

Mini-workshop on Multivalued Analysis

Abstracts of the main lectures

Multivalued chaos

Jan Andres

Palacky University in Olomouc, Czech Republic

The relationship between various sorts of chaos in the original spaces and those in the induced hyperspaces (i.e. hyperchaos) will be clarified for multivalued maps (whence the title). The research was stimulated by the recent results in [AFP1], [AFP2],[OO] as well as by a series of papers dealing with the topic called (by the authors rather incorrectly) as a set-valued chaos.

[AFP1] J. Andres, T. Fuerst and K. Pastor: Period two implies all periods for a class of ODEs: a multivalued map approach. Proc. AMS 135 (2007), 3187-3191.

[AFP2] J. Andres, T. Fuerst and K. Pastor: Sharkovskiis theorem, differetial inclusions and beyond. Topol. Meth. Nonlin. Anal. 33 (2009), 149-168.

[OO] F. Obersnel and P. Omari: Period two implies chaos for a class of ODEs. Proc. AMS 135 (2007), 2055-2058.

Floquet Solutions of Semilinear Multivalued Evolution Equations

Luisa Malaguti

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This talk concerns multivalued semilinear evolution equations and its main aim is to discuss the existence of Floquet solutions for such dynamics, i.e. the existence of solutions x on an interval $[a, b]$ satisfying $x(b) = Mx(a)$ where M is a linear bounded operator. Upper-Carathèodory regularities of the nonlinear terms are always assumed.

Most of this discussion is in arbitrary Banach spaces and it involves first order equations:

$$x'(t) + A(t)x(t) \in F(t, x(t)), \quad t \in [a, b].$$

In this case, alternative topological approaches are proposed, for the investigation of classical and mild Floquet solutions. Indeed, the theory of condensing

multimaps is used as well as the introduction of weak topologies and also a continuation principle, suitably combined with a bound set approach. The special case of the existence of periodic solutions is treated in some details.

For second order equations

$$x''(t) + A(t)x'(t) + B(t)x(t) \in F(t, x(t)), \quad t \in [a, b]$$

an existence result of classical Floquet solutions is showed, in Euclidean spaces, when assuming a strictly localized condition involving a Liapunov-like function.

The results come from joint researches with Andres, Benedetti, Cecchini, Pavlačková and Taddei.

Nonsmooth constrained optimization problems via a gradient-like differential inclusion

Paolo Nistri
Università di Siena

A gradient-like differential inclusion is built upon a nonsmooth, not necessarily convex, constrained minimization problem in finite dimensional space. Under minimal assumptions on the functions defining the constraint set and the functional to be minimized it is proved that all the trajectories of the differential inclusion converge to the set of the constrained critical points. The rate of convergence of the trajectories is also evaluated. An application to a class of quadratic programming problems is presented.

Degree theory and multivalued elliptic problems

Nikolas Papageorgiou
University of Athens

We develop a degree theory for multivalued perturbations of nonlinear operators of monotone type and we apply it in the study of nonlinear elliptic problems with unilateral constraints and nonsmooth potentials.