VARIATIONAL ADAPTIVITY

THOMAS P. WIHLER*

ABSTRACT

We present a novel adaptive finite element methodology for the efficient numerical approximation of linear and nonlinear variational partial differential equations (PDE). The basic principle of our approach consists of an effective interplay of two key components, both aiming towards critical points of an underlying energy: Whilst the first component takes care of possible nonlinearities by means of appropriate problem-dependent iteration schemes, the second component is a new and quite generally applicable energy-based adaptive local mesh refinement technique. We thereby design a carefully balanced cost-benefit procedure that generates a trajectory of discrete approximations (travelling through a sequence of adaptively refined finite element spaces), which potentially tend to a solution of the PDE. Our general idea will be illustrated in the specific context of a class of semilinear reaction-diffusion models and of the Gross-Pitaevskii eigenvalue problem in quantum chemistry, whereby both theoretical as well as numerical results will be discussed.

This talk contains joint work with Mario Amrein (Zurich University of Applied Sciences), Pascal Heid (University of Oxford), and Benjamin Stamm (RWTH Aachen).

* Mathematics Institute, University of Bern, Switzerland, thomas.wihler@unibe.ch