Winter School Announcement

13-17 December 2010
University of Twente

Evolution Equations in an Applied Context

Speakers

Odo Diekmann	*Utrecht University*
Keith Promislow	*Michigan State University*
Björn Sandstede	*Brown University*

Since their inception in the 18^{th} century, Partial Differential Equations have been hugely successful in modeling spatially extended physical systems. Concurrently, and thanks also to the concerted effort undertaken by analysts in the 20^{th} century, this has become part of the theory of evolutionary systems and is an integral component of mathematical analysis.

To a large extent, the success of evolution equations is due to the fact that they are able to incorporate the nonlinearities inherent in the world they model. This winter school focuses on certain behavioral aspects of nonlinear evolution equations arising in a wide array of applications. It is aimed at Ph.D. students and advanced Master's students in Mathematics and Physics, whose research interests focus on nonlinear analysis and dynamical systems.

The morning lectures cover the theory underpinning delay equations and population dynamics, geometric evolution of structured interfaces, and the dynamics of modulated wave trains. The afternoon sessions expand—in a hands-on fashion—on the topics covered in these morning lectures. The activities will be concluded by a series of evening research-level talks on selected days.

Location	*University of Twente, Enschede, The Netherlands*
Time period	*December 13 — 17, 2010*
Registration	*Marielle Slotboom: secraacs@ewi.utwente.nl*
Registration fee (*including 4—day lodging and all meals*)	*450€ until October 31* *500€ after November 01*
Information	*Stephan van Gils: s.a.vangils@math.utwente.nl* *Antonios Zagaris: a.zagaris@math.utwente.nl* http://aacs.ewi.utwente.nl/AACS/Winterschool_2010.html

The winter school is organized under the auspices of 3TU.AMI.

Odo Diekmann is Professor of Applied Mathematics in Utrecht. His talks will focus on delay equations (differential equations with delay as well as renewal equations) arising in the context of population dynamics and epidemiology of infectious diseases. He will show how to associate an infinite-dimensional dynamical system with a delay equation, thus bringing us into the realm of operator semigroups. For the linear case, the infinitesimal generator will be introduced, the characteristic equation for its spectrum will be derived and next related to solving the delay equation by the Laplace transform. He will then introduce the adjoint operator, which leads in a canonical way to an enlarged state-space (sun-star space). Both the abstract general theory and the concrete examples offered by delay equations will be utilized to present this methodology. Throughout the course, models leading to delay equations are introduced, analyzed, and interpreted biologically to gain insight. For example, the threshold phenomenon in the general Kermack–McKendrick epidemic model and the instability phenomenon due to delayed negative feedback in a model for Daphnia feeding on algae are discussed.

Keith Promislow is Professor of Mathematics at Michigan State. The material he will present in the winter school concerns the *geometric evolution of structured interfaces*. Functionalized materials have embedded energy that drives the creation of interface, which is balanced against higher-order geometric effects such as curvature. Energy models for functionalized materials, based upon regularizations of the Canham–Helfrich energy, generate networks with bi-layer and pore-like morphologies. Prof. Promislow will derive curvature driven flows for these structures which couple the geometric evolution to the intrinsic parameters of the structures.

Björn Sandstede is Professor of Mathematics at Brown and the 2001 J.D. Crawford Prize awardee. His sessions will cover *the dynamics of modulated wave trains* and, more generally, of defects which can be thought of as interfaces mediating between wave trains with possibly different wave numbers. Slowly-varying modulations of wave trains can be described by appropriately defined local phases or wave numbers. Prof. Sandstede will show that the local wave number formally satisfies the viscous Burgers equation and discuss this equation's rigorous validation over large but finite time intervals. He will also outline implications of these results for diffusive phase mixing. He will show that the profiles of a particularly interesting class of solutions of the viscous Burgers equation for the local wave number—namely, of Lax shocks—correspond to stable moving interfaces in the underlying reaction–diffusion system separating two wave trains with almost identical wave numbers. Finally, a classification of arbitrary interfaces of this kind using the group velocities of wave trains as the main characteristic quantity distinguishing key properties of these defects will be discussed.