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Title: Discriminative Parameter Estimation for Random Walks Segmentation
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Abstract: The Random Walks (RW) algorithm is one of the most efficient and easy-to-use probabilistic segmentation methods. By combining contrast terms with prior terms, it provides accurate segmentations of medical images in a fully automated manner. However, one of the main drawbacks of using the RW algorithm is that its parameters have to be hand-tuned. In order to avoid this onerous task, we propose a novel discriminative learning framework that estimates the parameters using a training dataset. The main challenge we face is that the training samples are not fully supervised. Specifically, they provide a hard segmentation of the medical images, instead of a probabilistic segmentation. We overcome this challenge by treating the optimal probabilistic segmentation that is compatible with the given hard segmentation as a latent variable. This allows us to employ the latent support vector machine formulation for parameter estimation. We show that our approach significantly outperforms the baseline methods on a challenging dataset consisting of real clinical 3D MRI volumes of skeletal muscles.

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