

Purpose:

The delineation of the prostate on CT images is crucial for radiotherapy treatment planning. In order to help identify the prostate, contrast is often injected to the bladder when acquiring CT. Deformable image registration is used for dose accumulation, but unfortunately, all intensity driven algorithms fail to handle images with contrast. In addition, significant shape change of organs makes image registration less accurate. The purpose of this work is to develop a hybrid method to register images with contrast and large organ deformation.

Method and Materials:

Six pairs of CT images, one planning CT with bladder contrast and one daily treatment CT without any contrast, were retrospectively selected for this study. The prostate, bladder and rectum were contoured on both images. The contrasted bladder was replaced by pixel intensities of a Gaussian distribution. On each image, a ring of 3mm thickness was generated inward from the outline of contours of the bladder and rectum. The ring was masked with Hounsfield number -500 and 500 for the bladder and rectum, respectively. A fluid-based deformable image registration method and a rigid body-based method (for comparison purposes) were used to register pre-processed images. The accuracy of registration was estimated by the coincidence index (CI).

Results:

The fluid image registration tool maps treatment day CT onto the contrasted planning CT with relatively high accuracy. The overlap of contours reached CI 89.5% for the prostate, 95.1% for the bladder and 83.9% for the rectum. The rigid body method resulted in CI 50.1% for the prostate, 52.1% for the bladder and 31.7% for the rectum.

Conclusion:

We develop a novel hybrid tool to register the images with contrast. It relatively accurately overlaps the organ with large deformation, which makes it a promising tool for dose accumulation.