

New computational approaches to curvature driven interface evolution with applications to crystal growth and image analysis

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Abstract:

In crystal growth and image segmentation, one of the most important tasks in image analysis, interfaces move by a speed involving the curvature of the interface. We present new computational approaches which allow for an efficient computation of curvature driven interface motion. The approach is based on a parametric finite element method (PFEM) and leads to evolving meshes which do not deteriorate - a common feature of traditional interface tracking methods. We also demonstrate how junctions and topology changes can be incorporated into the methodology.

As one application of the approach we explain how the parametric finite element method can be used to compute anisotropic nearly crystalline motion in solidification. In particular we present computations of snow crystal growth. As a second application we discuss geometric active contour models of Chan-Vese type. Instead of level set methods, which are typically used in this context, we also use the parametric finite element approach for the evolution of the active contours. Since we allow for junctions, we can also deal with multi-phase situations and as topology changes are included we can handle almost all situations of practical relevance.