

Seminar of the Work Group
Nonlinear Partial Differential Equations
WS 2020/21

Speaker: Kevin Drescher
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Computer-assisted Existence Proofs for nonlinear Boundary Value Problems

Abstract

In this talk we will present a rather general method which states the existence of solutions to boundary value problems for semilinear elliptic partial differential equations. With this computer-assisted method not only the existence and local uniqueness of solutions to such boundary value problems are given, but also an enclosure of those, i.e. we know that there exists a solution in an explicit and small neighborhood of some approximate solution. The main theorem is based on a fixed-point formulation, to which a fixed point theorem is applied. In order to verify its assumptions, eigenvalue bounds for the linearization at the approximate solution have to be computed. In order to make the proof rigorous, all numerical errors have to be taken into account.

Computer-assisted existence proofs have been applied to many problems. In various examples where a purely analytical approach had not been successful, such methods could provide the existence of solutions.

Further details and examples can be found in the book "Numerical Verification Methods and Computer-Assisted Proofs for Partial Differential Equations" by M. Plum, M. Nakao and Y. Watanabe.