Three Postdoc Positions in

Probability and Stochastic Processes

Stochastic Modeling of Interacting Systems

Fapesp 17/10555-0

The Instituto de Matemática e Estatística at Universidade de São Paulo is offering three post-doctoral positions in the field of probability and stochastic processes (stochastic modeling of interacting systems) starting April 11, 2022 or latter.

Research activities will concentrate on central and contemporary topics of Probability Theory, Stochastic Processes and related areas. Among them, the study of the properties of random walks in graphs and interlacings; particle systems, percolation theory and their variations such as epidemic models and rumors; biological models such as mutation-selection and population dynamics, random-media processes, scale limits, and aging of disordered system dynamics and random networks.

Colonization and catastrophes models.

We will investigate a model for population growth with disasters in which colonies grow for a random time until their collapse. At the time of collapse, a random number of individuals survive. These survivors try to establish new colonies in the neighborhood, in an independent fashion. We will analyze this process subject to distinct stochastic rules regarding to (i) colony growth; (ii) colony collapse time (catastrophe); (iii) reaction to catastrophe. We hope to obtain limit theorems (such as Law of Large Numbers, Central Limit Theorem, Large Deviations, Shape theorem) to make comparisons seeking better strategies for population survival.
Fábio Machado and Anatoli Yambartsev

Rumors spread and fake news models.

We are interested in a long-range percolation model in infinite, locally finite and connected graphs. The dynamics of these models can be understood as describing the spread of a rumor or virus as follows. For each vertex v of graph G, we assign a random radius of influence R(v). Next we think of a discrete-time chain reaction according to the following rules: (1) at time zero only the vertex o, the root of G, helps spreading the rumor by passing it to all vertices that are at a graph distance to o less than R(o). (2) at a generic moment n, all vertices that are less than R(v) from any vertex v that had contact with the rumor prior to instant n receive the rumor. The model known as *fireworks* (direct and reverse) on a tile fits into this framework and has received attention in recent articles. The aim of this project is to answer questions about the distribution of R(v) so that the survival probability of the rumor is positive, bounds for

spreading speed, shape and asymptotic density of the individuals receiving the rumor or even to study characteristics of G that facilitate or disrupt the rumor survival event.
Fábio Machado and Anatoli Yambartsev

Spin glass dynamics: Long time behavior of stochastic mean field models, such as the Metropolis dynamics for the REM in the hypercube at low temperature in ergodic time scales.

Long time behavior of random walks in noncompact dynamical random environments, such as independent birth-and-death processes. LLN, CLT, environment seen from the particle, large deviations, and other results would be of interest (we have a the CLT in the independent b-a-d case with jump rates given by a negative exponential of the environment, embedded chain independent of the environment, and a class of initial conditions for the environment).

System of interacting mechanical particles: we dispose particles of stationary, neutral, unit mass particles at marks of a renewal process on the positive reals; each of these, independently, are either sticky, with probability p, or non-sticky. A particle with unit positive electrical charge is initially placed at the origin, and a positive electric field is turned on, displacing the charged particle to the right, according to the laws of electrodynamics. The charged particle collides elastically with the non-sticky particles, and totally inelastically with the sticky ones; the latter kind of collision results in the particle along with its mass being incorporated to the charged particle. Non-sticky particles do not interact with each other. We are interested in the long-time behavior of the position of the charged particle.
Luiz Renato Fontes

Inference and model selection for stochastic processes in high dimensions

The main goal of this research line is to develop statistical inference methods for high-dimensional stochastic processes. The data considered are of different types and structures, such as random graphs and networks, high-dimensional vectors, or space-time data. The focus is on predictive models and the main goal is to select models with adequate dimensions to minimize the prediction error. This approach is related to the statistical learning theory, which supports several of the techniques currently used in the fields of machine learning, artificial intelligence, or data science.
Florencia Leonardi

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