AbstractID: 8962 Title: A simulation study of an online adaptive treatment technique for tomotherapy to reduce intra-fraction motion effects

Purpose: Many studies have shown that intra-fractional motion has a great impact on radiotherapy treatment. Previous methods to accommodate for these effects include respiratory gating and 4D treatment planning. This study demonstrates an online adaptive treatment delivery technique for tomotherapy which can reduce these effects without increasing treatment duration or treatment planning workload.

Method and Materials: For purposes of illustration the simulation was done for one-dimensional tomotherapy treatments with only longitudinal target motion as a generalization of complete 3D motion. The motion trace was recorded from a normally breathing patient. One minute of respiratory data were collected before the treatment to generate the ARMA model using MATLAB System Identification Toolbox. During the delivery, the tumor displacement from the reference position is predicted by this model and binary-MLC opening is calculated based on the history of previous projections and the offline-optimized plan. Rigid-body motion of the target volume is presumed. The maximum peak-to-peak amplitude of breathing was 4 cm. And the beam width, pitch, and modulation factor chosen are 1.5 cm, 2.1, and 3.0 respectively, which represent parameters that are expected to develop hot and cold spots if there is no motion management.

Results: The simulation showed the maximum variation of delivered dose on target can reach 15% compared to planning dose without motion management. The online adaptive delivery can reduce this variation to 2~4% and 3~7% for one and two projection lag respectively. This technique also improves the dose conformity which suggests a smaller than traditional motion margin would be sufficient.

Conclusion: The online adaptive treatment delivery was shown to be able to reduce the intra-fractional motion effect in a one-dimensional case. This method offers a more efficient solution than respiratory gating. The feasibility of this method in a more clinical relevant case is still under investigation.