Karlsruher PDE-Seminar

Pattern formation and Partial Differential Equations

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In three specific examples, we shall demonstrate how the theory of partial differential equations (PDEs) relates to pattern formation in nature: Spinodal decomposition and the Cahn-Hilliard equation, Rayleigh-Bénard convection and the Boussinesq approximation, rough crystal growth and the Kuramoto-Sivashinsky equation.

These examples from different applications have in common that only a few physical mechanisms, which are modeled by simple-looking evolutionary PDEs, lead to complex patterns. These mechanisms will be explained, numerical simulation shall serve as a visual experiment. Numerical simulations also reveal that generic solutions of these deterministic equations have stationary or self-similar statistics that are independent of the system size and of the details of the initial data.

We show how PDE methods, i. e. a priori estimates, can be used to understand some aspects of this universal behavior. In case of the Cahn-Hilliard equation, the method makes use of its gradient flow structure and a property of the energy landscape. In case of the Boussinesq equation, a "driven gradient flow", the background field method is used. In case of the Kuramoto-Sivashinsky equation, that mixes conservative and dissipative dynamics, the method relies on a new result on Burgers' equation.

Termin: Mittwoch, 9. Januar 2013, 17:30 Uhr
Ort: 1C-04, Allianz-Gebäude 05.20
Gastgeber: Die Dozenten des Schwerpunkts Partielle Differentialgleichungen