Robert Nürnberg

Focus session 3: Optimization and Free Boundaries

A semismooth Newton method for a gradient constrained minimization problem

A path-following method for finite element discretizations of a Moreau-Yosida regularization for a gradient constrained minimization problem is considered. The arising subproblems are solved with a semi-smooth Newton method. Merits of the method are discussed and some numerical results are presented.

Focus session 4: Crystalline interface evolution and related singular curvature flow

Numerical approximation of facetted pattern formation in snow crystal growth

We present a finite element approximation for a continuum model of snow crystal growth. The problem features a fully anisotropic Gibbs–Thomson law, with a nearly crystalline hexagonal surface energy. In our numerical computations we simulate snow crystal growth in two and three space dimensions. On choosing realistic physical parameters, we are able to produce several distinctive types of snow crystal morphologies.

Focus session 8: Numerical methods for evolving hypersurfaces

Stable approximation of Stefan problems with fully anisotropic Gibbs-Thomson law

We introduce a parametric finite element approximation for the Stefan problem with the Gibbs–Thomson law and kinetic undercooling. The proposed method is also applicable to certain quasi-stationary variants, such as the Mullins–Sekerka problem, as well as to one-sided situations. In addition, fully anisotropic energies are easily handled. Our approximation, which couples a parametric approximation of the moving boundary with a finite element approximation of the bulk quantities, can be shown to satisfy a stability bound, and it enjoys very good mesh properties which means that no mesh smoothing is necessary in practice.