International Conference on Infinite Dimensional Dynamical Systems, York University, Sept. 24-28, 2008.

Organizers: John Mallet-Paret, Brown University; Jianhong Wu, York University; Yingfei Yi, Georgia Institute of Technology; and Huaiping Zhu, York University.

Infinite dimensional dynamical systems are generated by evolutionary equations describing the evolutions in time of systems whose status must be depicted in infinite dimensional phase spaces. Studying the long-term behaviors of such systems is important in our understanding of their spatiotemporal pattern formation and global continuation, and has been among major sources of motivation and applications of new development of nonlinear analysis and other mathematical theories. Theories of the infinite dimensional dynamical systems have also found more and more important applications in physical and life sciences.

This international conference was designed to bring together researchers working in different areas of the subject to celebrate the past achievements, to exchange most recent progresses and to stimulate and develop future collaborations. The conference was held with great success at York University, Sept. 24-28, 2008, thanks to generous supported by the Fields Institute, PIMS and York University and to over 80 participants from all over the world.

48 invited lectures covered a wide range of topics and addressed the common features and distinctions in those infinite dimensional dynamical systems generated by parabolic partial differential equations, hyperbolic partial differential equations, solitary equations, lattice differential equations, delay differential equations, and stochastic differential equations.

The conference started with a talk by Barbara Keyfitz to discuss the difficulties in conservation laws from the point of view of infinite dimensional dynamical systems. After some discussions about the essential difference between conservation laws and other infinite dimensional system that behave somewhat like finite-dimensional dynamical systems, Dr. Keyfitz reviewed some of her collaborative work, providing critical tools to understand the dynamics of multidimensional systems. This talk was then followed by lectures of Susan Friedlander, Michael Jolly and Genevieve Raugel on the Onsager's conjecture, on the global attractors and on the long-term behaviors of high dimensional Navier-Stokes equations.

Invariant manifolds and their approximations remains to be a major concept and technical tools in the study of infinite dimensional systems, this was clearly illustrated in the conference. Peter Bates presented his work on using the invariant manifold theory to reveal the global dynamics of boundary spike states for the generalized Allen-Cahn equation, and Chongchun Zeng described the unstable manifolds and L^2 nonlinear instability of the Euler equation. Alexandre N. Carvalho discussed perturbation of attractors, while Yuncheng You talked about the existence of global attractors of the cubic autocatalytic reaction-diffusion systems. Singular perturbation techniques were shown, through the presentations of Weishi Liu and Ken Palmer, to be effective tools to investigate the impact of turning points on global dynamics and homoclinic orbits.

A conference in the subject area normally has many talks dedicated to the dynamics of parabolic equations, and this conference was no exception. Peter Polacik talked about parabolic Liouville theorems and their applications; Hiroshi Matano showed how a braid-group method can be used to the blow-up problem in nonlinear heat equations; and James Muldowney described the Bendixson conditions for differential equations in Banach spaces and used them to rule out periodic motions in

certain parabolic equations. There were talks about "beyond" the classical diffusion. For example, Chris Cosner considered conditional dispersal in ecological models, and Stephen Gourley presented a novel nonlocal reaction-diffusion model for cellular adhesion. Travelling waves and their connections to the global dynamics as well as their applications to biological invasion, disease propagation and combustion were the central subject of a number of talks, by Wenzhang Huang, Xing Liang, Xiao-Biao Lin, Stephen Schecter, Wenxian Shen and Xiaoqiang Zhao.

Delay differential equations, another prototype of infinite dimensional dynamical systems, received their deserved attention in the conference. Stefan Siegmund presented his work on a general qualitative theory for equations with random delay, based on the recent work of Zeng Lian and Kening Lu on generalized multiplicative ergodic theorem of Oseledets in Banach spaces. Delay differential equations with state-dependent delay were covered by a few featured talks: Hans-Otto Walther provided a brief account of his recent work on algebraic-delay differential systems in the aspect of temporal order of reactions, Roger Nussbaum and Tibor Krisztin presented their results on the global structure of solutions, and introduced several major technical tools developed for this important class of dynamical systems.

Global attractivity of solutions of differential equations, both retarded or neutral types, with infinite delay and certain monotonicity were discussed in the talks by Carmen Núñez and Rafael Obaya. Yuming Chen gave a rather complete description of the global attractor of a delayed differential system with monotone feedback, and Bernhard Lani-Wayda showed, for a scalar equation, how a disk-like global attractors changes when the nonlinearity changes from to non-monotone shapes. Two other speakers, Sue Ann Campbell and Connell McCluskey, added further the strong Canadian representation in the subject area: Sue Ann considered a model for regenerative chatter in a drilling process and some perturbation techniques to obtain the delayed induced Canards, and Connell illustrated how the classical Lyapunov functional method coupled with some local analysis can yield the global asymptotic stability of a biologically meaningful equilibrium for a disease model with distributed delay. The interface between spatial diffusion and time delay were addressed by the talks of Sérgio Oliva and Xingfu Zou.

Horst Thieme's talk concerned about a classical but difficult issue of differentiability of convolution operator from solving an abstract linear inhomogeneous evolution equation, where the linear part gives rise to an integrated semigroup. Semilinear equations involving integrated semigroups and non-densely defined Cauchy problem were then discussed in a back-to-back presentations by Pierre Magal and Shigui Ruan, their talks focused on the center manifold theorem and applications to structured population models.

Martin Golubitsky talked about feed-forward networks near Hopf bifurcation and illustrated how the theoretical work finds applications to auditory receptor cells on the basilar membrane in the cochlea. Pattern formation due to the interaction of symmetric coupling and feedback was addressed by Yuan Yuan, and the realization of critical eigenvalues for linear delay-differential equations with multiple delays and with a certain symmetry was discussed by Pietro-Luciano Buono.

There were a couple of talks about data and database, by and for, nonlinear dynamical systems: Arno Berger spoke about "Digits and dynamics: from finite data to infinite dimensions" while Konstantin Mischaikow discussed his adventure of "Building a database for global dynamics of parameterized nonlinear systems".

The conference concluded with a talk by Water Craig that provided an authoritative update of some remarkable progresses on infinite dimensional Hamitonian systems. Hamitonian systems were also discussed by Yingfei Yi.

This conference was also dedicated to Professor George Sell from University of Minnesota on the occasion of his 70th birthday. George was honored by an invitation to deliver a public lecture “An evolution in evolutionary equations”, this lecture and the reception following the lecture was sponsored by Mathematics for Information Technology and Complex Systems (MITACS). George described some of the historical developments of the theory of infinite dimensional dynamical systems during the last 50 years, with particular focus on the theory of the dynamics of solutions of partial differential equations, and specially on the applications of the theory of the Navier-Stokes equations in fluid flows. A number of colleagues from Minnesota delivered their best wishes to George, along with their lectures: Marta Lewicka on “Derivation of shell theories from 3d nonlinear elasticity” and Arnd Scheel, about “How robust are Liesegang patterns?”.

A special feature presentation was jointly given by John Mallet-Paret and Gerry Sell about some personal anecdotes George's mathematics and life: participants certainly had the glimpse of the evolution of evolution equations and the dynamics of the study of dynamical systems from a legendary figurer with infinite energy.