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A Cahn-Hilliard-Willmore energy for non-oriented interfaces

Friday, 24 October 2025 09:00 (1 hour)

The Cahn-Hilliard energy is a celebrated phase-field model for the smooth approximation of the area of domain's boundaries. Its L2 gradient flow provides an excellent approximation, both theoretically and numerically, of the smooth mean curvature flow.
In this talk, I will present a new model for approximating the area of general interfaces not associated with any interior domain, which we call non-oriented.
This model was obtained by analyzing the structure of certain neural networks capable of simulating mean curvature motion for non-oriented interfaces. I will show that, instead of using neural networks, one can adopt a more classical variational approach combining a Cahn-Hilliard-type functional with an appropriate non-smooth potential and a Willmore-type stabilizing energy.
I will describe some theoretical properties of this model in dimension one, and for radial functions in arbitrary dimension.
A simple numerical scheme can be designed to approximate the L2 gradient flow of the model, so I will present several numerical experiments illustrating, at least formally, the connection between this new model and the mean curvature flow of interfaces of codimension 1 or 2 in space dimensions 2 and 3.
It is a joint work with E. Bretin (INSA Lyon) and A. Chambolle (CNRS & Paris-Dauphine).

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