AbstractID: 6952 Title: A novel 4D-CT reconstruction method and estimation of respiratory motion

Purpose: We have developed a novel 4D-CT reconstruction method based on deformable image registration. We used it to reconstruct lung 4D-CT images at any breathing tidal volume. We also fitted the estimated the lung motion field to the 5D lung motion model (Low 2005).

Method and Materials: The multi-slice 3D-CT images were acquired by scanning the patient multiple times at each couch position and at multiple couch positions while the patient was free breathing. For 4D-CT reconstruction, firstly we reconstructed the reference 3D-CT image by using scans from the end of exhalation phases. We then computed the image motion for all multi-slice scans with respect to the common reference image. The motion computation was accurate and free from the boundary occlusion problem. Motion field at any target tidal volume can be generated by interpolation on the computed motion fields. We then deformed the reference image according to the interpolated motion field to get the full volume 3D-CT images at the target tidal volume. Finally, we fitted the computed image motion to the 5D lung motion model at selected voxel positions.

Results: The reconstructed 3D-CT images were smooth and without misalignment on the couch position boundaries. Statistical analysis results suggest that our new 4D-CT reconstruction method typically (for over 87% situations) generates more accurate 3D-CT images than conventional amplitude or phase angle sorting 4D-CT reconstruction methods. The motion field fitted very well with the 5D lung motion model.

Conclusion: Our new method to compute image motion with 4D-CT dataset enables more accurate estimation of the respiratory motion parameters and allows for motion free 4D-CT reconstruction. This help would help improve the lung breathing motion models and enhance its integration into radiation therapy treatment planning systems.