AbstractID: 11077 Title: Esophagus segmentation in thoracic CT images for radiotherapy planning

Purpose: Contouring organs at risk in thoracic CT images for radiotherapy planning is labor intensive. We propose a technique to semi-automatically segment the esophagus in thoracic CT images.

Method and Materials: We used training datasets to learn the distribution of relative spatial location of esophagus centers with respect to neighboring structures and to construct models of their anterior-posterior (x) and left-right (y) coordinate trajectories as a function of cranial-caudal (z) position after local normalization by transverse scaling and translation. In the z direction, we selected 8 anatomical reference points and matched these points for each training set. We observed that the centers can be modeled by a single cubic polynomial in the sagittal plane and by a shape-preserving spline in the coronal plane.

To segment the esophagus in a 3D dataset, we estimated the center based on histograms for each reference slice and fit the polynomial center models for other slices. We then used level-sets to locate the esophagus wall. We initialized the level-set function and shape prior using the estimated centers and updated to minimize an energy functional combining several existing region, shape and smoothness terms to impose a smooth slice-to-slice change of ellipse parameters.

Results: Testing on 8 subjects against expert segmentations, the center-estimation algorithm achieved 2mm average error in the x-direction but was less accurate in the y-direction with a 4.3mm average error. The level-set method improved the average error in y-direction to 2.8mm.

Conclusion: Segmentation of the esophagus using prior information from training including spatial dependence between neighboring structures and models of the esophagus centers can be performed with a level set approach. Using spatial information and slice-to-slice smoothing improves the performance for regions with no contrast.

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