AbstractID: 7110 Title: Real Time Motion Adaptive Delivery—II. Tomotherapy

Purpose: Intra-fraction target motion hits the fundamental basis of IMRT including tomotherapy. Without modification of simplicity of tomotherapy machine, we develop a technique for delivering helical tomotherapy plan with real time target motion compensation.
Methods: Tomotherapy delivery is controlled by a planned projection-wised leaf sequence (sinogram), which is optimized assuming stationary target. Tomotherapy's gantry rotation synchronizes with its couch proceeding. Both are in constant speed. To compensate longitudinal target motion in real time, instead of sequential execution of the planned sinogram, the projections are out of order executed. That is, a previous or future projection of the planned sinogram is chosen instead. That chosen projection has the same gantry angle and closest planned target position as the current status. The transversal target motion is further compensated by shifting and scaling the open time of each leaf from the chosen projection.
Results: We tested different tomotherapy planned sinograms with various tomotherapy machine parameters and target shapes. Arbitrary respiratory motions were simulated. As we delivered a well-conformed tomotherapy plan without motion compensation to a patient with respiration motion, significant differences between the delivery doses and the planned doses appeared. While we applied the real time motion adaptive delivery (MAD) technique, the delivery doses matched with the planning dose very well in both DVH and dose profiles. The dose errors are well below 3mm and 3% criteria. No hot and cold spots are noticeable.
Conclusions and Discussions: We present a novel technique for real time MAD in tomotherapy. Unlike the dynamic MLC based method, this technique only requires instantaneous target position, which greatly simplifies its implementation. This technique re-uses the planned sinogram by shuffling its projection and leaf indices. It does not involve time consuming operations, such as re-optimization. The simulations and experiments validated the presented technique.