DFG Research Center MATHEON
Mathematics for key technologies

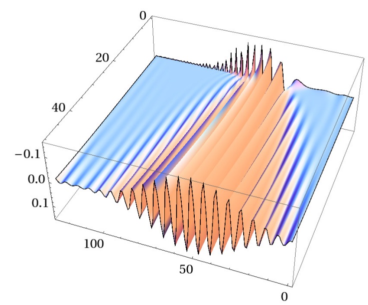
MATHEON Multiscale Seminar*

organised by R. Klein (FU), D. Peterseim (HU), K. Schmidt (TU), and B. Wagner (TU)

TU Berlin, MA 313, **Monday, April 8th 2013**, 14h15

Alexander Mielke (WIAS / HU Berlin)

Evolutionary Gamma convergence and amplitude equations

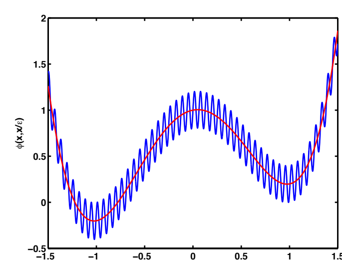


We consider the spatially homogeneous Swift-Hohenberg equation as a prototype of a pattern-forming system. Close to the threshold of instability the solutions behave locally as a periodic solution that is modulated on a larger spatial scale. This modulation is described by the so-called amplitude equation also called envelope equation, which in this case is the real Ginzburg-Landau equation.

We consider the amplitude equation as an effective equation for the multiscale system. While first proofs of this multiscale limit were given in the early 1990, we provide a new proof that relies on the gradient structure of the Swift-Hohenberg equation. The general theory of evolutionary Gamma convergence provides sharper results for the convergence theory and highlights the underlying structural properties of the system.

Carsten Hartmann (FU Berlin)

Optimal control of multiscale diffusions



Stochastic differential equations with multiple time scales appear in various fields of applications, e.g. biomolecular dynamics, material sciences or climate modelling. The separation between the fastest and the slowest relevant timescales poses severe difficulties for control and simulation of such systems. If fast and slow scales are well separated, however, asymptotic techniques for diffusion processes are a means to derive simplified reduced order models that are easier to simulate and control. In certain situation, the limit theorems of averaging and homogenization theory provide bounds on the approximation error, e.g. for the relevant slow degrees of freedom. The situation becomes more difficult if the system is subject to additional control variables that are chosen so as to maximize or minimize a given cost functional. One of the questions that arise here is whether the optimal (feedback) control computed from a reduced model is a reasonable approximation of the optimal control obtained from the full system, the computation of which is often infeasible. It turns out that very few reduced models are "backward stable" in the aforementioned sense, even though they are forward stable, in that they give good approximations when the control is known in advance. This talk tries to shed light on this issue. To this end we review the "standard" asymptotic theory for uncontrolled stochastic differential equations, along with illustrating examples from physics, engineering and biology, and discuss the problem of backward stability.

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* The MATHEON Multiscale Seminar takes place approximately three times per term with one or two talks about recent work on partial differential equations with multiple scales. Please contact one of the organisers if want to be invited by e-mail or if you would like to contribute a talk.

Webpage: `http:://www.tu-berlin.de/?multiscale-seminar`