SU-FF-J-81

Importance of Daily Portal Imaging for Head and Neck IMRT Treatments

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Purpose: To investigate the set up variation for head and neck IMRT patients based on daily portal imaging. **Method and Materials:** Reproducible patient setup is critical to accurate delivery of head and neck IMRT. At our institution, these patients are immobilized using a head-neck-shoulder thermoplastic immobilization system (S-Type, Medtec) and a customized headrest. Orthogonal digital portal images are taken daily to check patient positioning and are compared with plan DRRs. Isocenter misalignments are corrected by the therapists using a couch shift, with a 3mm action level. Therapists also carefully examine patient positioning in the mask, especially shoulder position, and re-position the patient in the mask if considered necessary. Isocenter shifts and frequency of patient repositioning were investigated by review of record-and-verify records for 15 patients. The magnitude of the shoulder respositioning was evaluated for 10 patients by comparing portal images and plan DRRs for a point 8cm inferior of isocenter, which is typically located at C2. **Results:** Isocenter discrepancies of 3mm or smaller were recorded for a median of 92.5% of fractions (range: 71.4 – 100%). Isocenter shifts larger than 5mm were only recorded twice (2 patients, 1 fraction each; 0.38% of all fractions). On the basis of pre-treatment daily imaging, patients were repositioned in the immobilization mask before treatment for a median of 14% of fractions (range: 3-34%). Fifty nine percent of these repositioning were for a shoulder shift of less than 5mm. Thirty percent, however, were for shoulder shifts of 1cm or larger. **Conclusion:** With our current immobilization, daily isocenter positioning accuracy is excellent, while correct shoulder position is more variable. Frequent imaging of head and neck IMRT patients is essential to accurate delivery of therapy, with shoulder position an important factor.

SU-FF-J-82

Improving Soft Tissue Contrast in 4D CT Images of Liver Cancer Patients Using Deformable Image Registration Method

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Purpose: To investigate image quality improvement in 4DCT images of liver cancer patients by using deformable image registration. The low soft-tissue contrast in liver CT images is always a challenge for accurate target delineation. **Method and Materials:** Ten patients with liver cancers were selected in this study. These patients received 4DCT scans for radiotherapy treatment planning using 120kVp and 150mA on a GE PET/CT system. The 4DCT images were retrospectively sorted and binned into 10 equispaced phases. The end-expiration phase was chosen to be a reference phase, and the images from the other 9 phases were co-registered to the reference phase using an intensity-based, automatic deformable image registration algorithm. Then the 10 matched 4DCT images were averaged to give a single, high quality reference-phase CT image for tumor target delineation. The image quality enhancement was quantified relative to the original CT by calculating the signal-to-noise ratio (SNR) inside the liver region. The incremental improvement in image quality was also studied by combining fewer 4DCT data sets. **Results:** The image contrast in the soft tissue region is noticeably improved. SNRs inside the liver increased for all patients by a factor of at least 2.3 (average at 3.0). The improvement in image quality is not linearly proportional to the number of images averaged. Averaging 6 CTs can achieve 85% of the SNR enhancement obtained by averaging all 10 CTs of different phases. **Conclusion:** We developed an effective method to improve soft tissue contrast in the liver by co-registering and combining multiple CTs within the 4DCT data set using a deformable image registration method. The resultant, high-quality, single-phase CT could be used for better delineation of tumor target volume and critical avoidance structures. The deformable image registration method can also map these contoured structures back to each individual phases for motion-compensated 4DCT planning.

SU-FF-J-83

Inaccuracy of Fixed Threshold Segmentation for PET

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Purpose: Several automatic segmentation methods have been developed to aid physicians in drawing tumor contours from PET images. Our goal is to compare the consistency of current methods for delineating in vivo tumors and uniform objects in phantom. **Method and Materials:** We compare three published methods, each based on a single threshold value per scan, for segmenting objects in experimental or Monte Carlo simulated PET scans of cylinders and spheres with uniform activity concentration in a phantom, and for segmenting tumor volumes in the torso from 20 patient PET scans. **Results:** For uniform activity objects in phantom, segmented volumes generated by the 3 methods differ from true values by more than a factor of 2. The segmented volumes are within a factor of 3 and 4 of the true volume when the objects are larger than twice the PET resolution. Between the methods, the segmented volumes differ by up to 78% and 93% for objects in zero and non-zero background respectively. These differences are close to the volume change caused by adding a single voxel layer to the surface of the object. The discrepancies between the different segmentation methods are even larger for segmenting in vivo tumors where volume differences larger than a factor of 10 were observed, far larger than the single voxel enlargement effect. **Conclusion:** Threshold value based segmentation methods can be used only as a rough guide for tumor delineation and then only after adapting to each clinics PET scanner and procedures. Among the probable sources of inaccuracy are various patient dependent factors including tracer uptake non-uniformity. This suggests that effort in analyzing PET images should be shifted towards providing accurate quantitative information to the physician to improve confidence in target delineation amidst the various phenomena affecting the PET image. Supported in part from NCI Grant P01-CA59017.

SU-FF-J-84

Integration Of 3D Stereovision System In Image-Guided Radiotherapy: A DICOM-Based Method

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Purpose: To seamlessly integrate a 3D stereovision system (or 3D camera in short) with complex planning and treatment systems and implement a 3D image-guided patient positioning for radiotherapy of breast cancer. **Method and Materials:** A high speed commercially available 3D camera is installed on the ceiling of treatment room to capture real-time 3D surface images of patient. After transformed from camera coordinate system to treatment machine coordinate system, the real-time 3D surface image is matched with a 3D reference image which is defined in planning systems. A stack of external contours with position information from DICOM RP and RS files are re-sampled to generate a 3D reference image. Regions of interest (ROIs) of both images are defined by the PTV parameters from DICOM RP files. An Iterative Closest Points (ICP) algorithm is adopted to conduct the registration of ROIs. The parameters of patient positioning derived from the registration can be used to adjust the patient position. **Results:** Outliers and noise of captured 3D surface images are automatically and effectively removed when applying PTV parameters to define ROIs. Phantom test and An institutional IRB approved clinical trial indicates a typical case of image-guided RT, including loading reference images, capturing real-time images, and image matching can be done in less than 1 min. By double checking with online EPID, a millimeter positioning accurate can be achieved without considering deformation of images. **Conclusions:** This work shows the clinical potential for utilizing a 3D camera in image-guided RT. The integration of 3D camera in image-guided RT based on DICOM standard provides faster and more precise patient positioning than other image-guided RT. How to deal with the deformation of ROIs will be our research direction in future.