

AbstractID: 5749 Title: Development of a Patient Specific Respiratory Motion Model for Predicting Dose to Moving Organs during Radiotherapy

Purpose: Respiratory motion is an important limitation to accurate calculation of dose to organs in the thorax and abdomen during treatment. We describe a model to estimate 3-dimensional motion in patient CT images. This model can be parameterized by navigators such as a signal from a respiratory monitor, or diaphragm position measured in fluoroscopy. We evaluate the accuracy of the model in predicting anatomic changes in respiration-correlated CT (RCCT) images of lung cancer patients.

Method and Experiment: Our method makes use of deformable image registration, thereby automating the model calibration and providing a complete determination of 3D trajectories for all tissue voxels of the moving organs. Calibration of the model uses a series of RCCT images. Each 3D image in the series is tagged by two navigators: current diaphragm position and precursor position which distinguishes between the inspiration and expiration portion of the respiratory cycle. Nonrigid registration is used to calculate the deformation field that maps each 3D image to a reference 3D image at end expiration. We perform a principle component analysis (PCA) to determine the 3D deformation parameterized by navigators. We evaluate the model by comparing the predicted 3D images with actual 3D images at different phases in the breathing cycle.

Results: For RCCT images, predicted images calculated from the first two principal components at different respiration phases are found to accurately reproduce anatomic motion observed in the actual images, indicating the model's ability to predict the voxel trajectory anywhere in the cycle. Furthermore, the model can predict motion induced changes that were not in the original image set, such as deeper and shallower breathing.

Conclusion: Preliminary experimental results indicate that the proposed method is a potentially useful tool for treatment planning and evaluation of dose to moving organs when patient breathing is monitored.