FRONTIER PROBABILITY DAYS 2007 Program Information

Schedule

Monday, May 21, 2007		
Morning Session	9:00-9:50	Sunder Sethuraman
	9:50-10:20	Chris Orum
	10:20-10:40	Break
	10:40-11:10	Florian Sobieczky
	11:10-12:00	Stefan Heinz
	12:00-2:00	Lunch
Afternoon Session	2:00-2:30	Vicky Yang
	2:30-3:20	Frank Gao
	3:20-3:50	Jesse Gilbert
	3:50-4:10	Break
	4:10-4:40	Robertas Gabrys
	4:40-5:30	David Aldous

Tuesday, May 22, 2007		
Morning Session	9:00-9:50	Davar Khoshnevisan
	9:50-10:20	Burt Simon
	10:20-10:40	Break
	10:40-11:10	Manuel Lladser
	11:10-12:00	Sergei Kuznetsov
	12:00-2:30	Lunch
Afternoon Session	2:30-3:00	Anatolii Puhalski
	3:00-3:50	Noam Berger

Titles and Abstracts

David Aldous. Probability and Spatial Networks.

Abstract. Network design and analysis have been studied in many different applied contexts, yet many simple-to-state abstracted mathematical problems have not been studied very systematically. For a road network on n cities, what is the trade-off between total network length and the efficiency of the network in providing short routes? For an airline network on n cities, requiring routes to have an average of no more that 3 hops, how short can network length be? Such questions can involve probability in several ways. First, the ``average case'' model of randomly-distributed cities is a natural counterpart to worst-case analysis. Second, while upper bounds on performance are obtained by explicit construction, lower bounds need more mathematical arguments provided by classical integral geometry. Third, the Poisson line process turns out to be very useful! (Joint work with Wilf Kendall. The two papers discussed are available at http://arxiv.org/abs/cond-mat/0702502 and http://front.math.ucdavis.edu/math.PR/0701140)

Noam Berger. Detecting the trail of a random walker in a random scenery.

Abstract. Flip a fair coin on each vertex of a transient graph. We call this i.i.d. measure P. Then a random walker re-tosses the coins along its path, this time with a bias. We call this new measure Q. Seeing the configuration, can we tell whether it is a sample of P or of Q? In other words, are P and Q absolutely continuous or singular w.r.t. each other? In this talk we answer this question for a large variety of graphs and walks.

Robertas Gabrys. Portmanteau test of independence for functional observations.

Abstract. In a number of fields, most notably finance and physical sciences, the time series of finely spaced measurements form curves over some natural time interval, e.g. a day or a week. Recent years have seen the development of tools for analyzing such data which rely on concepts of Functional Data Analysis. To validate the assumptions underlying these tools, it is important to apply some test of independence to functional model errors or to suitably transformed functional observations. We propose a χ^2-test for independence and identical distribution which extends to the functional framework a well-established univariate test. The test is easy to implement using the R package fda and relies on the now standard functional principal component decomposition. It has good empirical size and power which, in our simulations and examples, is not affected by the choice of the functional basis. Its application is illustrated on two data sets: credit card sales activity and geomagnetic records. Asymptotic theory based on correlations of matrix valued random variables, functional principal component expansions and Hilbert space techniques is developed.

Frank Gao. Metric Entropy Estimate of some shape-constrained function classes and its small ball connection

Abstract. Shape constrained functions appear very commonly in nonparametric estimation in statistics via renewal theory and mixing of uniform distributions. Metric entropy estimate of these function classes is needed because, as is well known, it determines the rate of convergence of the nonparametric estimators such as the Maximum Likelihood Estimator. In this talk, I will present some recent results on entropy estimate of several shape-constrained multivariate function classes, and on the small ball rate of their associated random processes.

Jesse Gilbert. Tree Packings.

Abstract. We prove a variant of the Ringel-Kotzig conjecture. That is, we show for all connected graphs H of size n, the complete graph K2n+1 has a H-decomposition. We also pose several related questions.

Stefan Heinz. The Probabilistic Approach to Turbulence.

Abstract. The application of stochastic methods to turbulent flow simulations has significant advantages compared to the use of deterministic methods: several important effects (chemical reactions) can be treated exactly, and the closure problems of deterministic equations can be solved on the basis of consistent models for the dynamics of turbulent fluctuations. However, stochastic methods developed previously are still faced with a variety of problems. The talk describes these problems and presents new solution strategies. The talk is organized in four parts. The first part addresses the question of why the development of stochastic methods for turbulence is needed. The second part describes the basics of stochastic methods for

turbulent flows. The modeling of molecular dynamics and turbulent velocity and scalar fields will be discussed. Emphasis is placed on the explanation of problems and novel approaches for their solution. The third part of the talk describes the application of stochastic methods to simulations of turbulence. Both non-reacting and reacting turbulent flows will be considered. The fourth part summarizes these developments and describes future activities.

Davar Khoshnevisan. Dynamical Processes.

Abstract. Consider a sequence of i.i.d.\ random variables $X_1,X_2,\ldots\,.$ To each variable we associated a rate-one Poisson clock, all independent of one another and the X_i's. When a clock ``rings,'' we replace the corresponding X_i with an i.i.d.\ copy. Let $X_i(t)$ denote the value of the X_i variable at time t. Then $t\mapsto (X_1(t),X_2(t),\ldots)$ is a strong Markov process whose invariant measure is the law of the original sequence, $X_1,X_2,\ldots$, of random variables. This model of equilibrium dynamics was introduced in H\"aggstr\"om, Peres, and Steif (1997, 1998) and Benjamini, H\"aggstr\"om, Peres, and Steif (2003), who ascribe the model to P. Malliavin. A variant appears earlier in the work of Rusokov (1995). When the X_i's take the values zero and one, Benjamini, H\"aggstr\"om, Peres, and Steif (2003) showed that there can be times t when the process $(X_1(t),X_2(t),\ldots)$, of zeros and ones, can have unusually long runs of ones (say). R\'ev\'esz (2005) has made a conjecture about the length of runs of ones that have a predescribed number of ``impurities.'' Here we describe: 1. A resolution of R\'ev\'esz's conjecture, and mention some of the consequences of the method of proof; 2. A solution to a problem of Benjamini et al (2003) on a connection between their parity test and the potential theory of Riesz; and 3. Time permitting, describe analogous problems for dynamical percolation on trees. Much of this material (1 and 2) is based on joint work with David Levin and Pedro M\'endez.

Sergei Kuznetsov. On the equivalence of traces for solutions of non-linear PDE.

Abstract. There exist two approaches to the problem of classification of positive solutions of semilinear PDE in terms of their boundary traces. One of them is (partly) probabilistic, suggested by Dynkin and the speaker (DK-trace or fine trace). The other is purely analytic, suggested by Marcus and Veron (recently suggested MV-trace or exact trace). Since the definitions of the traces are absolutely different, the relation between them is not clear. We prove that the traces are, in fact, equivalent up to indistinguishiability.

Manuel Lladser. Minimal Markov chain representation of patterns problems.

Abstract. The study of regular patterns in random strings relies strongly on the Markov chain embedding technique. This technique consists in embedding a random string into a Markov chain that is at the same time informative of the pattern of interest. An important application of this technique is the assessment of patterns in RNA or DNA sequences: the main heuristic in genomic searches is that over- or under-represented patterns in the genome are of biological significance. The talk will characterize the smallest state-space size Markov chain required to specify the exact or asymptotic distribution of the count statistic of a regular pattern in the context of non-stationary Markov sources. The characterization of such a chain is important to analyze patterns, which a priori require exponentially large state spaces e.g. due to a large Markov order. Some on-going research in the same lines but in the context of non-Markovian strings will be also addressed during the talk.

Chris Orum. Branching processes and Navier-Stokes equations.

Abstract. The model for the analysis of Navier-Stokes equations that was introduced by Le Jan and Sznitman (PTRF, Vol 109, No. 3, 1997) involved representing the solution as the expected value of a multiplicative functional defined on a stochastic branching process. Some results stemming from the line of research started by their paper will be discussed.

Anatolii Puhalskii. The large deviation principle for join the shortest queue.

Abstract. A large deviation principle is established for a broad class of join-the-shortest-queue models. The action functional is expressed in terms of solutions to mathematical programming problems. The large deviation limit point is identified as a weak solution to a system of idempotent equations. Uniqueness of the weak solution is proved by establishing trajectorial uniqueness.

Burt Simon. Performance Analysis of a Base-station Queue in a Wireless Communication Network

A base-station in a wireless network is a receiver/transmitter that communicates with the wireless devices in its coverage region ("cell"). We imagine a plane with base-stations scattered about. Each base-station has a fixed coverage region, e.g., its Voronoi cell. Active wireless devices appear and disappear as a (spatial) birth-death process. While a device is active, it transmits data to its base-station at a rate b_i that depends on the state i of a transient, continuous-time Markov chain, Z(t). When Z(t) expires, the device "dies". We conjecture the form of a heavy traffic limit for the basestation queue, which turns out to be a reflected Brownian motion whose drift and variance terms can be expressed explicitly in terms of the basic model parameters. As the average number of active devices in a cell increases, a properly scaled version of the vector Q(t) (the number of devices in each state of the Markov chain) converges to a certain multidimentional Ornstein-Uhlenbeck process which can be used to approximate Q(t). The auto-covariance function for the OU process is the same as for Q(t), and the OU process is easier to work with in some applications. Wireless devices outside of a given cell cause interference with the devices within the cell, and this directly affects the dynamics of Z(t). If the wireless devices are scattered around the plane as a (spatial) Poisson process, and a few other technical conditions are satisfied, we can derive the Laplace transform of the stationary distribution of the total interference level at a fixed location.

Sunder Sethuraman. On nonequilibrium fluctuations of a tagged particle in zero-range interacting systems.

Abstract. The 'zero-range' particle system, one of several introduced in the '70's as models of certain physical phenomena, follows a collection of random walks on a lattice which interact infinitesimally only with those particles already at their various locations. In this talk, we consider the asymptotics of a distinguished, or tagged particle in this interacting particle system. In particular, we discuss a 'nonequilibrium' invariance principle, in one dimension when the transition rates are unbiased, with respect to a diffusion whose coefficients depend on the 'hydrodynamic' density, and give some open questions.

Florian Sobieczky. Strong amenability of horocyclic products of Galton Watson trees.

Abstract. Certain percolative partial graphs of the horocyclic product of two homogeneous trees are considered. Removal of edges by a Bernoulli bond-percolation process is carried out only on a subset of the set of edges. By its construction, the connected component containing a preassigned root is the horocyclic product of two random trees, sampled from the augmented Galton Watson measure. It is shown, that it is almost surely amenable, if the offspring-distributions of the two Galton Watson trees have supports with non-empty intersection. Given the case in which the percolation results from the horo- cyclic product of two trees realized as samples of two identical independent augmented Galton Watson measures, there is strong amenability, almost surely. For a subclass of these random product graphs, sufficient closeness to unsymmetric horocyclic products guarantees anchored expansion. In this case, we show the existence of a phase- transition between strong amenability and weak non-amenability.

Vicky Yang. Estimation for Non-negative Levy-driven Ornstein-Uhlenbeck Processes.

Abstract. The Ornstein-Uhlenbeck process (or stationary continuous-time autoregression of order 1, i.e. CAR(1)) driven by non-decreasing Levy process has been used to model stochastic volatility of the log prices of financial assets (see e.g. Barndorff-Nielsen and Shephard (2001)). In this talk, I will present a highly efficient method of estimation for the parameters of a CAR(1), taking advantage of the non-negativity of the driving process. I will also show how to reconstruct the background driving Levy process from a continuously observed realization of the process and use this result to estimate the increments of the Levy process itself when closely-spaced observations are available. Then, I derive the asymptotic distribution of the coefficient estimator for a gamma-driven CAR(1) and illustrate the performance of the procedure through a simulation study. Lastly, a real dataset is analyzed using our estimation procedure.