Abstract ID: 16446 Title: Development of a Lung Tumor Motion Predictor for Intra-Fractional Tumor Tracking Based On a Self-Optimizing Artificial Neural Networks (ANN)

Purpose: To develop a newly designed lung tumor motion predictor for intra-fractional MR tumor tracking based on self-optimizing artificial neural networks (ANN). The new predictor could resolve practical issues of (1) ANN structure optimization and (2) tumor tracking failure due to MLC stopping.

Methods: An adaptive, 4 layered feed-forward ANN was built to predict future positions of lung tumor. The ANN training was performed with back-propagation learning along with a self-adaptive learning rate. A particle swarm optimization was implemented in the predictor to optimize and customize the ANN structure and its weights for each patient. To minimize tracking failures due to MLC stopping, we implemented a dual ANN structure in our predictor, so that multiple consecutive future positions of MLC could be assigned at each prediction. We extracted 8 minutes long, 1D superior-inferior lung tumor motion patterns from the first 3 fractions of 10 lung cancer patients' data. These were used to evaluate the performance of our predictor by calculating root-mean-square-error (RMSE) and normalized RMSE (nRMSE : normalized to the max. amplitude of given original data) between the original and predicted pattern.

Results: For each of 10 patients, tumor motion patterns were predicted in 2 fractions. The maximum amplitude of original pattern ranges from 4.87 to 19.72 mm. All optimized ANN structures contains 2 hidden layers except in one case. RMSE values ranged 0.26 to 1.01 mm, and nRMSE ranged from 4.46 to 10.11%. In most cases, RMSE were less than 1mm with nRMSE less then 10%.

Conclusions: A self-optimizable lung tumor motion predictor was developed based on adaptive ANNs. The predictor's performance was evaluated with 10 lung cancer patients' data. The results suggest ANN structure with 2 hidden layers for lung tumor motion prediction, as well as the necessity of individually optimized predictor for each patient.