Research Center MATHEON
Mathematics for Key Technologies

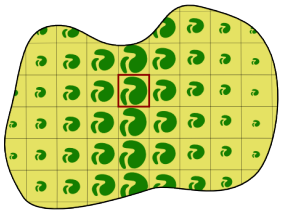
MATHEON Multiscale Seminar*

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

TU Berlin, MA 415, **Wednesday, December 3rd, 2014**, 9.15 a.m.

Sina Reichelt (WIAS, 9.15 a.m.)

Two-scale homogenization of nonlinear reaction-diffusion systems involving different diffusion length scales

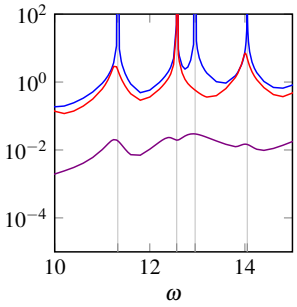


Many reaction-diffusion processes arising in civil engineering, biology, or chemistry take place in strongly heterogeneous media, for instance concrete carbonation or the spread-out of substances in biological tissues. Letting the heterogenities be periodically distributed with microscopic period length $\varepsilon > 0$, we are facing difficulties with respect to numerical simulations and the study of pattern formation. It is therefore our aim to rigorously derive effective equations for the limit $\varepsilon \to 0$.
The system under consideration comprises one species with characteristic diffusion length of order $O(1)$ and another with diffusion length $O(\varepsilon)$, whereas both species are coupled via nonlinear reaction terms. The slow diffusion of the second species leads to degenerating gradient bounds and hence a lack of compactness, which in turn prevents a straight forward convergence of the nonlinear reaction terms. To overcome the complication of missing compactness and nonlinearities, which was not done before, we employ the method of periodic unfolding and we prove strong two-scale convergence of the slow diffusive species. Finally, we obtain a novel system of coupled reaction-diffusion equations in the two-scale space, which consists of the macroscopic domain and the microscopic unit cell attached to each macroscopic point. Moreover, for smooth given data, we have convergence rates of order $O(\varepsilon^{1/2})$.

— Coffee break —

Anastasia Thöns-Zueva (TU Berlin, 10.35 a.m.)

Asymptotic expansion for nonlinear viscous acoustic equations close to rigid wall



In this study we continue to investigate the acoustic model of the compressible Navier-Stokes equations without mean flow and heat flux taking into account nonlinear advection term. For gases the (dynamic) viscosity η is very small and leads to viscosity boundary layers close to walls. Current work is constrained to the case of the acoustic source with a small amplitude of order $O(\eta)$. We are going to derive a complete asymptotic expansion using the method of multiscale analysis, which separates velocity and pressure into far field and correcting near field. With this approach the far field solution in addition to absorption inside the boundary layer takes into account the advection term and gives highly accurate description of the pressure or velocity in the domain outside a small layer close to the boundary.

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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`