AbstractID: 11628 Title: Development of an organ surface statistical model for uncertainty-weighted deformable image registrations

Purpose: To develop an organ surface statistical model for uncertainty-weighted probabilistic deformable registrations.
Materials and Methods: The contours of the prostate, the bladder, and the rectum were manually delineated by five observers on fan beam CT images of four prostate patients. The reliability of the organ boundary delineation was estimated by calculating the intra-observer, the inter-observer, and the inter-modality variability (e.g., standard deviation) of the organ boundary surfaces. For each set of contours, an average surface was computed by first superimposing individual organ contours and generating a composite bitmap image. Then after smoothing, a matching tetrahedron algorithm was used to extract the average surface mesh. The distance map between each individual segmentation and the average surface mesh can be calculated based on the normal defined on 1) each vertex or 2) each triangle of the average mesh. A simple 3D visualization program was developed using OpenGL to interactively viewing 3D organ surfaces and standard deviation surface maps.
Results: Population-based organ surface statistical models of the prostate, the bladder, and the rectum were created by mapping the patient specific standard deviation surface maps to the population-averaged surface. 3D visualization indicates that the boundary uncertainties are anatomical location dependent.
Conclusions: We proposed a general method for objectively constructing surface maps of uncertainties derived from topologically complex organ boundary segmentations from multiple observers. The computed boundary uncertainties can be used as weighting factors for a surface-based probabilistic deformable registration.

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