First Joint Meeting Brazil-Italy of Mathematics
Special Session # 14: Stochastic processes in random environment and applications

Rio de Janeiro, August 29 - September 02, 2016

Note: the name in **bold** among the authors identifies the speaker.

Title: Rhythmic behavior in large-scale systems.

Authors: **Paolo Dai Pra**, Francesca Collet, Marco Formentin, Elena Sartori, Marco Tolotti.

Abstract: Systems comprised by many interacting components may exhibit, in the thermodynamic limit, time-periodic behavior in some macroscopic observable. When the microscopic dynamics are described by irreducible, continuous-time Markov processes, this is a purely thermodynamic phenomenon, since no periodicity is allowed at the microscopic level. The study of this phenomenon is mainly motivated by its applications to neurosciences, more specifically to systems of interacting neurons, but is occurs in many other contexts, including multi-agent systems in Economics. In this talk we show that rhytmic behavior may arise by suitably breaking time-symmetry in a reference reversible model. Sources of symmetry breaking include: dissipation, delay, quenched randomness. We finally suggest a further mechanism that is related to strategic behavior of microscopic units, and requires a game-theroretic approach.

Title: Two-dimensional random interlacements and late points for random walks

Authors: Francis Comets, **Serguei Popov**, Marina Vachkovskaia.

Abstract: We define the model of two-dimensional random interlacements using simple random walk trajectories conditioned on never hitting the origin, and then obtain some properties of this model. Also, for random walk on a large torus conditioned on not hitting the origin up to some time proportional to the mean cover time, we show that the law of the vacant set around the origin is close to that of random interlacements at the corresponding level. Thus, this new model provides a way to understand the structure of the set of late points of the covering process from a microscopic point of view. Also, we discuss a continuous version of the model.

Title: Modified contact processes as models for biological colonies

Authors: **Daniela Bertacchi**, Nicolas Lanchier, Gustavo Posta, Fabio Zucca

Abstract: In this talk we discuss the asymptotic behaviour of a population which lives on a spatial structure, which is $\mathbb{Z}^d$ or its percolation cluster. Individuals breed and die; offspring are placed onto neighbouring sites. In the classical contact process, when one individual is present at site x, no other individual is allowed to be placed at x. In our processes, there is a penalization function which penalizes birth at crowded sites (if the penalization is the highest possible, then births are prevented on occupied sites and one obtains the usual contact process). We provide conditions for extinction or survival.

Title: Generalized Nonlinear Yule Models

Authors: **Federico Polito**

Abstract: We propose a fractional nonlinear modification of the classical Yule model often studied in the context of macrovolution. The model is analyzed and interpreted in the framework of the development of networks such as the World-wide Web. Nonlinearity is introduced by replacing the linear birth process governing the growth of the in-links of each specific webpage with a fractional nonlinear birth process with completely general birth rates. The fractional nonlinear birth process can be viewed as a classical nonlinear birth process evolving in a suitable random environment. Furthermore the fractionality added by the presence of fractional operators furnishes the model with a persistent memory. Among the main results we derive the explicit distribution of the number of in-links of a webpage chosen uniformly at random taking separated the contribution to the asymptotics and the finite time correction. The mean value of the latter distribution is also calculated explicitly in the most general case. Furthermore, in order to show the usefulness of our results, we particularize them in the case of specific birth rates giving rise to a saturating behaviour, a property that is often observed in nature.

Title: TBA

Authors: **Heinrich Matzinger**

Abstract:

Title: Poisson Boundary and Transformations of Markov Chains.

Authors: **Iddo Ben-Ari**, Behrang Forghani.

Abstract: We discuss the stability of the Poisson boundary of a Markov chain under transformations. We will focus on the following class of transformations. Given a Markov chain $X = (X_n : n \geq 0)$, a stopping time for X, τ, a non-decreasing sequence of stopping times is defined: $\tau_0 = 0$, $\tau_{n+1}(X) = \tau \circ \theta_{\tau_n}(X)$, where θ_n is the shift operator $\theta_n(X) = (X_n, X_{n+1}, \dots)$. The transformed process $Y = (Y_n : n \geq 0)$ is obtained by letting $Y_n = X_{\tau_n}$, namely Y_n is equal to X sampled at the "n-th iteration" of τ, and we ask when the Poisson boundary of Y and X coincide.

Title: A Decoupling of Random Interlacements.

Authors: Diego Bernardini, **Christophe Gallesco**, Serguei Popov

Abstract: In this talk, we will first present the random interlacements process introduced by Sznitman in 2010. Then, we will construct a coupling between the random

interlacements process restricted to two disjoint balls of the same size and a "soup" of independent excursions of simple random walks. Our construction is obtained by mean of the soft local time technique introduced by Popov and Teixeira in 2012. Finally, we will provide an application of this result.

Title: Convergence to upper equilibrium for two state contact process
Authors: E. Andjel, T. Mountford and D. Valesin
Abstract:

We consider a two state contact process where one state is subordinate to the other on a natural "one sided" set of configurations. We characterize the equilibrium distributions for the process seen from the rightmost dominant class element and give necessary and sufficient conditions for convergence to the upper invariant distribution.