AbstractID: 11557 Title: Utilizing shape models composed of geometric primitives for organ segmentation

Purpose: Image segmentation technology can automate the task of contouring organs for radiation treatment planning. A segmentation method using a five-layer hierarchy, proposed in AAPM 2008, propagates information from the voxel layer up to voxel neighborhoods, then tissues, then organs, and finally organ systems. An improvement to the organ layer is proposed that uses shape models composed of geometric primitives.

Method and Materials: The organ layer generally follows a sequence of six steps for each muscle and organ: (1.) Generate an ROI that limits the search space. (2.) Generate a field of candidate tissues within the ROI. (3.) On a slice-by-slice basis, recognize the object within the field that best matches expectations. (4.) Fit a geometric shape model to the cross-section of the object on each slice. (5.) Smooth the shape parameters over all slices. (6.) Refine the object boundary by reconciling shape and image data. Consider how to define the shape model used by the fourth step. Use an ellipse for the bladder, rectum, and penile bulb. For the prostate, use a large circle with its bottom quarter cut off, and two small side-by-side circles with radii half that of the large circle lowered into position. For seminal vesicles, use a horizontal ellipse for the caudal-most centimeter, which then splits into two ellipses that are permitted to tilt and slide laterally and posteriorly.

Results: The segmentation method using geometric shape models has been trained and tested on 50 prostatic datasets. Processing time for volumes with roughly 90 slices, and 256x256 pixels per slice, is 40 seconds on a standard PC, without any human interaction. The segmentation results were verified by trained experts and redeemed to be acceptable.

Conclusion: Shape models composed from geometric primitives are a useful method of regularizing the segmentation of muscles and organs.

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