AbstractID: 9196 Title: An automatic contouring method that combines rule-based, atlas-based, and mesh-based approaches

Purpose: Image segmentation technology can automate the task of contouring organs at risk for radiation treatment planning. While automatic methods tend to be rule-based, atlas-based, or mesh-based, a combination of all three approaches is proposed.

Method and Materials: Model-based segmentation can be initialized by automatically positioning the adaptable meshes relative to the scan. The entire scene is segmented in order to recognize the approximate organ locations. Segmentation is accomplished by a 5-layer hierarchy that propagates information from the voxel layer up to voxel neighborhoods, then tissues, then organs, and finally organ systems.

The *voxel layer* treats each voxel as an independent statistical event. Bayesian classification uses an atlas in the form of a spatially varying prior constructed from training data. The classification is adaptive within an Expectation-Maximization framework that iteratively performs segmentation and model-estimation simultaneously.

The *neighborhood layer* introduces local contextual constraints using Markov random fields. The *tissue layer* corrects mistakes using a series of logical rules. The *organ layer* divides tissue into different organs, or stitches different tissues together to form an organ. Organ cross-sections are segmented in order by quantitative confidence measures. The *systems layer* manipulates geometric primitives that have been fit to organs in order to reconcile overlaps.

Results: The automatic initialization of meshes has been trained and tested on 5 prostatic datasets. Processing time for volumes with roughly 60 slices, and 256x256 pixels per slice, is 40 seconds on a standard PC, without any human interaction. The segmentation results from the same 5-layer hierarchy were verified by the trained experts and redeemed to be acceptable.

Conclusion: A 5-layer hierarchy can perform both recognition and delineation, seeing the big picture as well as the details. Such a framework where local decisions are supported by global properties can be useful in addressing inconsistent rectum contents.