Workshop on

Stochastics and Dynamics

on the occasion of Michael Scheutzow's 60th birthday

Titles and abstracts

On the meteor process

Krzysztof Burdzy (University of Washington, USA)

Abstract. The meteor process is a model of mass redistribution on a graph. I will present results on existence of the process and existence, uniqueness and properties of the stationary distribution. I will also discuss special questions arising in the case when the graph is a cycle or the set of integers. Joint work with Sara Billey, Soumik Pal and Bruce Sagan.

On dynamics of a certain fluid–plate interaction model driven by white noise

Igor Chueshov (Kharkov National University, Ukraine)

Abstract. We consider a stochastically perturbed coupled system consisting of linearized 3D Navier–Stokes equations in a bounded domain and the classical (nonlinear) elastic plate equation for in-plane motions on a flexible flat part of the boundary. This kind of models arises in the study of blood flows in large arteries. Our main result states the existence of a random pullback attractor of finite fractal dimension. The talk is based on a joint paper with B. Schmalfuß.

Dynamics for stochastic nonlinear Schrödinger equations

Hannelore Lisei (Babeş-Bolyai University, Romania)

Abstract. We consider a Schrödinger problem with multiplicative Gaussian noise term and power-type nonlinearity. In order to prove the existence and uniqueness of the variational solution, a further process will be introduced which allows to transform the stochastic problem into a pathwise one. Galerkin approximations and compact embedding results are used. We also investigate the existence of a random attractor for the random dynamical system.

Synchronization by noise

Benjamin Gess (University of Chicago, USA)

Abstract. We study the possibly synchronizing effects of noise on (random) dynamical systems. Here, synchronization means that the random attractor consists of a single random point even if the dynamics for the deterministic counterpart are not globally stable. In particular, if synchronization occurs, then each two trajectories converge to each other for large times. Starting with

the model case of a multi-dimensional double-well potential with additive noise, i.e.

$$dX_t = (X_t - X_t^3)dt + dW_t$$

we develop a general framework providing sufficient conditions for synchronization by noise. This is joint work with Franco Flandoli and Michael Scheutzow.

Avalanche Dynamics

Manfred Denker (Penn State University, USA)

Abstract. The Integrate-And-Fire model in neural dynamics goes back to Lapicque in 1907 and has found a discrete formulation by Eurich, Herrmann and Ernst in 2002. The talk will relate this model to random dynamics, a new discrete probability distribution (the Abelian distribution), and some open questions around the ergodic hypothesis for this type of dynamics. The work is mostly joined with A. Levina from the MPI for Mathematics in Sciences and the Bernstein Center for Computational Neuroscience.

Homogeneization on homogeneous manifolds

Xue-Mei Li (University of Warwick, UK)

Abstract.

Skorokhod embeddings for two-sided Markov chains

Peter Mörters (University of Bath, UK)

Abstract. Let $(X_n : n \in \mathbb{Z})$ be a two-sided recurrent Markov chain with fixed initial state X_0 and let ν be a probability measure on its state space. We give a necessary and sufficient criterion for the existence of a non-randomized time T such that $(X_{T+n} : n \in \mathbb{Z})$ has the law of the same Markov chain with initial distribution ν. In the case when our criterion is satisfied we give an explicit solution and study its moment properties. We show that this solution minimizes the expectation of $\psi(T)$ in the class of all non-negative solutions, simultaneously for all non-negative concave functions ψ. The talk is based on joint work with Istvan Redl (Bath).

The Interface of the Symbiotic Branching Model

Marcel Ortgiese (WWU Münster, Germany)

Abstract. The symbiotic branching model describes two interacting spatial populations whose evolution is given by system of correlated SPDEs. Starting from two spatially separated populations, one can consider the growth of the interface where particles of both types are present. We show that for negative correlations the system converges under a diffusive rescaling. We will discuss first properties of the limiting system and their implications for the interface. (Joint work with Jochen Blath and Matthias Hammer (both TU Berlin)).

Random matrix models for population ecology

David Steinsaltz (University of Oxford, UK)

Abstract. Population growth rates are related in sometimes obscure ways to an organism's demographic rates, the age-specific pattern of mortality and fertility. Since the work of Leslie in the 1940s, matrix models have been the primary tool used by demographers, ecologists, and evolutionary biologists to study population dynamics. Since the 1980s environmental variability has come to be seen as a crucial factor, leading to random matrix models. This talk will outline the key Monte Carlo algorithms that are used to analyse population growth rates in random environments, and present some new theoretical results on the perturbation analysis of top Lyapunov exponents, with application to the evolution of diapause and migration.

Random attractors for retarded SPDEs with time smooth diffusion coefficients

Björn Schmalfuß (FSU Jena, Germany)

Abstract. We consider a retarded SPDE where the coefficient in front the noise satisfies special smoothness condition. A similar condition has been considered by M. Scheutzow and coauthors. We prove by an integration by parts method that this equation generates a random dynamical system. In addition, we can show that this system has a random attractor.

Multiscale analysis of emerging rare mutants

Andreas Greven (Universität Erlangen-Nürnberg, Germany)

Abstract. We discuss a mathematical formulation of the problem to describe the fixation of rare fit mutants in a population. In the model we carry out an asymptotic analyses based on a multiscale analysis revealing interesting new effects.The basic model is a meanfield spatial Fleming-Viot diffusion,where small mutation rates and spatial size scale such that in finite times the total number of mutions in all of space are order one.

Some Markovian equilibria

Heinrich von Weizsäcker (TU Kaiserslautern, Germany)

Abstract. In this rather informal talk I want to sketch two essentially unrelated results on equilibria: a result from Michael Scheutzow's PhD thesis and some recent work by Frank Page based on Komlos' subsequence theorem.

Title MH

Martin Hairer (University of Warwick, UK)

Abstract.

Rough integration via Fourier analysis

Peter Imkeller (HU Berlin, Germany)

Abstract. In 1961, Ciesielski established a remarkable isomorphism of spaces of Hölder continuous functions and Banach spaces of real valued sequences. The isomorphism can be established along Fourier type expansions of (rough) Hölder continuous functions by means of the Haar- Schauder wavelet. We will use Schauder representations for a pathwise approach of the integral of one rough function with respect to another one, using Ciesielski's isomorphism. In a more general and analytical setting, this pathwise approach of rough path analysis can be under- stood in terms of Paley-Littlewood decompositions of distributions, and Bony paraproducts in Besov spaces. It allows a smooth approach of formal products of singular distributions, and consequently of SPDE with rough and multiplicative noise. This talk is based on work in progress with M. Gubinelli (U Paris-Dauphine) and N. Perkowski (HU Berlin).

On the infinite dimensional approach to path-dependent problems

Franco Flandoli (University of Pisa, Italy)

Abstract. Path dependent equations and functionals have been recently studied by means of Dupire-Cont-Fournie calculus. Since they are similar to delay equations, an infinite dimensional approach is also possible. It will be discussed in the talk, also in connection with the problem of self-attracting diffusions investigated by M. Scheutzow and co-workers.

Motion of interfaces in random media: pinning and some applications

Patrick Dondl (TU München, Germany)

Abstract. We consider the evolution of an interface, subject to a driven mean curvature flow, in a random environment. The environment is modeled by a non-linear, random, forcing term in the evolution equation and describes localized obstacles which are harder to penetrate by the interface. First we will consider a the problem of pinning a nearly flat interface in such a random field of obstacles, proving existence of a stationary solution of the evolution equation by a combination of percolation results and sub- and supersolution techniques. This leads to the emergence of a hysteresis that does not vanish for slow loading, even though the local evolution law is viscous (in particular, the velocity of the interface in the model is linear in the driving force). We will then apply some of these ideas to solutions of Landau-de Gennes' theory of nematic liquid crystals in the sharp interface limit, considering the evolution of interfaces with spherical initial conditions.

Stochastic Dynamics of Singular Stochastic Differential Equations

Salah Mohammed (Southern Illinois University, USA)

Abstract. We show the existence of a unique stochastic flow of Sobolev diffeomorphisms for stochastic differential equations (SDEs) with bounded measurable drift coefficients. The result is striking: The dominant 'culture' in stochastic (and deterministic) dynamical systems is that the flow 'inherits' its spatial regularity from the driving vector fields. As a corollary of the analysis, we will indicate some conjectures for unbounded singular drifts. If time permits, we will show that spatial regularity of the stochastic flow yields existence and uniqueness of a Sobolev differentiable weak solution of the (Stratonovich) stochastic transport equation with singular coefficients (cf. work by Kunita (1990); and Flandoli-Gubinelli-Priola (2010)). The results are joint work with T. Nilssen and F. Proske.

Connection times in large ad hoc networks

Hanna Döring (Ruhr Universität Bochum, Germany)

Abstract. We consider the following dynamic continuum percolation model: A large number of participants move randomly in a given large domain. A prime example of the movement schemes that we consider is the random waypoint model. Messages are instantly transmitted according to a relay principle, i.e., they are iteratedly forwarded from participant to participant over distances smaller than a fixed communication radius, until they reach the recipient. The aim of this talk is to quantify the limiting behaviour of the connection time of two sample participants, the amount of time over which these two are connected with each other. This is joint work with Wolfgang König and Gabriel Faraud.

A Dirichlet Form Approach to Averaging

Max von Renesse (Universität Leipzig, Germany)

Abstract. We present a simple approach to the averaging phenomenon of Langevin type stochastic systems, based on Mosco convergence of non-symmetric Dirichlet forms. The limiting dynamics will be a diffusion process on connected the level sets of the Hamiltonian whose coefficients can be easily determined using the co-area formula. The method applies in arbitrary dimension and generalizes previous results by Freidlin-Wentzell. Joint work with Florent Barret (Max Planck Instititute Leipzig)