

# BGTS Doctoral Day 2019

October 25, 2019

## Session 1: Networks

### Filip Bosnić - mathematics

Random conductance model and invariance principle

In random conductance model one takes the lattice  $\mathbb{Z}^d$  and chooses a positive number, called conductance, for every pair of lattice points in a random way. For a concrete realization one then analyzes the behavior of random walk with jump probabilities proportional to the conductance. It is known that for many choices of conductance this walks converges to the a diffusion process after rescaling, which is called the invariance principle, but this is not always the case. We will investigate the percolation, i.i.d. and ergodic conductance and present some affirmative results obtained in these cases. We will also illustrate the trapping phenomenon which could break the invariance principle and introduce the area of long range conductance.

### Jonas Scheunert - physics

Free graph expansion

The free graph expansion as a tool to organize perturbative expansions of lattice models is presented. Embedding and symmetry numbers of the graphs that arise during the computation are explained and their systematic evaluation is outlined. Finally the possibility of renormalization schemes due to the factorizability of the free embedding number is discussed.

### Mariam Nanumyan - economics

Union formation in network spill-over games

## Session 2: Stochastic Processes

### Simon Dentinger - physics

Markov chains and Metropolis algorithm

(Practically) infinite high-dimensional integrals are a common problem for numerical calculations like Lattice Quantum Chromodynamics (LQCD). One method to numerically solve these kind of integrals is by Monte Carlo Sampling. One way to get appropriate random values for a weighted integral similar to the one in LQCD is to use Markov chains. This stochastic sequence of values can be created through different kinds of algorithms. The simplest of these algorithms is the Metropolis algorithm.

### Patrick Schuhmann - economics

An optimal production problem under regime switching

In this talk we discuss a stochastic inventory control problem with regime switching. The cumulative demand of a good is considered as a Brownian Motion with drift and volatility coefficients

modulated by a continuous time Markov chain representing the regime of the economy. The manager of the firm chooses a (non-negative) production strategy to maintain the inventory level as close as possible to given target value. The firm is penalized for derivations from the target value and the objective of the manager is to minimize the total cost. We consider two different cases: (1) the production is non-negative and unbounded from above and (2) the production is bounded by above and below. This cases result in, respectively, problems of singular stochastic control and classical stochastic control with regime switching. We use a Guess-and-Verify approach to find a analytical solution for the optimal production strategy in both cases.

This is a joint work with Abel Cadenillas from University of Alberta.

### **Emanuela Gussetti - mathematics**

A rough path approach to the stochastic Landau-Lifshitz-Gilbert equation

The Landau-Lifshitz-Gilbert equation describes the behaviour of a ferromagnetic material on a bounded domain. I will present a result on existence and uniqueness of strong solutions to this problem posed on a one dimensional domain and perturbed by a linear multiplicative noise driven by a general rough path.

## **Session 3: Dynamical Systems**

### **Alessandro Basurto - economics**

Asset price targeting under behavioral learning

### **Shayan Alikhanloo - mathematics**

Hyperbolic dynamical systems: attractors and SRB measures

Hyperbolic dynamics which is characterized by the existence of complementary expanding and contracting directions for the derivative forms a foundation for chaos. It is known that in dissipative dynamical system, attractors usually have zero Riemannian volume. This talk will review the appropriate measures, i.e. “SRB measures” on uniformly hyperbolic attractors in order to describe the dynamics on such geometrically complicated spaces. The goal is to define a symmetric Markov semigroup and an associated diffusion process on uniformly hyperbolic attractors. This is an ongoing project joint with Michael Hinz.

### **Pragya Singh, Ismail Soudi - physics**

Early time dynamics of heavy-ion collisions

Heavy-Ion collisions (HIC) are a crucial way of understanding the strong interactions between quarks and gluons.

The initial stage of the Heavy-Ion collision (HIC) is modeled by the Color Glass Condensate (CGC). Which may explain how particles are produced during the collision. Highly dense gluonic matter is then formed after the collision. These Gluons thermalize into a Quark-Gluon-Plasma (QGP), while highly energetic partons traverse the plasma and end in a shower of particles called jets.

We discuss how the dynamics of the initial stage of the HIC is described. As well as we can use jets as “hard probes” to learn about the properties of QGP.