THURSDAY

Plenary talk:
Combinatorial and probabilistic growth models

Ecaterina Sava-Huss, Thu, 9:00-10:00
University of Innsbruck

Abstract

The focus of my talk is on cluster growth models based on systems of interacting particles that move in a random or in a deterministic fashion. I will start by introducing the basic tools for such models, which are random walks and rotor walks. Then, with the help of such walks, I will introduce the following aggregation models: internal DLA, rotor aggregation, divisible sandpile and abelian sandpile. In all these models, one of the many issues is to understand the limit shape behavior for a variety of underlying spaces. After reviewing some limit shape results, I will conclude my talk with ongoing and future work on iid sandpiles and on the limit shape universality behavior.

The Wasserstein-space of stochastic processes

Mathias Beiglböck, Thu, 10:00-10:30
University of Vienna

Abstract

When interpreting $\mathcal{P}(R^N)$ as the laws of stochastic processes, the adapted Wasserstein distance AW is a convenient refinement of the classical Wasserstein distance: it is useful for applications in different fields and it provides a natural compatible metric for the weak adapted topology that has independently been discovered by a number of authors from different areas.

Notably, $(\mathcal{P}(R^N), AW)$ is not complete. A main result of this article is that its completion consists precisely in the space FP of *filtered processes*, i.e. stochastic processes together with a filtration. In contrast to other topologies for stochastic processes, probabilistic operations such as the Doob decomposition, optimal stopping problems and Snell-envelopes are continuous w.r.t. AW. We also show that (FP, AW) is a geodesic space, isometric to a classical Wasserstein space, and that the set of martingales forms a closed displacement convex subspace.

Split time-step schemes for McKean-Vlasov SDEs

Gonçalo dos Reis, Thu, 11:00-11:30
University of Edinburgh

Abstract

We present two fully probabilistic Euler schemes, an explicit and a split-step implicit scheme, for the simulation of McKean-Vlasov Stochastic Differential Equations (MV-SDEs) with drifts of super-linear growth and random initial condition.

The general split-step implicit scheme attains the standard 1/2 rate in stepsize and closes the gap in the literature regarding efficient implicit methods and their convergence rate for this class of McKean-Vlasov SDEs.

The explicit Euler scheme, under certain structural conditions (but with non-constant diffusion matrix), draws on ideas from splitting operators to produce an order 1 Euler convergent method.

Convergence of the tamed-Euler-Maruyama scheme for SDEs with discontinuous and polynomially growing drift

Kathrin Spendier, Thu, 11:30-12:00
University of Klagenfurt

Abstract

SDEs with irregular coefficients are currently of high interest. There are some specific types of irregularities leading to different problems when studying convergence of numerical schemes. These types of irregularities are usually studied separately in the literature. Examples are polynomially growing coefficients, or discontinuous coefficients. We consider SDEs that suffer from both of these types of irregularities and study strong convergence of the tamed-Euler-Maruyama scheme.

This is joint work with Michaela Szölgyenyi (University of Klagenfurt).

Plenary talk:
Finite Difference Approximations of Fully Nonlinear Partial Differential Equations

Tsiry Randrianasolo, Thu, 13:30-14:30
University of Bielefeld

Abstract

The talk consists of two parts, where we present finite difference approximations of two fully nonlinear partial differential equations. First, we consider a system of Hamilton–Jacobi–Bellman equations for the value functions of an optimal innovation investment problem of a monopoly firm facing bankruptcy risk. Here, we will talk about a combination of an Upwind finite difference approximation for the spatial discretization and the Policy Iteration procedure for the discretization of the optimal investment. Next, we will introduce a Hamilton–Jacobi–Isaac equation for the value function of a zero-sum differential game with asymmetric information. We propose a finite difference approximation based on the probabilistic method and establish its convergence to the viscosity solution of the considered equation.

This is a joint work with L. Banas, H. Dawid, G. Ferrari, J. Storn, X. Wen.

Reinforcement Learning in Markov decision processes

Ronald Ortner, Thu, 14:30-15:00
Montanuniversitaet Leoben

Abstract

This talk will give a brief introduction to *Markov decision processes* (MDPs) and their use as models in the field of *reinforcement learning*. We will present respective key results for learning in MDPs with undiscounted rewards in the form of bounds on the so-called *regret*. Finally, we will discuss the optimization paradigm underlying current MDP theory and alternatives that shall be investigated in the FWF project TAI-590 on *Reinforcement Learning: Beyond Optimality*.

Sara Svaluto-Ferro, Thu, 15:30-16:00
University of Vienna

Abstract

Discrete neural networks for partial integro-differential equations

Verena Köck, Thu, 16:00-16:30
WU Vienna

Abstract

Partial integro-differential equations (PIDEs) appear in many applications that are related to insurance or finance, such as pricing models or stochastic optimization problems. Frameworks that take many different economical factors or assets into account lead to high-dimensional PIDEs, that are typically not explicitly solvable. In the literature there are already methods to tackle PDEs with deep-learning based methods, yet on the other hand, the literature on PIDEs is scarce. Besides of the problem of "the curse of dimensionality", the majority of approximation methods only provide a solution for a single space point. We propose a deep neural network (DNN) algorithm for solving parabolic partial integro-differential equations with boundary conditions in high dimension and apply the method on several examples. Specifically, the solution $u(t,x),\ x \in \Xi$ to a PIDE is computed for a fixed time $t \in [0,T]$ and a subset $\Xi \subset \mathbb{R}^d$. Hereby we concentrate on insurance and finance related problems.

Importance sampling for option pricing with feedforward networks

Aleksandar Arandjelović, Thu, 16:30-17:00
TU Vienna

Abstract

We study the problem of reducing the standard error in Monte Carlo simulations when pricing path-dependent options through suitable changes of measure which are induced by feedforward networks. To this end, we first highlight the role that these functions play for the corresponding Cameron–Martin spaces of a large class of Gaussian measures. We then provide a theoretical analysis that shows how feedforward networks can be used to approximate the optimal sampling measure arbitrarily well. A numerical experiment highlights the efficiency of this method. This talk is based on joint work with Thorsten Rheinländer and Pavel V. Shevchenko.

Friday

Plenary talk: The volume ratio of Schatten classes

Joscha Prochno, Fr, 9:00-10:00
University of Graz

Abstract

Introduced by Robert Schatten and John von Neumann in the 1960s, the Schatten p-classes are the most important operator ideal studied in functional analysis today. Those spaces share several structural characteristics with the classical ℓ^p sequence spaces and are often referred to as non-commutative ℓ^p spaces. However, while the former are quite well understood from the analytic, geometric and probabilistic point of view, this cannot be said for the Schatten classes. Due to their role, for instance, in the non-commutative compressed sensing approach of low-rank matrix recovery, a lot of effort has been made in recent years to gain a deeper understanding of their structure. In this talk, we will see how log-potential theory can be used to determine the asymptotic volume ratio of the Schatten classes, a quantity of fundamental importance in geometric functional analysis and high-dimensional probability, for which only lower and upper bounds had been known for the last 37 years (obtained by Saint Raymond). The talk is based on joined work with Zakhar Kabluchko (Münster) and Christoph Thäle (Bochum).

Stochastic parabolic equations with singularities

Tijana Levajković, Fr, 10:00-10:30
TU Vienna

Abstract

This talk is devoted to the study of stochastic parabolic evolution problems where the coefficients, initial and boundary conditions might be highly singular, i.e., generalized stochastic processes. In the analysis of these evolution problems, we combine the polynomial chaos expansion (PCE) method with the concept of very weak solutions. The PCE method is a spectral method based on the tensor product of deterministic orthogonal polynomials as a basis in the space of square integrable stochastic processes. The main idea of the very weak solution concept is to model irregular objects in equations by approximating nets of regular functions with moderate asymptotic. The notion of a stochastic very weak solution is introduced and the existence of a corresponding stochastic initial value problem is proved. The questions on the uniqueness of the stochastic very weak solution as well as its consistency to the stochastic weak solution are discussed. The results are obtained in collaboration with Snežana Gordić and Ljubica Oparnica.

Random sections of p-ellipsoids and optimal recovery

Mathias Sonnleitner, Fr, 11:00-11:30
JKU Linz

Abstract

Understanding whether the circumradius of a random section of a set is close to the minimal circumradius is related to understanding the power of random (Gaussian) information compared to optimal information for recovering vectors from this set. We consider p-ellipsoids, which are generalizations of ellipsoids, and present recent results on the power of random information for them. In the case of polynomially decaying semiaxes, we find that for a certain range of parameters we have a threshold of decay, above of which Gaussian information is close to optimal and below of which it is useless. Concepts from compressed sensing will be used for an upper bound for non-convex p-ellipsoids. This is joint work with A. Hinrichs and J. Prochno.

Strong convergence of a Euler-Maruyama method for fractional stochastic Langevin equations

Arzu Ahmadova, Fr, 11:30-12:00
Eastern Mediterranean University

Abstract

The novelty of this work consists in deriving a mild solution by means of recently defined Mittag-Leffler type functions of fractional stochastic Langevin equations of orders $\alpha \in (1, 2]$ and $\beta \in (0, 1]$ whose coefficients satisfy standard, Lipschitz and linear growth conditions. Then we prove existence and uniqueness results of the mild solution and show the coincidence between the notion of mild solution and the integral equation. For this class of systems, we construct the fractional Euler-Maruyama -method and establish new results on the strong convergence of this method for fractional stochastic Langevin equations. We also introduce a general form of the nonlinear fractional stochastic Langevin equation and derive a general mild solution. Finally, numerical examples are illustrated to verify the main theory.

A new bivariate extreme value copula and new families of univariate distributions based on Freund's exponential model

Sándor Guzmics, Fr, 13:30-14:00
University of Vienna

Abstract

The use of the exponential distribution and its multivariate generalizations is popular in lifetime modeling. Freund's bivariate exponential model (1961) is based on the idea that the remaining lifetime of any entity in a bivariate system is shortened when the other entity defaults. Such a model can be useful for studying systemic risk, for instance in financial systems. Guzmics and Pflug (2019) revisited Freund's model, deriving the corresponding bivariate copula and examined some characteristics of it. In the current talk (and in the corresponding paper) we present further investigations in the bivariate model: the tail dependence coefficients; the marginal and joint distributions of the componentwise maxima, which leads to an extreme value copula, which has not been investigated in the literature before. The original bivariate model of Freund has been extended to more variables by several authors. We also turn to the multivariate setting, and our focus is different from that of the previous generalizations, and therefore it is novel: examining the distribution of the sum and of the average of the lifetime variables (provided that the shock parameters are all the same) leads to new families of univariate distributions, which we call Exponential Gamma Mixture Type I and Type II (EGM) distributions. We present their basic properties, we provide asymptotics for them, and finally we also provide the limiting distribution for the EGM Type II distribution.

Backtesting Systemic Risk Forecasts using Multi-Objective Elicitability

Tobias Fissler, Fr, 14:00-14:30
WU Vienna

Abstract

Backtesting risk measure forecasts requires identifiability (for model validation) and elicitability (for model comparison). The systemic risk measures CoVaR (conditional value-at-risk), CoES (conditional expected shortfall) and MES (marginal expected shortfall), measuring the risk of a position Y given that a reference position X is in distress, fail to be identifiable and elicitable. We establish the joint identifiability of CoVaR, MES and (CoVaR, CoES) together with the value-at-risk (VaR) of the reference position X, but show that an analogue result for elicitability fails. The novel notion of *multi-objective elicitability* however, relying on multivariate scores equipped with an order, leads to a positive result when using the lexicographic order on $\mathbb{R}^2$. We establish comparative backtests of Diebold–Mariano type for superior systemic risk forecasts and comparable VaR forecasts, accompanied by a traffic-light approach. We demonstrate the viability of these backtesting approaches in an empirical application to DAX 30 and S&P 500 returns.

The talk is based on the preprint `https://arxiv.org/abs/2104.10673` which is joint work with Yannick Hoga.

A time-inconsistent dividend problem with a ruin penalty

Josef Strini, Fr, 15:00-15:30
TU Graz

Abstract

We consider the classical dividend problem including a ruin penalty. The time-inconsistency is due to different discount rates in the dividend and the penalty term. This special reward function originates from the classical problem including a constraint on the ruin event. Using constant coefficients for the state process, we are able to reveal an explicit solution, i.e. an equilibrium control strategy and the associated equilibrium value function. We show how this solution can be used to fulfil the original constraint in a specific way and present some illustrations.

Boundary behaviour of branching Markov chains

Wolfgang Woess, Fr, 15:30-16:00
TU Graz

Abstract

We study branching Markov chains (i.e., the synthesis of Markov chains and Galton-Watson processes) on denumerbale state spaces in discrete time. It is supposed that the underlying Markov chain is transient and irreducible. Given the population at time n at the different states, we normalize it by it dividing by its total number. The resulting empiricial distribution is a random probability measure on the state space. Assuming that the latter is equipped with a "geometric" compactification with a boundary at infinity, a main focus is on the question whether the sequence of empirical distributions converges a.s. weakly to a random probability distribution on the boundary.

This is joint work with Vadim A. Kaimanovich (Ottawa)
