

AbstractID: 3586 Title: Automation of Image Registration and Verification for Image-Guided Stereotactic Body Radiotherapy

Purpose: To facilitate image-guided stereotactic body radiotherapy (SBRT) with high precision and fully automated target localization and patient position verification.

Method and Materials: A mutual information based image registration algorithm was developed to register the patient's daily 3D computed tomography (CT) images with those taken for treatment planning to assess and correct patient position shifts in all three translational and three rotational directions. A digitally reconstructed radiograph (DRR) algorithm generates and displays the corresponding DRRs in one frame in a split screen format along with their intensity differences to enhance verification. In the same way, the portal image verification algorithm processes the portal image and displays it with the corresponding planning DRR in the same frame as final verification of the patient's position. The algorithms were programmed using MatLab and were assembled seamlessly in one package and the operation was fully automated.

Results: Target localization and patient position verification process in our image-guided SBRT is significantly simplified and the time needed for this process is reduced from 30 minutes or more to 3-4 minutes. The image registration algorithm was found to be accurate to within 0.1 mm with a head and neck phantom. The DRR generation algorithm generates high quality DRRs with a spatial resolution of 0.289×0.289 mm²/pixel. It removes unrelated anatomical structures for a cleaner background in the DRR to help identify the target isocenter more easily and more accurately. The DRR comparison and portal image verification algorithms readily detect misalignments of less than 0.2 mm.

Conclusion: Application of the algorithms in determining patient position shift in actual SBRT cases demonstrated that they were accurate, fast, and reliable. They serve as a useful tool for image-guided radiotherapy.