Image Segmentation: Structural Similarity, Belief Propagation and Radial Basis Functions for Level Sets Based Methods

By

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Dissertation

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Abstract

In this dissertation, we investigate structural similarity, belief propagation, and radial basis functions in level sets based image segmentation. In order to separate the objects from the background, the level sets based method uses image features such as edges and contrasts to derive differential equations for segmentation. In general segmentation, most of the parameters in level set based methods are empirically determined. We first propose a novel level set method which formulates a cost function to minimize the structural similarity between objects and background. The parameters in our approach are automatically determined according to the image information during the evolution of level sets. Secondly, in order to apply user information into interactive segmentation to detect a specific target in the image, we develop a level set based algorithm to handle human interaction during segmentation. In our method, belief propagation is used to spread out the user information according to the local level sets. The experimental results indicate that our method is robust to objects with high shape variation and inhomogeneous intensity appearance. Moreover, the evolution of level sets often involves solving partial differential equations using finite difference method which is time consuming and complicated. We present an alternative method using radial basis functions to evolve the level sets, where the centers and the number of basis functions are determined based on a mathematical approach. We validate our methods by evaluating the segmentation results of different kinds of images, and by comparing them qualitatively and quantitatively with other relevant methods.