4th Austrian Stochastics Days

Vienna, September 28 – 29, 2015

General Information

The 4th Austrian Stochastics Days are intended to provide scientists and young researchers working in Stochastics an opportunity to meet each other and present their results.

Organizing Committee

Friedrich **Hubalek** (Vienna University of Technology)
Christian **Kühn** (Vienna University of Technology)

Invited Speakers

Evelyn **Buckwar** (Johannes Kepler University Linz)
Jiří **Černý** (University of Vienna)

Location

Room "**Zeichensaal 3**"
"Freihaus" building, 7th floor, green section

Vienna University of Technology
Wiedner Hauptstraße 8
1040 Wien, Österreich/Austria

(Public) Transportation:
https://fam.tuwien.ac.at/contact/way.php

Dinner / Get-Together

Monday, September 28, 18:00

Wieden Bräu
Waaggasse 5, 1040 Wien
(5-10 minute walking distance from Freihaus building)

Program (Version: 2015-09-18)

Monday, September 28

11:00 – 11:40	Jiří **Černý**
11:45 – 12:10	Christian **Irrgeher**
12:15 – 12:40	Florian **Baumgartner**
12:45–14:00	Lunch
14:00 – 14:25	Michaela **Szölgyenyi**
14:30 – 14:55	Wen **Yue**
15:00 – 15:25	Harald **Hinterleitner**
15:30 – 16:00	Coffee Break
16:00 – 16:25	Andreas **Thalhammer**
16:30 – 16:55	Kosmas **Kepesidis**
17:00 – 17:30	Judith **Kloas**
18:00	**Dinner / Get–Together**

Tuesday, September 29

09:00 – 09:25	Luigi Amedeo **Bianchi**
09:30 – 09:55	Tijana **Levajkovic**
10:00 – 10:25	Markus **Ableidinger**
10:30 – 11:00	Coffee break
11:00 – 11:40	Evelyn **Buckwar**
11:45 – 12:10	Julio **Backhoff Veraguas**
12:15 – 12:40	Holger **Waubke**

Abstracts: Invited Speakers

ČERNÝ Jiří

University of Vienna, Vienna, Austria

Vacant set of random walk on finite graphs

It was conjectured that the vacant set of random walk on (some) finite graphs exhibits a phase transition similar to the Erdös-Rényi random graph. This conjecture was proved on graphs that are "locally tree-like", but the most interesting graph, the large d-dimensional discrete torus, remains open.
The talk will give a gentle introduction to the topics, and present some recent results supporting this conjecture in the torus case.

BUCKWAR Evelyn

Johannes Kepler University Linz, Linz, Austria

Stochastic Numerics and Stability Issues

Stochastic Differential Equations (SDEs) have become a standard modelling tool in many areas of science, e.g., from finance to neuroscience. Many numerical methods have been developed in the last decades and analysed for their strong or weak convergence behaviour. In this talk we will provide an overview on current directions in the area of stochastic numerics and report on recent progress in the analysis of stability properties of numerical methods for SDEs, in particular for systems of equations. We are interested in developing classes of test equations that allow insight into the stability behaviour of the methods and in developing approaches to analyse the resulting systems of equations.

Abstracts: Contributed Speakers (in alphabetic order)

ABLEIDINGER Markus

Institute for Stochastics, Johannes Kepler University, Linz, Austria

Variance reduction techniques for the numerical simulation of the stochastic heat equation

We consider the finite dimensional stochastic heat equation (obtained by spatial discretisation) with homogeneous Dirichlet boundary conditions and multiplicative noise w.r.t. a Q-Wiener process. For growing intensity of the diffusion, the equilibrium solution of the system eventually gets mean-square unstable, however it takes an unreasonably large number of numerical trajectories to see this instability in Monte-Carlo simulation. We will discuss the practicability and the influence of variance reduction techniques, namely importance sampling via Girsanov's theorem and control variates, on the Monte-Carlo estimation. This talk is based on joint work with E. Buckwar and A. Thalhammer and connected with the talk "Computational mean-square stability analysis for linear systems of SODEs" by A. Thalhammer, which treats the interplay of different stability concepts in numerical simulation.
Joint work with E. Buckwar and A. Thalhammer

BACKHOFF VERAGUAS Julio

Mathematics Institute, University of Vienna, Vienna, Austria.

Some sensitivity results in stochastic optimal control and mathematical finance

In this joint work with Francisco Silva, we provide a functional framework for classical stochastic optimal control problems and justify rigorously that the adjoint state (p,q) appearing in the stochastic Pontryagin principle corresponds to a Lagrange multiplier associated to the controlled stochastic differential equation. This point of view allows to find and rigorously prove, in several interesting cases, various expressions for the derivative of the value function of the problem w.r.t. the drift and diffusion coefficients. For the classical expected utility maximization problem of Mathematical Finance, however, the previous stochastic control set-up is not yet fully functional, and we rely on recent results by the first author and J. Fontbona to nevertheless obtain a sensitivity analysis through the direct method.

BAUMGARTNER Florian

Department of Mathematics, University of Innsbruck, Innsbruck, Austria

Convergence and measurability techniques in certain non-metrizable spaces

Abstract: Locally convex spaces with uncountable neighbourhood bases cause difficulties in applying convergence results for series of independent random elements and in treating measurability questions on the path space. We present two techniques based on the additional assumption on the space to be a Suslin space to overcome these obstacles.

BIANCHI Luigi Amedeo

Institute of Mathematics, University of Augsburg, Augsburg, Germany

Modulation equations for stochastic Swift-Hohenberg equation

Pattern formation is an interesting phenomenon that arises in physical situations. An example is the convection in a heated fluid. We consider as a mathematical model of this phenomenon the stochastic Swift-Hohenberg equation

$$
\partial_t u = -(1+\partial_x^2)^2u+\varepsilon^2\nu u
-u^3+\varepsilon^{\sfrac{3}{2}}\xi(t,x).
$$

Near its change of stability, the fluid motion can be described in a multiscale setting as the product of a slowly varying amplitude equation and a faster periodic wave. The amplitude (or modulation) equation is the solution to a stochastic Ginzburg-Landau equation. After an introduction to the problem in its deterministic setting, we'll review some known stochastic results and see some recent results for the linear case in the unbounded space domain setting.

HINTERLEITNER Harald

Institute for Stochastics, Johannes Kepler University Linz, Linz, Austria

Efficient and structure-preserving numerical scheme applied to a continuous-time particle filter for a stochastic neural mass model

Neural mass models provide a useful framework for modelling mesoscopic neural dynamics and in this talk we consider the Jansen and Rit Neural Mass Model (JR-NMM). This system of ODEs has been introduced as a model in the context of electroencephalography (EEG) rhythms and evoked potentials and has been used for several applications, e.g. for detecting epileptic diseases. We propose a stochastic version of the JR-NMM which arises by incorporating random input and has the structure of a nonlinear stochastic oscillator. We simulate the stochastic JR-NMM by an efficient numerical scheme based on a splitting approach which preserves the qualitative behaviour of the solution. The final goal is to use the stochastic JR-NMM as the underlying model in a nonlinear filtering framework. We take advantage of our efficient numerical method in order to solve the inverse problem by a continuous-time particle filter.

IRRGEHER Christian

Department of Financial Mathematics and Applied Number Theory, Johannes Kepler University Linz, Linz, Austria

Fast Brownian path construction

To solve problems using simulation methods, like Monte Carlo (MC) or quasi-Monte Carlo (QMC) methods, it often requires to sample paths of stochastic processes which depend on Brownian motions. While different ways of constructing Brownian paths does not make a difference for MC simulation in terms of accuracy, it may have a big impact for QMC methods. A "good" choice of constructing a Brownian path can have a positive effect on the convergence rate of the QMC method, but one may have a drawback in terms of the computational costs. Therefore, it is of interest to have a broad range of methods available to generate Brownian paths which can be applied fast. In this talk I present some classical results about (fast) Brownian path construction as well as some new developments.
The talk is based on joint research with Gunther Leobacher and Josef Dick.

KEPESIDIS Kosmas

Institute of Atomic and Subatomic Physics, TU Wien, Vienna, Austria

The role of noise in physical systems with underline parity-time symmetry

The breaking of a combined PT (parity- and time-reversal) symmetry in non-Hermitian systems with balanced gain and loss is conventionally associated with a transition from a purely oscillatory to an exponentially amplified dynamical regime. In this work we analyze the steady state of systems with an underlying PT symmetry and show that the combination of nonlinear saturation effects and noise, both of which shall be present in actual experiments, result in unexpected behavior that differs significantly from the usual dynamical picture. In particular, we observe additional phases with preserved or weakly broken PT symmetry, and an unconventional transition from a high-noise thermal state to a low-amplitude lasing state. We illustrate these effects here for the specific example of coupled mechanical resonators with optically-induced loss and gain, but the described mechanisms will be essential for understanding the steady-state properties of actual PT-symmetric systems in general.

KLOAS Judith
Department for mathematical structure theorie, Graz University of Technology, Graz, Austria

The reflected random walk

In this talk I want to give a short introduction to random dynamical systems. Especially we will study the reflected random walk which in the 1-dimensional case is given by $X_0=x_0$, $X_{n+1}=|X_n-Y_{n+1}|$, where $Y_1,Y_2,...$ is a sequence of i.i.d. random variables. We will mention some known facts, in particular we look on the conditions to have recurrence and the expected return time. Moreover we want to introduce the reflected random walk in higher dimensional cases.

LEVAJKOVIC Tijana
Department of Mathematics, University of Innsbruck, Innsbruck, Austria

Stochastic operator differential algebraic equations

This talk is devoted to the study of semi-explicit stochastic operator differential algebraic equations (DAEs) for which the constrained equation is explicitly stated. The motivation example is the Stokes equation that arises in fluid dynamics. By the application of the polynomial chaos expansion method we reduce the initial stochastic DAE to an infinite system of deterministic DAEs, and thus we solve its regularized version. We also prove the convergence of obtained solution in a weighted space of generalized stochastic processes.
The results are achieved in collaboration with Robert Altmann and Hermann Mena.

SZÖLGYENYI Michaela
Institute for Statistics and Mathematics, Vienna University of Economics and Business, Vienna, Austria

An optimization problem for an energy storage facility under partial information

We study the valuation problem of a general energy storage facility by maximizing its expected discounted reward. The energy storage manager thereby controls the policy of charging and discharging. This policy will depend on the energy price process. Since the energy price depends on economic and geopolitical factors which are normally not directly observable, we assume the energy price dynamic to be driven by a Markov chain the current state of which is unobservable with respect to the energy storage facility manager's observation filtration. We apply a result from filtering theory to overcome uncertainty. Then we solve the optimization problem by deriving the associated Hamilton-Jacobi-Bellman equation and solve it numerically. Furthermore, we address the issue of admissibility of the resulting charging policy.
Joint work with Anton A. Shardin, Brandenburg University of Technology (BTU) Cottbus–Senftenberg.

THALHAMMER Andreas
DK Computational Mathematics / Institute for Stochastics, Johannes Kepler University Linz, Linz, Austria

Computational mean-square stability analysis for linear systems of SODEs

We consider the mean-square stability analysis for linear SODEs from a computational point of view. The criteria for deciding whether the equilibrium solution of a linear system of SODEs is stable or unstable in the mean-square sense, is theoretically well understood. However, the numerical simulations obtained by Monte-Carlo techniques are strongly influenced by the pathwise behaviour of the numerical trajectories. In the case of almost sure stable but mean-square unstable systems, the mean-square instability depends on very rare exploding trajectories which renders the computational cost of the standard Monte-Carlo approach prohibitively high. We will illustrate this behaviour by numerical studies for linear SODE systems obtained e.g. by the spatial discretisation of SPDEs. This talk is based on a joint work with M. Ableidinger and E. Buckwar and is connected with the talk Variance reduction techniques for the numerical simulation of the stochastic heat equation by M. Ableidinger, where the numerical simulation of the spatially discretised stochastic heat equation is treated.

WAUBKE Holger
Acoustics Research Institute, Austrian Academy of Sciences, Vienna, Austria

Gaussian Closure for a single degree of freedom oscillator with Bouc hysteresis

We consider the mean-square stability analysis for linear SODEs from a computational point of view. The criteria for deciding whether the equilibrium solution of a linear system of SODEs is stable or unstable in the mean-square sense, is theoretically well understood. However, the numerical simulations obtained by Monte-Carlo techniques are strongly influenced by the pathwise behaviour of the numerical trajectories. In the case of almost sure stable but mean-square unstable systems, the mean-square instability depends on very rare exploding trajectories which renders the computational cost of the standard Monte-Carlo approach prohibitively high. We will illustrate this behaviour by numerical studies for linear SODE systems obtained e.g. by the spatial discretisation of SPDEs. This talk is based on a joint work with M. Ableidinger and E. Buckwar and is connected with the talk Variance reduction techniques for the numerical simulation of the stochastic heat equation by M. Ableidinger, where the numerical simulation of the spatially discretised stochastic heat equation is treated.

YUE Wen
Institute of Analysis and Scientific Computing, Vienna University of Technology, Vienna, Austria

Discrete Beckner inequality via Bochner-Bakry-Emery method for Markov chain

Beckner inequalities, which interpolate between the logarithmic Sobolev Inequalities and Poincare inequalities, are derived in the context of Markov chains. The proof is based on the Bakry-Emery method and the use of discrete Bochner-type inequalities. We apply our result to several Markov chains including Birth-Death process, Zero-Range process, Bernoulli-Laplace models and Random Transposition models and thus get the exponential convergence rates of the "distributions" of these Markov chains to their invariant measures.
