Meeting of the Swedsih, Spanish and Catalan Mathematical Societies
Umeå, June 12 – June 15, 2017
Special session: SPDEs: From Theory to Simulation
Preliminary Program

Tuesday June 13

Time	**Speaker**	**Talk title**
14.00–14.30	Mihály Kovács	*Existence, uniqueness and regularity for a class of semilinear stochastic Volterra equations with multiplicative noise*
14.30–15.00	Rikard Anton	*Exponential integrators for stochastic Schrdinger equations driven by Itô noise*
15.00–15.30	Eulalia Nualart	*Moment bounds for some fractional stochastic heat equations*
15.30–16.00		**COFFEE BREAK**
16.00–16.30	Andreas Petersson	*Mean-square stability analysis of SPDE approximations*
16.30–17.00	Konstantinos Dareiotis	L^∞*-estimates for Stochastic PDEs of parabolic type and applications*
17.00–17.30	Stig Larsson	*Strong convergence of a fully discrete finite element approximation of the stochastic Cahn–Hilliard equation*
17.30–18.00	Annika Lang	*Simulating weak convergence rates for SPDE approximations*

Abstracts for Tuesday June 13

Existence, uniqueness and regularity for a class of semilinear stochastic Volterra equations with multiplicative noise

Mihály Kovács (Chalmers University of Technology and University of Gothenburg)

We consider a class of semilinear Volterra type stochastic evolution equation driven by multiplicative Gaussian noise. The memory kernel, not necessarily analytic, is such that the deterministic linear equation exhibits a parabolic character. Under appropriate Lipschitz-type and linear growth assumptions on the nonlinear terms we show that the unique mild solution is mean-p Hlder continuous with values in an appropriate Sobolev space depending on the kernel and the data. In particular, we obtain pathwise space-time (Sobolev-Hlder) regularity of the solution together with a maximal type bound on the spatial Sobolev norm. As one of the main technical tools we establish a smoothing property of the derivative of the deterministic evolution operator family. This is a joint work with B. Baeumer (Otago) and M. Geissert (Darmstadt).

Exponential integrators for stochastic Schrdinger equations driven by Itô noise

Rikard Anton (Umeå University)

We study an explicit exponential scheme for the time discretisation of stochastic Schrdinger equations driven by additive or multiplicative It noise. The numerical scheme is shown to converge with strong order 1 if the noise is additive and with strong order 1/2 for multiplicative noise. In addition, if the noise is additive, the exact solution satisfy a trace formula for the expected mass (i. e., linear drift in this quantity). We analyse the behaviour of the numerical solution with respect to this trace formula. The presentation is based on joint work with D. Cohen.

Moment bounds for some fractional stochastic heat equations

Eulalia Nualart (Pompeu Fabra University)

We consider the fractional stochastic heat equation on an interval with Dirichlet boundary conditions driven by a space-time white noise with a multiplicative term of the form $\lambda\sigma(u)$, where $\lambda > 0$ is a parameter that measures the level of the noise, and σ is a Lipschitz function. We obtain sharp moment bounds in terms of λ for the solution. We provide also some extensions of this result.

Mean-square stability analysis of SPDE approximations

Andreas Petersson (Chalmers University of Technology and University of Gothenburg)

Mean-square stability analysis is the study of the asymptotic behaviour of the second moment of solutions to stochastic differential equations. In this talk we consider the behaviour of approximations of solutions to infinite-dimensional stochastic differential equations. We give general necessary and sufficient conditions that ensure mean-square stability of such approximations. These conditions are then used to characterize the stability properties of typical discretization schemes such as combinations of spectral Galerkin, finite element, Euler-Maruyama, Milstein, Crank-Nicolson, and forward and backward Euler methods. We also present some results on their relationship to stability properties of the analytical solutions. We end the talk with spectral and finite element simulations of the stochastic heat equation that confirm the theory.

This is joint work with Annika Lang and Andreas Thalhammer (JKU Linz).

$\mathbf{L}^{\infty}$−estimates for Stochastic PDEs of parabolic type and applications

Konstantinos Dareiotis (Uppsala University)

We will present L^{∞}-estimates for solutions of Stochastic PDEs of parabolic type obtained by techniques motivated by the works of De Giorgi and Moser in the deterministic setting. The global estimates will then be applied in order to prove solvability for a class of semilinear SPDEs, while the local estimates will be used in order to obtain a weak Harnack-type inequality for solutions of linear equations, which is in turn used to deduce information about the oscillation of the solutions. The results are from joint work with Mate Gerencser (IST, Austria).

Strong convergence of a fully discrete finite element approximation of the stochastic Cahn–Hilliard equation

Stig Larsson (Chalmers University of Technology and University of Gothenburg)

We consider the stochastic Cahn–Hilliard equation driven by additive Gaussian noise in a convex domain with polygonal boundary in dimension $d \leq 3$. We discretize the equation using a standard finite element method in space and a fully implicit backward Euler method in time. By proving optimal error estimates on subsets of the probability space with arbitrarily large probability and uniform-in-time moment bounds we show that the numerical solution converges strongly to the solution as the discretization parameters tend to zero. This is joint work with D. Furihata, M. Kovács, and F. Lindgren.

Simulating weak convergence rates for SPDE approximations

Annika Lang (Chalmers University of Technology)

The finding of weak convergence rates for approximations of solutions is one of the current and still partly open problems in the numerical analysis of stochastic partial differential equations. The confirmation of the existing theory as well as of conjectured rates with simulations has hardly been done and has not been successful for equations driven by multiplicative noise so far. In this talk it is discussed why the standard methods fail even for toy examples to recover theoretical rates and new error estimators are introduced that allow for simulations of weak convergence rates for SPDEs driven by multiplicative noise.

This is joint work with Andreas Petersson.
