III Congresso Brasileiro de Jovens Pesquisadores
em Matemática Pura, Aplicada e Estatística

Curitiba, December 12-14, 2018

Session: Processos Estocásticos e Aplicações

Organized by Alexsandro Gallo (Universidade Federal de São Carlos)
and Florencia Leonardi (Universidade de Sâo Paulo)

Schedule

Wednesday, December 12

9:00 - 9:30	Opening
9:30 - 10:30	Plenary talk 1
10:30 - 11:00	Coffee break
12:00 - 13:30	Lunch
13:30 - 14:30	Plenary talk 2
16:40 - 17:10	Coffee break
17:10 - 18:40	Round Table

Thursday, December 13

9:00 - 10:00	Plenary talk 3
10:00 - 10:30	Coffee break
12:00 - 13:30	Lunch
13:30 - 14:30	Plenary talk 4
14:40 - 15:20	Roberto Imbuzeiro Oliveira (IMPA) *A high dimensional central limit theorem for martingales, with applications*
15:20 - 16:00	Guilherme Ost (UFRJ) *Sparse space-time models: Concentration Inequalities and Lasso*
16:00 - 16:40	Aline Duarte de Oliveira (USP) *Estimating the interaction graph of stochastic neural dynamics*
16:40 - 17:10	Coffee break
17:10 - 17:50	Cristian Favio Coletti (UFABC) *Global survival of tree-like branching random walks*
17:50-18:30	Dirk Erhard (UFBA) *Non-equilibrium fluctuations for the simple symmetric exclusion process with a slow bond*
20:00 - 0:00	Social dinner

Friday, December 14

9:00 - 10:00	Plenary talk 5
10:00 - 10:30	Coffee break
10:30 - 11:10	Erika Alejandra Rada Mora (UFABC) *Ornstein and Weiss theorem for entrance time and Rényi Entropy*
11:10 - 11:50	Rodrigo Lambert (UFBA) *Limit theorems for fads diffusion via generalized Pólya urn models*
12:00 - 13:30	Lunch
13:30 - 14:30	Plenary talk 6
14:40 - 15:20	Jorge Guerra Pires (UFBA) *Stochastic models in medicine and life sciences: a short-term dynamics for ghrelin*
15:20 - 16:00	Guilherme Vieira Nunes Ludwig (Unicamp) *Interacting cluster point process model for epidermal nerve fibers*
16:00 - 16:40	Leonardo Bacelar Lima Santos (MCTI) *Matemática Aplicada a Redução do Risco de Desastres*
16:40 - 17:10	Coffee break
17:10 - 18:40	Assembly

Abstracts

1. *Speaker:* **Roberto Imbuzeiro Oliveira**
   Affiliation: IMPA
   Title: ***A high dimensional central limit theorem for martingales, with applications***

   We establish a quantitative central limit theorem for the largest coordinate in a high dimensional vector martingale. In a nutshell, we show that the maximum distribution matches that of a Gaussian vector with matching covariance. In fact, this holds even when the dimension of the vector grows rapidly with the sample size. In the spirit of the work of Chernozhukov, Chetverikov and Kato on the iid case, we show that one can use our theorem to build bootstrap confidence intervals. In particular, we use this in context-tree based estimation of time series.

2. *Speaker:* **Guilherme Ost**
   Affiliation: UFRJ
   Title: ***Sparse space-time models: Concentration Inequalities and Lasso***

   Inspired by Kalikow-type decompositions, we introduce a new stochastic model of infinite neuronal networks, for which we establish oracle inequalities for Lasso methods and restricted eigenvalue properties for the associated Gram matrix with high probability. These results hold even if the network is only partially observed. The main argument rely on the fact that concentration inequalities can easily be derived whenever the transition probabilities of the underlying process admit a sparse space-time representation.

3. *Speaker:* **Aline Duarte de Oliveira**
   Affiliation: Universidade de São Paulo
   Title: ***Estimating the interaction graph of stochastic neural dynamics***

   We consider a stochastic model for a system of interacting neurons and address the question of statistical model selection for this class of stochastic models. More preciselly, each neuron will be modeled as a chains with memory of variable length. The relationship between a neuron and its pre and postsynaptic neurons defines an oriented graph, the interaction graph of the model. In this seminar we present a consistent procedure to estimate this graph based on the observation of the spike activity of a finite set of neurons over a finite time.

4. *Speaker:* **Cristian Favio Coletti**
   Affiliation: UFABC
   Title: ***Global survival of tree-like branching random walks.***

   The reproduction speed of a continuous-time branching random walk is proportional to a positive

parameter λ. There is a threshold for λ, which is called λ_w, that separates almost sure global extinction from global survival. Only for some classes of branching random walks it is known that the global critical parameter λ_w is the inverse of a certain function of the reproduction rates, which we denote by K_w. We provide here new sufficient conditions which guarantee that the global critical parameter of tree-like branching random walks equals $1/K_w$. This result is part of a joint work with Bertacchi, D. and Zucca, F. (ALEA, v. 14, p. 381-402, 2017).

5. *Speaker:* **Dirk Erhard**
Affiliation: Universidade Federal da Bahia
Title: ***Non-equilibrium fluctuations for the simple symmetric exclusion process with a slow bond***

The simple symmetric exclusion process with a slow bond in one dimension is an interacting particle system that can be described as follows: particles perform one-dimensional independent simple random walks subject to (i) two particles never occupy the same site at the same time; (ii) the jump rate over any fixed edge is 1, except over the edge connecting 0 to 1, here the jump rate is α/n, where α is a positive constant and n is a parameter that will be send to infinity. In this talk I consider the case in which the above process starts out of equilibrium and I will discuss its fluctuations around its mean. It turns out that at large scales they can be described by a generalised Ornstein-Uhlenbeck process, which formally is given by a linear SPDE. This is joint work with Tertuliano Franco, Patrícia Gonçalves, Adriana Neumann and Mariana Tavares.

6. *Speaker:* **Erika Alejandra Rada Mora**
Affiliation: CMCC-UFABC
Title: ***Ornstein and Weiss theorem for entrance time and Rényi Entropy***

For ergodic systems with generating partitions, the well known result of Ornstein and Weiss shows that the exponential growth rate of the recurrence time is almost surely equal to the metric entropy. Here we look at the exponential growth rate of entrance times, and show that it equals the entropy, where the convergence is in probability in the product measure. This is however under the assumptions that the limiting entrance times distribution exists almost surely. This condition looks natural in the light of an example by Shields in which the lim sup in the exponential growth rate is infinite almost everywhere but where the limiting entrance times do not exist. We then also consider ϕ-mixing systems and prove a result connecting the Rényi entropy to sums over the entrance times orbit segments. Joint with N. Haydn, M. Ko and C. Gupta.

7. *Speaker:* **Rodrigo Lambert**
Affiliation: FAMAT-UFU/DMAT-UFBA
Title: ***Limit theorems for fads diffusion via generalized Pólya urn models***

We propose a model for diffusion of social decisions. The main results are classical limiting theorems for the proportion of some decision (tendency) on the population. The proofs include a linkage between non-markovian stochastic processes with memory lapses and generalized Pólya urn models with random replacement rules. This is joint work with M. González-Navarrete.

8. *Speaker:* **Jorge Guerra Pires**
Affiliation: Federal University of Bahia
Title: ***Stochastic models in medicine and life sciences: a short-term dynamics for ghrelin***

One of the approaches to making sense of experimental data is by mathematical modeling: herein we show how mathematical modeling can be used to make sense of interpret experimental data from physiology (i.e., an alternative approach for methodologies more well-known, e.g., machine learning), using stochastic differential equation, derived from a set of differential equations. Physiological processes at several scales (i.e., subcellular, cellular, tissue, organ and even population) are inherently stochastic due to a great variety of noisy factors affecting the phenomenon under investigation. In view of that, in recent years there has been an increased emphasis into modeling the randomness inherent in many physiological phenomena, and tools like Stochastic Differential Equations (SDEs) have found initial applications. Herein, it is exploited the Itô's formulation, more precisely what is called the Itô's formula, as a mathematical formulation of the SDE. On the other hand, ghrelin is an orexigenic hormone; i.e., it is an appetite stimulant; different from leptin, it works in a matter of minutes; it raises within 1-2 before each meal and falls off about one hour after. The production of ghrelin is influenced by mainly two group of factors; 1) macronutrients (bloodstream); and 2) signals from the gastrointestinal tract; others would be environment and tastants. Herein it is presented a stochastic model for modeling the contribution from the gastrointestinal tract on ghrelin control, a physiological phenomenon. The mathematical models are applied to an in vivo dataset, collected from a third-party publication.

9. *Speaker:* **Guilherme Vieira Nunes Ludwig**
Affiliation: Universidade de Campinas (UNICAMP)
Title: ***Interacting cluster point process model for epidermal nerve fibers***

We propose an interacting cluster model for the spatial distribution of epidermal nerve fibers. The model is an interacting spatial point process for the centers of nerve fiber bundles, where from each center a random number of fibers start. The center process is, however, inhibited by fiber endings that belong to different center bundles. The fibers themselves have random length and spatial orientation, following a von Mises distribution. We examine the processes that can be described with our model, how coefficient estimation can be performed via Markov chain Monte Carlo methods, and detail approaches for the implementation of efficient MCMC sampling schemes. An application to diabetic neuropathy data is presented, as well as a simulation study. Joint work with Nancy Garcia (Unicamp) and Peter Guttorp (University of Washington)

10. *Speaker:* **Leonardo Bacelar Lima Santos**
Affiliation: Centro Nacional de Monitoramento e Alertas de Desastres Naturais (Cemaden/MCTI)
Title: ***Matemática Aplicada a Redução do Risco de Desastres***

A matemática tem papel fundamental na redução do risco de desastres, em suas diversas componentes. Técnicas de análise da Atmosfera como sistema dinâmico não linear, acoplado e complexo, unem-se a análises estatísticas para a detecção antecipada de eventos extremos, que ao encontrar ambientes e populações vulneráveis deflagram ocorrências. Análises multiescala e adaptativas podem revelar diversas peculiaridades das dinâmicas. Os terrenos são a base territorial dos eventos - multifractais e tensores de estabilidade são valiosas ferramentas para análise de propriedades relacionadas a escorregamentos. Aprendizagem de máquina e Cadeias de Markov representam inovações promissoras em modelagem hidrológica. Pesquisa operacional e otimização combinatória podem ajudar na expansão da rede observacional hidro-geo-meteorológica do país. Além de perdas diretas em vidas humanas, DNs tem relações com processos de saúde-doença, especialmente em arboviroses influenciáveis pelo aquecimento global e em doenças de veiculação hídrica, e geram impactos em infraestrutura - que podem ser estimados como um problema inverso em vibrações, resolvido por formalismo Lagrangeano, e por métricas de Redes Complexas em infraestruturas críticas. Neste trabalho serão apresentados o histórico, atuação e perspectivas do Comitê Temático "Matemática & Desastres" da Sociedade Brasileira de Matemática Aplicada e Computacional (SBMAC), bem como oportunidades de colaboração, especialmente na área de Processos Estocásticos. Este trabalho em particular é desenvolvido em colaboração com a Dra. Roberta Baldo Bacelar, do departamento de Comunicação da Faculdade Anhanguera de São José dos Campos/SP.