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

Einladung zur öffentlichen Defensio von

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Thema der Dissertation
Variational models for biological membranes

Abstract:

Biological membranes naturally occur in a fascinating variety of shapes. The most prominent example is the biconcave equilibrium configuration of red blood cells. In a continuum mechanical approach, biomembranes can be described as surfaces that minimize the Canham-Helfrich elastic bending energy. This quadratic curvature functional generalizes the illmore energy by taking different bending rigidities and the presence of a spontaneous curvature parameter into account. inimization has to be performed under constraints on membrane area and enclosed volume.

This thesis focuses on two different aspects of variational models involv-ing the Canham-Helfrich energy. First, we study heterogeneous biomem-branes, where we are interested in the influence of the varying material parameters on the existence of minimizers and their properties. We present results for a one-dimensional Canham-Helfrich model, describing a planar elastic curve whose stiffness parameter is modulated by an additional phase density. Moreover, we consider multiphase biomembranes with sharp phase-interfaces, where we prove existence of minimizers within the geometric mea-sure theoretical framework of curvature varifolds. The second focus of this thesis is to analyze the Canham-Helfrich gradient flow, which governs the time-evolution of biomembrane configurations towards equilibrium. Based on our varifold setting, we establish existence of global solutions via the Generalized Minimizing Movements method and also discuss the evolution of more regular surfaces. In both aspects addressed in this thesis, the ma-terial parameter bounds we require for existence of solutions are consistent with the available experimental data on biological membranes.

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