

AbstractID: 3470 Title: Deformable Registration of the Planning Image (KVCT) and Daily Treatment Images (MVCT) for Adaptive Radiation Therapy

Purpose:

The incorporation of daily images into the radiotherapy process leads to Adaptive Radiation Therapy (ART), in which the treatment is evaluated periodically and the plan is adaptively modified during the whole course of radiotherapy. Deformable registration between the planning image (usually KVCT) and the daily image is the key component of ART. The MVCT is one of the most informative yet convenient daily image modalities. In this presentation, we developed a fast technique for deformable registration between the KVCT image and the MVCT images.

Method and Materials:

The method is extended from the state-of-art deformable registration technique, which is fast and accurate for same modality registration. Considering the higher noise and lower contrast nature of MVCTs, special techniques such as “edge-preserving smoothing” and “reference based histogram calibration” are applied before the deformable registration process. The whole process is around 2-3 minutes for typical MVCT size (256x256x64) when runs on a single processor PC.

We retrospectively studied daily MVCTs from commercial TomoTherapy machines in different clinical centers. These data include 3 lung cases, 5 head-neck cases, 3 prostate cases and 2 pelvis cases. Each case has one KVCT image and 30-40 MVCT images. We registered the MVCT images with their corresponding KVCT image.

Results:

The similarity measures and visual inspection of contour matches by physicians validate this technique. The applications of deformable registration in ART, including “accumulative dose calculation”, “automatic ROI re-contouring” and “tumor growth/shrinkage monitoring” through the whole course of radiotherapy are studied.

Conclusion:

Deformable registration between the KVCT and MVCT images is an essential step towards ART. Through the combination of conventional image processing techniques and the fast intensity based deformable registration, such task becomes feasible. Extensive tests based on the daily MVCT data from the TomoTherapy machines validate such technique. Several key components of ART are developed.