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Speaker: Ed Perkins
Title: On the Boundary of Super-Brownian Motion

Abstract: After a brief historical review, we calculate the Hausdorff dimension of the boundary of d-dimensional super-Brownian motion for d\le 3.

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Speaker: Alison Etheridge
Title: Super-Brownian motion and the Spatial Lambda-Fleming-Viot process

Abstract: In a series of papers, Cox, Durrett, Merle and Perkins showed that when suitably rescaled, sparse voter models converge to superBrownian motion. Since the mechanism that drives the spatial Lambda-Fleming-Viot process (SLFV) is essentially a continuum voting rule, it is not unreasonable to hope to extract a superBrownian motion as the population of individuals of a rare type in the SLFV. We present (almost complete) work which verifies that this can indeed be done. Moreover, we can prove the somewhat more surprising result, that by choosing the dynamics of the SLFV appropriately we can recover superBrownian motion with stable branching in an analogous way. This is a spatial analogue of (a special case of) results of Bertoin and Le Gall (2006), who show that the generalised Fleming-Viot process that is dual to the beta-coalescent, when suitably rescaled, converges to a continuous state branching process with stable branching mechanism. Joint work with Jonathan Chetwynd-Diggle, Oxford.

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Speaker: Sarah Penington
Title: Branching Brownian motion, mean curvature flow and the motion of hybrid zones.

Abstract: Hybrid zones are interfaces between populations which can occur when two genetically distinct groups interbreed, but hybrid offspring have a lower evolutionary fitness. We can model this situation using the spatial Lambda-Fleming-Viot process. I will discuss a result on the motion of hybrid zones and also a related probabilistic proof of a known PDE result connecting the Allen-Cahn equation and mean curvature flow. The proofs rely on duality relations with a branching and coalescing random walk and a branching Brownian motion. Joint work with Alison Etheridge and Nic Freeman.

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Speaker: Christina Curtis
Title: Quantifying tumor evolution through spatial computational modeling and Bayesian statistical inference

Abstract: Cancer results from the acquisition of somatic alterations in an evolutionary process that typically occurs over many years, much of which is occult. Understanding

the evolutionary dynamics that are operative at different stages of progression in individual tumors might inform the earlier detection, diagnosis, and treatment of cancer. Although these processes cannot be directly observed, the resultant spatiotemporal patterns of genetic variation amongst tumor cells encode their evolutionary histories. For example, we recently described a ‘Big Bang’ model of human colorectal tumor growth, whereby after transformation, the neoplasm grows predominantly as a single expansion in the absence of stringent selection and where the timing of a mutation is the fundamental determinant of its frequency in the final tumor. By analyzing multi-region genomic data within a spatial agent-based tumor growth model and Bayesian statistical inference framework, we demonstrated the early origin of intra-tumor heterogeneity and delineated the dynamics of tumor growth in a patient-specific manner. The Big Bang model is compatible with effectively neutral evolution and suggests that not all tumors exhibit stringent selection after transformation, thereby challenging the de facto clonal expansion model. These findings emphasize the need for the systematic evaluation of different modes of evolution across different tumor types and methods to infer the role of natural selection in established human tumors. To address this need, we developed an extensible framework to simulate spatial tumor growth and evaluate evidence for different modes of tumor evolution. Application of this approach to multi-region sequencing data from diverse tumor types reveals different evolutionary modes and tempos with implications for how human tumors progress and ultimately how they may be more effectively treated.

Speaker: David Aldous
Title: Random partitions of the plane via Poissonian coloring, and a self-similar process of coalescing planar partitions

Abstract: Plant differently colored points in the plane; then let random points (``Poisson rain'') fall, and give each new point the color of the nearest existing point. Previous investigation and simulations strongly suggest that the colored regions converge (in some sense) to a random partition of the plane. We prove a weak version of this, showing that normalized empirical measures converge to Lebesgue measures on a random partition into measurable sets. Topological properties remain an open problem. In the course of the proof, which heavily exploits time-reversals, we encounter a novel self-similar process of coalescing planar partitions. In this process, sets A(z) in the partition are associated with Poisson random points z, and the dynamics are as follows. Points are deleted randomly at rate 1; when z is deleted, its set A(z) is adjoined to the set A(z') of the nearest other point z'.

Speaker: Elchanan Mossel
My title is: Between Phylogeny and Deep Learning: Some Rigorous models and results.

Abstract: I will discuss a probabilistic generative model that interpolates between

standard Markov model on trees and model of deep nets. Some results and many open problems will be presented.

Speaker: Robin PEMANTLE, Univesrity of Pennsylvania

Title: (some of) my favorite (current) problems

Abstract: I will discuss half a dozen currently open problems, on topics such as interacting systems of points on a line, random recursions, activated random walks, mixing times and relations to complexity theory.

Speaker: Timo Seppalainen
Title: Variational formulas and geodesics for percolation models

Abstract: First-passage percolation has remained a challenging field of study since its introduction in 1965 by Hammersley and Welsh. Two fundamental results go back to Rick Durrett's papers from 1981: the shape theorem by Cox and Durrett and the flat edge in the percolation cone by Durrett and Liggett. This talk discusses recently found variational descriptions of the limit shape of first-passage percolation and some related ideas, such as a convex duality between the mean edge weight and the Euclidean length of the geodesic. Based on joint work with Arjun Krishnan and Firas Rassoul-Agha.

Speaker: Daniel Remenik
Title: The KPZ fixed point

Abstract: I will describe the construction and main properties of the KPZ fixed point, which is the scaling invariant Markov process conjectured to arise as the universal scaling limit of all models in the KPZ universality class, and which contains all the fluctuation behavior seen in the class. The construction follows from an exact solution of the totally asymmetric exclusion process (TASEP) for arbitrary initial condition. This is joint work with K. Matetski and J. Quastel.

Speaker: Michael Damron
Title: The travel time to infinity in percolation

Abstract: On the two-dimensional square lattice, assign i.i.d. nonnegative weights to the edges with common distribution F. For which F is there an infinite self-avoiding path with finite total weight? This question arises in first-passage percolation, the study of the random metric space Z^2 with the induced random graph metric coming from the above

edge-weights. It has long been known that there is no such infinite path when F(0)<1/2 (there are only finite paths of zero-weight edges), and there is one when F(0)>1/2 (there is an infinite path of zero-weight edges). The critical case, F(0)=1/2, is considerably more difficult due to the presence of finite paths of zero-weight edges on all scales. I will discuss work with W.-K. Lam and X. Wang in which we give necessary and sufficient conditions on F for the existence of an infinite finite-weight path. The methods involve comparing the model to another one, invasion percolation, and showing that geodesics in first-passage percolation have the same first order travel time as optimal paths in an embedded invasion cluster.

Speaker: Allan Sly
Title: Evolving Voter Model on Dense Random Graphs

Abstract: The evolving voter model, is a model of evolving random graphs. In the standard voter model when a neighbouring site has a different state the vertex may adopt this site with some rate. The evolving voter model adds the additional possibility of instead removing the edge to the neighbour and attaching it to a different vertex. In a sense, if you disagree with your friend you can change your opinion or you find a different friend. Durrett et. al. (PNAS 2012) studied this model and made numerous predictions including a phase transition in the time to separate into two components of uniform opinions. We verify some of these predictions in a dense version of the model. Many open problems remain. Joint work with Riddhipratim Basu

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Speaker: Ted Cox
Title: Weak atomic convergence of finite voter models to Fleming-Viot processes

Abstract: We consider empirical measures of multi-type voter models with mutation on large finite sets, and prove weak atomic convergence in the sense of Ethier and Kurtz (1994) to a Fleming-Viot process. Convergence in the weak atomic topology is strong enough to give a partial answer to a question raised in Aldous (2013) concerning an entropy statistic of the relative sizes of voter clusters.