

## AbstractID: 13710 Title: A Hybrid Deformable registration method between Helical CT and Cone-Beam CT for Prostate Patient

**Purpose:** Onboard CBCT imaging has been increasingly used in prostate cancer radiotherapy, but, to date, limited to the online image guided position correction with using the rigid-body image registration. To utilize online CBCT image for treatment dose assessment and 4D adaptive inverse-planning, a reliable image registration tool is essential for CBCT image based deformable organ registration. In this study, we developed a hybrid image registration method: Bladder, prostate, and rectal wall are registered based on model-based Finite Element Method method, the high density bones are registered by a rigid-body transformation, the rest part of the image is registered based on image intensity based free-form energy minimization method.

**Method and Materials:** One HCT and 5 online CBCT images were used. Each treatment CBCT was fused using the treatment isocenter position. The contours of prostate, bladder and rectum were manually delineated on all images. FEM was applied to register the three organs, then the FEM subvolume based displacement distribution was resampled into the image voxels inside organs. Rigid-body registration was used to map the bones mask from HCT to CBCT. During image intensity-based free form deformable registration, the obtained displacement distribution of bones and the organs was fixed and acted as a pre-defined boundary condition for the registration of the rest part of the image. Six fiducial points were manually tracked in all images. Their positions are used to evaluate the accuracy of this hybrid method.

**Results:** The registration errors for the fiducial points are  $0.3\pm 0.8$  mm,  $0.5\pm 0.6$  mm and  $-1.1\pm 1.4$  mm in Right-Left, Posterior-Anterior and Superior-Inferior direction respectively.

**Conclusion:** In this work, a hybrid deformable registration method for CBCT and HCT was developed and tested. Preliminary results show that the hybrid method can be a reliable tool for the deformable image registration between HCT and online CBCT for prostate cancer patients.