MINI-WORKSHOP ON ANALYSIS AND APPLICATIONS OF PDES

VIASM, Vietnam, 29/06/2016

Program

Morning session

09h00-09h45: Prof. Klemens Fellner (Uni. Graz, Austria): *On global existence and convergence to equilibrium for a nonlinear reaction-diffusion model.*
09h45-10h30: Prof. Dinh Nho Hao (VAST, Vietnam): *Determination of the initial condition in parabolic equations from boundary observation*
10h30-11h00: Coffee break
11h00-11h45: Dr. Phan Quang Sang (VNUA, Vietnam): *Hölder stable determination of a quantum scalar potential in unbounded cylindrical domains.*

Afternoon session

14h30-15h15: Prof. Nguyen Minh Tri (VAST, Vietnam): *The existence and decay rates of strong solutions for Navier-Stokes Equations in Bessel-potential spaces.*
15h15-16h00: Dr. Dao Thu Huyen (VNUA, Vietnam): *Comparison of upwind and centre schemes for compressible flows at low Mach number.*
16h00-16h30: Coffee break
16h30-17h15: Dr. Tang Quoc Bao (HUST and Uni. Graz, Austria): *Trend to equilibrium for complex balanced reaction-diffusion systems.*

List of Abstracts

On global existence and convergence to equilibrium for a nonlinear reaction-diffusion model

Klemens Fellner
University of Graz, Austria

Systems of nonlinear reaction-diffusion equations are encountered frequently as models in chemistry, physics, populations dynamics and biology. However, due to the lack of comparison principles for general reaction-diffusion systems, already the existence of global weak/classical solutions poses many open problems, in particular in 3D.

In the absence of comparison principles, so called duality methods have recently proven to be one of the most powerful tools in obtaining global solutions for nonlinear reaction-diffusion systems. The first part of this talk will present recent advances and results concerning the existence of global solutions via duality methods.

The second part of the talk will then consider reaction-diffusion systems, which feature an entropy functional and discuss the convergence to equilibrium states with computable rates for large classes of such reaction-diffusion models.

Determination of the initial condition in parabolic equations from boundary observation

Dinh Nho Hao
VAST, Vietnam

The problem of determining the initial condition in parabolic equations from boundary observations is studied. It is reformulated as a variational problem and then a formula for the gradient of the functional to be minimized is derived via an adjoint problem. The variational problem is discretized by finite difference splitting methods and solved by the conjugate gradient method. Some numerical examples are presented to show the efficiency of the method. Also as a by-product of the variational method, we propose a numerical scheme for numerically estimating singular values of the solution operator in the inverse problem.

This is a joint work with Nguyen Thi Ngoc Oanh, College of Science, Thai Nguyen University.

Hölder stable determination of a quantum scalar potential in unbounded cylindrical domains

Phan Quang Sang
VNUA, Vietnam

We consider the inverse problem of determining the time independent scalar potential of the dynamic Schrdinger equation in an infinite cylindrical domain from one boundary Neumann observation of the solution. We prove Hölder stability by choosing the Dirichlet boundary condition suitably.

The existence and decay rates of strong solutions for Navier-Stokes Equations in Bessel-potential spaces

Nguyen Minh Tri
VAST, Vietnam

In this talk, we present some new results on the existence and decay properties of high order derivatives in time and space variables for local and global solutions of the Cauchy problem for the Navier-Stokes equations in Bessel-potential spaces. Our results improve the previous ones by several authors including Miyakawa, Schobek, etc. The estimate for the decay rate is optimal in the sense that in coincides with the decay rate of a solution to the heat equation.

This is a joint with Nguyen Quang Khai, VAST.

Comparison of upwind and centered schemes for compressible flows at low Mach number

Dao Thu Huyen
VNUA, Vietnam

In this talk, we present fully implicit schemes for Navier-Stokes compressible equations. Using the finite volume framework, these schemes require the resolution of a nonlinear algebraic system at each time step. The schemes are robust, conservative and allow the use of large CFL numbers. We compare the results obtained using either the upwind or centered schemes for the convection flux at low Mach number. We also compare these results with that of the explicit scheme, and introduce a new preconditioning that allows faster computations.

Trend to equilibrium for complex balanced reaction-diffusion systems

Tang Quoc Bao
HUST, Vietnam & University of Graz, Austria

The trend to equilibrium for a certain classes of reaction-diffusion systems is investigated. The reaction-diffusion systems describe chemical reaction networks satisfying the *complex balance condition* which implies the monotonicity of a free energy functional (or Boltzmann's entropy functional). Then, we apply the so-called *entropy method* to obtain *explicit* exponential convergence to equilibrium for systems which do not have boundary equilibria. For systems possessing boundary equilibria, we give exponential decay results in two special cases and discuss on difficulties of the general case.

This is a joint work with Laurent Desvillettes and Klemens Fellner.