AbstractID: 6976 Title: Real-Time Lung Tumor Motion Prediction Using Neural Network Based Models Constructed from Unsorted Cine CT Images

Purpose: To develop neural network based models for predicting respiratory induced tumor motion from gating signals and unsorted cine CT images. The ability of the models to predict target motion given real-time surrogate marker motion was verified using a dynamic phantom with a target moving according to motion profiles derived from patient respiratory data.

Methods & Materials: Tumor motion profiles were derived using patient data and imported into CIRS Dynamic Thorax Phantom. The phantom was imaged with a 4-slice CT scanner in cine mode. Surrogate marker motion from the phantom exterior was recorded simultaneously using Varian's RPM system. Neural networks were constructed to model relationships between target presence or absence at each slice location and external marker motion. The combined networks for each of the slice locations were used to predict target motion. To verify the ability of the models to infer target position from surrogate signal, additional scans were performed. Models were used to predict target motion from external marker signals and compared to the motion patterns imported into the phantom.

Results: Five preliminary experiments were performed with motion patterns from different patients. The models performed well for two cases, predicting motion with average errors on the order of image resolution, 1.26 mm and 1.39 mm root mean squared errors (RMSEs). For motion patterns with large peak-to-peak displacements or highly irregular frequencies / amplitudes, the predictions were less accurate.

Conclusion: A neural network based method has been developed for modeling internal target motion using external surrogate signals and unsorted cine CT images. Preliminary results indicate that the approach may be useful for some cases. Adaptive networks utilizing real-time image information during the prediction process may be used to improve prediction accuracy for high frequency / amplitude motion patterns.

Conflict of Interest: Partially supported by Varian research grant.