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VARIATIONAL IMAGE SEGMENTATION ON ANISTROPIC ADAPTED MESHES FOR MEDICAL APPLICATIONS

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Image segmentation aims at recognizing the different homogeneous portions of a picture by tracking the inner contours. From a mathematical viewpoint, we tackle image segmentation through a variational approach, based on a regularized version of the Ambrosio - Tortorelli functional, consisting of three integral terms [1]. The first one enforces the fidelity of an approximated reconstruction to the original image to be segmented; the second term involves the image gradient in order to recognize abrupt changes in the dataset and to track the contours of the image; the last contribution is a phase-field-like regularization for the approximated contour. The minimization of such functional results in the identification of the different regions of the image and of the corresponding boundaries.

In this contribution, the minimization problem is discretized by means of standard finite elements coupled with a metric-based anisotropic mesh adaptation. The grid generation procedure is driven by an *a posteriori* error estimator properly designed to control the derivative of the error on the regularized Ambrosio-Tortorelli functional. Such estimator automatically identifies the contours to be tracked and, thus, guarantees a sharp segmentation of the image, while resorting to a limited number of mesh elements. The proposed workflow is a cost-effective strategy, capable to yield accurate results, especially in correspondence with the image boundaries [2].

We illustrate the proposed pipeline starting from the adaptive segmentation up to the geometry extraction procedure. We apply this methodology to a 3D medical dataset derived from CT scan and we verify it in comparison with state-of-the-art software.

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