. Finally, using the connection between planted satisfiability problems and the BSBM, we improve upon the sufficient number of clauses to completely recover the planted assignment.

Mortiz Voss (UCSB)

Title: A two-player stochastic differential price impact game

Abstract: We discuss a two-player linear quadratic stochastic differential game with random terminal state constraints. From a financial mathematic's perspective the game can be motivated as a competition for liquidity between two strategic agents; they interact on a financial market through concurrently trading in a single illiquid risky asset (e.g., a stock) and affecting its price in an unfavorable manner (so-called price impact). The game allows for a unique and explicitly available open-loop Nash equilibrium in feedback form; that is, an equilibrium configuration where no player has an incentive to deviate from. Mathematically, following a probabilistic and convex-analytic approach along the lines of Pontryagin's stochastic maximum principle, the two players' Nash equilibrium strategies are characterized via a coupled system of linear forward backward stochastic differential equations (FBSDEs) which can be solved explicitly. The closed-form equilibrium solution allows for some economically appealing interpretations. Indeed, it turns out that depending on the game's model parameters, different behavioral patterns ranging from cooperation to exploitation between the two agents can emerge as optimal in equilibrium.