AbstractID: 5089 Title: Intensity-based 3D/3D image registration for prostate localization on CBCT images

**Purpose:** We have developed an intensity-based 3D/3D image registration program for automatic prostate localization on CBCT images. The main application of this program will be the online and offline analysis of CBCT images for daily image guided radiation therapy.

**Methods and materials:** The program provides with two different ways of defining region of interests (ROI); rectangular ROI and irregular ROI. The rectangular ROI is generally defined around the pelvic bone for bone matching, and the irregular ROI is around prostate and seminal vesicle for prostate matching. The ROIs are defined on the simulation CT images, and the volumes within which are registered with daily CBCT images. Registration is accomplished by maximizing the similarity within the ROIs. Uphill simplex method is utilized for the maximization, and it stops when the number of iteration reaches a preset threshold, or when the simplex shrinks to a preset simplex radius. Then, the users verify the registration result in three different overlay views, and the treatment machine correction shifts are calculated from the verified registration.

**Results:** As a similarity function, mutual information provided very robust and accurate registrations for the pelvic bone registration. In one of our preliminary studies, the prostate registrations with gradient correlation, gradient difference, and pattern intensity showed 1.7±1.0mm average error, estimated from calcification mismatches. The registrations were also compared with the average manual registrations conducted by four clinicians. The isocenter difference in each dimension was around 1.0±0.7mm. The execution time, except the ROI definition and image loading, was around 7 seconds for each pelvic bone and prostate registration on a 1.8 MHz PC.

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**Conclusions:** Further thorough experiments are due, but the preliminary results indicated that the newly developed program may be able to provide accurate, robust, and fast online and offline CBCT analysis for image guided radiation therapy.