Janet Best

“Metastable Stochastic Models for Sleep-Wake Transitions”

Sleep and wake states are governed by competitive interactions between two mutually inhibitory neuronal networks, resulting in a power law distribution of wake bout durations. By what mechanisms may network competition generate power law dynamics? Does network architecture play a role? We explore these questions via examination of three levels of stochastic models: 1) a random graph model, 2) drift-diffusion dynamics of collective variables, and 3) a toy model of regulated Brownian motion.

Alexandra Chronopoulou

"Statistical Inference for fractional SDEs and applications"

Stochastic differential equations driven by fractional Brownian motion have an increasing presence in a wide range of applications,as they can model successfully phenomena that are characterized by long-memory and/or self-similarity. In this talk, we will review their basic theoretical properties, focus on the statistical inference of their parameters and discuss particular applications in bio-physics and mathematical finance.

Cindy Greenwood

"Genesis of Gamma Bursts in Neural Local Field Potentials"

Stochastic process modeling and analysis is beginning to play a role in the understanding of neural processing. This talk addresses local field potential (LFP) data from a recording electrode in the visual cortex of the brain. An LFP time series shows various oscillations including periods of "gamma burst" in a frequency band around 40 Hz. Study of the stochastic dynamics of a 2-dimensional stochastic differential equation model allows us to interpret gamma bursts in terms of excursions of an Ornstein-Uhlenbeck stochastic process.

Alice Guionnet

"Free monotone transport"

I will introduce the classical theory of optimal and monotone transport in classical measure theory and then talk about a recent result obtained with D. Shlyakhtenkho to extend some of this theory to the non-commutative setting and prove isomorphism of von Neumann algebras.

Kay Kirkpatrick

"Bose-Einstein condensation, the NLS, and a central limit theorem"

Near absolute zero, a gas of quantum particles can condense into an unusual state of matter, called Bose-Einstein condensation (BEC), that behaves like a giant quantum particle. The rigorous connection has recently been made between the physics of the microscopic many-body dynamics and the mathematics of the macroscopic model, the cubic nonlinear Schrodinger equation (NLS). I'll discuss recent progress with Gerard Ben Arous and Benjamin Schlein on a central limit theorem for the quantum many-body systems, a step towards large deviations for Bose-Einstein condensation.

Chia Lee

"Designing importance sampling schemes for simulating rare random graphs"

Given an Erdos-Renyi random graph, we ask how to simulate rare events in the random graph such as graphs with excessively large triangle counts. Due to the rarity of the event of interest, the simulation of rare events requires designing efficient sampling schemes. Here, we consider importance sampling schemes based on a family of Gibbs measures that generate exponential random graphs, and show when importance sampling outperforms direct Monte Carlo sampling. In the so-called replica symmetric phase, the choice of Gibbs measure is closely related to recently discovered large deviations results for the Erdos-Renyi graph. On the other hand, little is known about the large deviations rate outside the replica symmetric phase, but in this case simulations show that a modification of the Gibbs measure can nonetheless yield some decent improvement over direct Monte Carlo sampling.

(Joint work with S. Bhamidi, J. Nolen, J. Hannig)

Nevena Maric

“Convergence in a Fleming-Viot particle system”

In the Fleming-Viot particle system there are N particles where each particle evolves as an absorbing Markov chain (driving process). As soon as one particle is absorbed, it reappears, choosing a new position according to the empirical measure at that time. Between the absorptions, the particles move independently of each other. Our focus is in the relation of empirical measure of the FV process in equilibrium with quasi-stationary distributions (qsd) of the driving process. Some questions have been answered for finite space and countable space under certain conditions, but there are still many open problems regarding ergodicity of the FV process, especially in the cases of infinitely many qsd's. I will talk about recent progresses on this topic and present some intriguing simulations results.

Dana Randall

"Sampling paths, permutations and lattice structures"

We will discuss simple, classical Markov chains for efficiently sampling paths and permutations, as well as various natural generalizations. First, we consider sampling biased lattice paths and biased permutations, with applications to tile-based self-assembly, asymmetric exclusion processes, self-organized lists, and biased card shuffling. Next, we show how generating random configurations with multiple paths allows us to sample planar tilings and colorings. Using insights from statistical physics, however, we will see why these methods break down and may be inefficient in models with non-uniform bias, in higher dimensions, or in weighted models with sufficiently high fugacity.

Amandine Veber

"Evolution in a spatial continuum"

The spatial Lambda-Fleming-Viot process models the evolution of the genetic composition of a population spread over some continuous space. In this talk, we shall review some recent results and open questions on this process. In particular, we shall focus on the corresponding genealogical process, when the gene of interest is subject to natural selection.

Amy Ward

"Routing to Minimize Waiting and Callbacks in Large Call Centers"

In a call center, agents may handle calls at different speeds, and also may be more or less successful at resolving customers' inquiries, even when only considering customers calling with similar requests. One common measure of successful call resolution is whether or not the call results in the customer calling back. This presents a natural trade-off between speed and quality, where quality is defined by the percentage of the agent's calls that result in callbacks. The relevant control is the routing; that is, the decision concerning which agent should handle an arriving call when more than one agent is available. We formulate an optimization problem with the dual performance objective of minimizing customer wait time and minimizing the callback rate. We solve this optimization problem asymptotically in the Halfin-Whitt many-server limit regime, interpret its solution as a routing control for the discrete-event system, and show via simulation that the interpreted routing control is on the efficient frontier. In particular, any routing control that has a lower average wait time (callback rate) must also have a higher callback rate (average wait time).
** This is joint work with Dongyuan Zhan.