AbstractID: 5103 Title: Verification of a Monte Carlo Based Technique to Correct for Intrafraction Organ Motion

Purpose:
The most common planning technique to account for intrafraction organ motion is the application of a treatment margin to the clinical target volume (CTV). A uniform dose distribution is then planned for the resulting internal target volume (ITV). We have developed an alternative Monte Carlo based approach where the pattern of organ motion is directly incorporated into both the dose calculation and the optimization of IMRT treatment plans. We have verified the accuracy of this approach through a series of measurements performed with a moving phantom.

Method and Materials:
For each patient, a 4DCT was used to determine the pattern of respiration-induced anatomical displacement. The pattern of organ motion was incorporated into our Monte Carlo dose calculation by randomly sampling the isocenter location for each photon history. The resulting pencil beam dose distributions (incorporating motion) were used in the IMRT planning process. Treatment plans have been created for two phantom cases and three lung patients. Verifications were performed for two cases using a solid water phantom programmed for sinusoidal motion.

Results:
For the 3 lung patients in this study, the mean dose to the involved lung was reduced by 11.9% relative to the plans produced using traditional margin expansion. The verification measurements demonstrated a close agreement between the planned and delivered dose distributions. Incorporating organ motion into the IMRT planning process led to a 43.3% average reduction in the number of points that failed the gamma dose distribution comparison method.

Conclusion:
The use of Monte Carlo techniques to incorporate organ motion into IMRT optimization leads to significant improvements in normal tissue sparing and also results in improved agreement between planned and delivered dose distributions.