FAKULTÄT FÜR MATHEMATIK
Dekan Univ.-Prof. Dr. Radu Ioan Boţ

Einladung zur öffentlichen Defensio

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Thema der Dissertation

Variational models and methods in material science and evolution equations

Abstract:
Variational principles are an important tool to analyze and describe natural phenomena. The Weighted Energy-Dissipation (WED) variational principle offers significant mathematical advantages, particularly when dealing with partial differential equations (PDEs). A common approach to proving the existence of solutions for PDEs involves defining a functional whose Euler-Lagrange equation corresponds to the given PDE. If such a functional can be found, the problem of well-posedness for the PDE is translated into seeking stationary points for the identified functional. Generally, finding stationary points of the functional is often simpler than directly demonstrating the existence of solutions for the PDE. Despite its effectiveness, defining an appropriate functional is not always straightforward or trivial. The WED variational principle presents an alternative approach compared to classical variational principles. In this method, the goal is to find a functional whose Euler-Lagrange equation is a regularized version of the considered PDE. This regularization introduces greater flexibility in applications, allowing both conservative and dissipative systems to be described in a variational formulation. Nevertheless, this advantage of applicability comes at the expense of proving the so-called causal limit, namely the removal of the regularization.
In this thesis we tackle three problems by means of the WED approach.
We first introduce a novel approach to studying semilinear gradient flows by incorporating state-dependent dissipation. This extension has deep impact on the technical level. Most notably, the structure of the Euler-Lagrange equation features specific state-dependent dissipative terms showing minimal integrability in time. Then, we move to a general optimal control problem in the setting of gradient flows. We propose two approximations of the problem, both relying on the variational formulation of the gradient-flow dynamics via the WED approach. Eventually, we present a global-in-time variational approach to the dynamics of hyperelastic materials via the WED variational theory.

Prüfungssenat

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Zeit und Ort

Donnerstag, 27. Juni 2024, 09:00 Uhr

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