A generative model for multi-atlas segmentation across modalities

Current label fusion methods enhance multi-atlas segmentation by locally weighting the contribution of the atlases according to their similarity to the target volume after registration. However, these methods cannot handle voxel intensity inconsistencies between the atlases and the target image, which limits their application across modalities or even across MRI datasets due to differences in image contrast. Here we present a generative model for multi-atlas image segmentation, which does not rely on the intensity of the training images. Instead, we exploit the consistency of voxel intensities within regions in the target volume and their relation to the propagated labels. This is formulated in a probabilistic framework, where the most likely segmentation is obtained with variational expectation maximization (EM). The approach is demonstrated in an experiment where $T_1$-weighted MRI atlases are used to segment proton-density (PD) weighted brain MRI scans, a scenario in which traditional weighting schemes cannot be used. Our method significantly improves the results provided by majority voting and STAPLE.