AbstractID: 12883 Title: Optimizing principal component models for interfraction variation in lung cancer

Purpose: To optimize principal component models for modeling interfraction changes in lung cancer by investigating information and structure requirements. **Method and Materials:** In 16 patients, weekly CT sessions consisting of three repeat intrafraction scans were acquired with active breathing control at end of normal inspiration. The gross tumor volume (GTV) and lungs were delineated on the first week image by a physician, and propagated to all other images using deformable image registration. Principal components analysis (PCA) was used to model the target and lung variability during treatment. Four PCA models were generated for each patient: 1) individual models for the GTV and each lung from one image per week; 2) a composite model of all structures from the weekly images; 3) individual models using all images (weekly plus repeat intrafraction images); 4) composite model with all images. Dominant modes representing 95% of the total variability were used to reconstruct the observed anatomy. Residual reconstruction error between the model-reconstructed and observed anatomy was calculated to compare the accuracy of the models. **Results:** Two to seven eigenmodes were necessary to capture 95% variability over all patients. An average of 3.1 and 4.9 modes were required for the weekly plus repeat models, for the GTV and composite models, respectively. The weekly model required one less mode in 40% of patients. For the composite model, the average reconstruction error was 0.7 +/- 0.2 mm, which increased to 1.1 +/- 0.4 mm when the weekly model was used. Using the four dominant modes from the weekly model, 90% of the error was less than 3 mm for 86% of patients and less than 2 mm for 50 % of patients. **Conclusion:** Simple composite structure models using the four principal modes and weekly imaging is feasible for reproducing observed anatomy.

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