AbstractID: 9074 Title: Semi-Automatic Medical Image Segmentation with Adaptive Local Statistics in Conditional Random Field Framework

Purpose: We report on a semi-automatic method of CT image segmentation to improve productivity and consistency in delineating normal dose-limiting tissues for radiation treatment planning. **Method and Materials:** The approach combines interactive expert user guidance through a probabilistic framework and a fast graph partition algorithm for volumetric image segmentation. With an intuitive graphical interface, the user indicates samples of object and background tissue by loosely drawing a few brush strokes on the image, which provide statistical input for a Conditional Random Field (CRF) based segmentation. We show that boundary statistics provided on a few 2D slices can be propagated through the entire 3D stack of images without using the geometric correspondence between images. In addition, CRF based segmentation can be formulated as a graph partition problem which has a solution that is both globally optimal and fast. We compare our proposed method and other segmentation methods in analytical phantom and with manual expert segmentations (ground truth) in a clinical liver case. **Results:** The phantom study shows the method to be less sensitive to image noise and requiring less human input than previous graph partition methods. In liver, our method achieves 98% precision (=TP/(TP+FP) where TP (true positive) is the number of segmented liver voxels in ground truth liver, and FP=false positive) and 90% recall rate (sensitivity) compared to 90% precision and 90% recall rate using level-sets and 96% precision and 89% recall using region growing. Average computation time per slice is 6 seconds. **Conclusion:** The liver analysis shows that boundary statistics from a single slice can be reused for the entire image stack without retraining to achieve high accuracy. Compared to the earlier graph cut method, time required for manual interaction is significantly reduced. This is clinically important particularly for fast and accurate segmentation of large anatomic volumes.