セミナー＠KUEのご案内

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- TITLE: A phase field model for the Willmore flow with constraints applying to the evolution of membranes

- ABSTRACT: Biological cell membranes define the border between the interior of the cell and its surrounding medium and can be roughly described as a bilayer in which several kinds of lipids are assembled and through which proteins diffuse. The size of the cell (a few microns) is typically much larger than the thickness of the membrane (a few nanometers) and a possible approach to model the geometric properties of the latter is to assume the membrane to be a two-dimensional embedded surface in the three-dimensional space with a shape at equilibrium being determined by the Canham-Helfrich elastic bending energy. In a simplified setting, this energy reduces to the Willmore functional which is a well-known object in differential geometry. Two natural geometric constraints come along with cell membranes: the inextensibility of the membrane fixes the total area while a volume constraint follows from its permeability properties.

This talk reports on two joint works with Philippe Laurençot, in which a phase-field approximation to the Willmore flow with either a volume constraint or area and volume constraints is introduced and studied. The well-posedness of the phase-field approximation to the Willmore flow with either a volume constraint is proved in the general case, and with area and volume constraints is established when the functional approximating the area has no critical point satisfying the two constraints. The existence proofs rely on the underlying gradient flow structure of the problem: the time discrete approximation is solved by a variational minimization principle. The main difficulty stems from the nonlinearity of the area constraint.

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