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Research Article

Brain MRI Segmentation with Multiphase Minimal Partitioning: A Comparative Study

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Abstract

This paper presents the implementation and quantitative evaluation of a multiphase three-dimensional deformable model in a level set framework for automated segmentation of brain MRIs. The segmentation algorithm performs an optimal partitioning of three-dimensional data based on homogeneity measures that naturally evolves to the extraction of different tissue types in the brain. Random seed initialization was used to minimize the sensitivity of the method to initial conditions while avoiding the need for *a priori* information. This random initialization ensures robustness of the method with respect to the initialization and the minimization set up. Postprocessing corrections with morphological operators were applied to refine the details of the global segmentation method. A clinical study was performed on a database of 10 adult brain MRI volumes to compare the level set segmentation to three other methods: "idealized" intensity thresholding, fuzzy connectedness, and an expectation maximization classification using hidden Markov random fields. Quantitative evaluation of segmentation accuracy was performed with comparison to manual segmentation computing true positive and false positive volume fractions. A statistical comparison of the segmentation methods was performed through a Wilcoxon analysis of these error rates and results showed very high quality and stability of the multiphase three-dimensional level set method.