european social fund in the czech republic
EUROPEAN UNION
MINISTRY OF EDUCATION, YOUTH AND SPORTS
OP Education for Competitiveness
Silesian University in Opava
INVESTMENTS IN EDUCATION DEVELOPMENT

Silesian University in Opava April 25, 2012

Silesian Mathematical Summer School in Opava, June 11-15, 2012

DYNAMICAL SYSTEMS: SELECTED TOPICS

Second announcement

This activity is the first of the cycle of three summer schools on *Dynamical Systems and their Applications* organized by the Mathematical Institute in Opava during the period 2012-2014. The school is co-financed by the European Social Fund within the framework of the project *Development of Research Capacities of the Mathematical Institute of the Silesian University in Opava* [1]. For each year, the school program is designed to introduce the active researchers and doctoral students into two selected topics from the modern theory of Dynamical Systems. It includes 5 days of intensive lecturing combined with the exclusive possibility of direct communication with the leading mathematical experts. For this year, we have the following confirmed speakers:

Rafael Ortega (University of Granada)

PRIME ENDS AND DYNAMICS

Hal Smith (Arizona State University)

MONOTONE DYNAMICAL SYSTEMS AND APPLICATIONS

A detailed description of the both courses can be found on the next pages.

The first summer school will take place from June 11 to June 15, 2012, in a **HOTEL TANEČNICA** located in Pustevny region which is a beautiful part of the Morava-Silesian Beskydy Mountains. Registration for the summer school began on March 5, 2012 and will continue till the end of May. No registration fee is required, and the school cost includes only the lodging expenses. Hotel prices are: lodging + food = about 40EUR per person and day. These should be paid directly to the hotel after the formal inscription procedure is done via e-mail at Karel.Hasik@math.slu.cz. We recommend early registration due to the limited hotel capacities. **We can fully support the participants from Czech Republic. The individual support will cover full board and lodging during the summer school period as well as the associated travel expenses.** Please fill the attached registration form and send it to the email stated above.

At the same place and during the same week, the Mathematical Institute in Opava is also organizing the 16th Czech-Slovak Workshop on Discrete Dynamical Systems

[1] For more information about the project visit http://projects.math.slu.cz/RVKMU/

(CSWDDS 2012). The timetables of both events will be synchronized in order to stimulate major interaction between their participants. In particular, each evening workshop session will begin after the fourth (i.e. the last) daily summer school lecture ends.

Prime ends and dynamics

Rafael Ortega, University of Granada

Abstract. Riemann's theorem says that every open and simply connected proper subset of the plane can be mapped conformally onto the open unit disk. Caratheodory introduced the notion of prime end to understand the behavior of these maps on the boundary of the domain. This theory is usually presented in textbooks of complex analysis but it has found applications in fixed point theory and planar dynamics. Probably Birkhoff was the first to use the theory prime ends in dynamics, to associate rotation numbers to an invariant region. Later Cartwright and Littlewood found a deep theorem on fixed points in the plane, motivated by their study of the forced Van der Pol equation. We will discuss some connections between prime ends and stability theory and some applications to periodic differential equations.

Some of the following topics will be treated:

1. An intuitive introduction to Caratheodory's prime ends
2. Homeomorphisms of the plane and prime ends
3. Some fixed points theorems
4. The rotation number of an attractor
5. Global asymptotic stability and extinction in population dynamics
6. Orientation-reversing homeomorphisms and periodic differential equations
7. Denjoy homeomorphisms and non commensurable rotation numbers

References.

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2. G.D. Birkhoff, *Sur quelques courbes fermes remarquables,* Bull. Soc. Math. de France 60 (1932) 1-26.

3. M.L. Cartwright and J.E. Littlewood, *Some fixed point theorems,* Annals of Math. 54 (1951) 1-37.

4. L. Hernndez-Corbato, R. Ortega and F. R. Ruiz del Portal, *Attractors with irrational rotation number*, Mathematical Proc. Cambridge Ph. Soc. (2012)

5. J.N. Mather, *Topological proofs of some purely topological consequences of Carathodory's theory of prime ends.* Selected Studies. North Holland Publis. Co Eds. Th.M. Rassias, G.M. Rassias (1982), 225-255.

6. R. Ortega and F.R. Ruiz del Portal, *Attractors with vanishing rotation number,* J. Eur. Math. Soc. (2011),

7. Ch. Pommerenke, *Boundary behaviour of conformal maps,* Lecture Notes in Math., Springer-Verlag 1991.

Monotone Dynamical Systems and Applications

Hal Smith, Arizona State University

Abstract. I will give an overview of the theory of monotone dynamical systems and its applications to ordinary differential equations, delay differential equations, and reaction diffusion systems. Specific examples taken from the biological sciences will be used to illustrate the application of the theory. A monotone dynamical systems is simply a dynamical system on a partially ordered space such that the partial order is preserved by the (semi-)flow. They arise in systems which possess a comparison principle or maximum principle and they often arise in biological systems and chemical reaction networks due to the inherent positivity of modeled quantities. Many authors have contributed to the rich theory of monotone dynamics, most notably M.W. Hirsch. Some references include [1, 2, 3, 5]. My recent work has focused on applications to modeling the interaction of bacteriophage (virus that parasitize bacteria) and their bacterial hosts [6, 4]. I will discuss some of these applications.

References.

1. G. Enciso, M.W. Hirsch and H. Smith, *Prevalent behavior of strongly order preserving semiflows,* J.Dynamics and Diff. Eqns., 20 (2008) 115-132.

2. M.W. Hirsch and H.L. Smith, *Monotone Dynamical Systems,* Handbook of Diff. Equations, ODE, v.2 eds. A. Cabada, P. Drabek, A. Fonda, Elsevier, 239-357, 2005.

3. M.W. Hirsch and H.L. Smith, *Monotone systems, a mini-review,* in Positive Systems. Proceedings of the First Multidisciplinary Symposium on Positive Systems (POSTA 2003). Luca Benvenuti, Alberto De Santis and Lorenzo Farina (Eds.) Lecture Notes on Control and Information Sciences vol. 294, Springer-Verlag, 2003.

4. D. Jones, G. Rost, H. Smith and H. Thieme, *On Spread of Phage Infection of Bacteria in a Petri Dish,* to appear, SIAM J. Applied Math. 2012.

5. H. L. Smith, *Monotone Dynamical Systems, An introduction to the theory of competitive and cooperative systems,* Math. Surveys and Monographs, 41, American Mathematical Society, Providence, Rhode Island, 1995.

6. H.L. Smith and H. Thieme, *Persistence of Bacteria and Phages in a Chemostat,* J. Math. Bio., 2011, (on-line).