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FAKULTÄT FÜR MATHEMATIK
Dekan Univ.-Prof. Dr. Christian Krattenthaler

Einladung zur öffentlichen Defensio von

Dott. mag. Dott. Stefano Melchionna

Thema der Dissertation:

On some global variational methods for evolution equations

Abstract: This thesis is a collection of five papers (submitted, published or accepted for publications in international journals) containing advances in the so-called *Weighted-Energy-Dissipation* (WED) theory. Given a target evolution equation, the WED procedure consists in introducing a one-parameter family of WED functionals I_ε defined over entire trajectories, and proving that their minimizers converge, up to subsequences, to *strong* solutions of the target problem, as the approximation parameter ε vanishes. An intermediate step in the procedure is to verify that the Euler-Lagrange equation associated with the WED functional corresponds to an elliptic-in-time regularization of the target problem. In recent years the WED formalism has attracted the interest of a large number of authors. The interest lies in the fact that this procedure paves the way to the application of general techniques of the Calculus of Variations (e.g., Direct Method, relaxation, and Γ-convergence) in the evolutionary setting. Moreover, the WED procedure also brings a new tool to check qualitative properties of solutions and comparison principles for evolutionary problems. Furthermore, the minimization problem provides more regular (in time) solutions, i.e., more regular approximations of solutions to the target problem.
In the first two chapters of the thesis we extended the WED theory to nonpotential perturbations of doubly nonlinear gradient flows of nonconvex energies. This enlarges significantly the range of applications of the theory for it allows to consider systems.
In the third chapter the WED theory is used as a flexible and easy-to-handle tool that allows us to check a large number of different qualitative properties for a variety of different problems ranging from systems of doubly nonlinear gradient flows to hyperbolic problems.
The fourth chapter investigates Γ-convergence properties of families of WED functionals. Sufficient conditions for Γ-convergence are established. Moreover, the relation between Γ -convergence and the limit $\varepsilon \to 0$ is discussed, as well as explicit estimates on convergence rates.
Finally, in the last chapter we discuss the WED procedure in the case of functionals defined on trajectories over unbounded time intervals.

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