

Purpose:

During a course of radiation therapy for the prostate, organs such as the bladder and rectum may change shape significantly from day to day, causing the delivered dose to differ from that planned. Deformable image registration has been used to overlap structures with different shape. In this project, we propose a method to validate the correspondence accuracy of a deformable registration algorithm using images of previously treated prostate patients.

Method and Materials:

The planning and one daily treatment CT images for each of five patients with three Calypso transponders implanted in their prostate were retrospectively selected for the study. Two CT volumes of each patient were pre-processed to mask the fiducials. A fluid-based image registration method was used to register images. The displacement fields obtained were applied on the original images with fiducials. The overlap of prostate volumes between the registered images was evaluated by the coincidence index (CI). The centroid positions of each transponder were calculated. The distance between the corresponding transponders was used to quantify the accuracy of correspondence of image registration.

Results:

The fluid deformable image registration produced satisfactory results of the overlap of the prostate volumes. The mean CI is 95.3%, with 91.5% as minimum and 98.7% as maximum. The average distance between the centroid of all pairs of transponders is 0.35 mm. The displacement is related to the quality of image registration. For image registration with CI 98.7%, all displacement of three pairs of transponders is within 0.22 mm. When less overlap is achieved, CI 91.5%, one pair of transponder is 0.78 mm apart.

Conclusion:

We have used real patient data to validate the correspondence of the fluid deformable image registration method. For the prostate, it has maintained sub-millimeter mapping accuracy, which is dependent on image registration quality.