AbstractID: 5716 Title: Modeling of Lung Tumor Response to Image-Guided Radiation Therapy

Purpose: To employ locally weighted regression (LWR) as an empirical technique for modeling tumor response to radiation treatment.

Methods and Materials: Daily Megavoltage CT (*MVCT*) images were acquired prior to the delivery of 660 lung treatment fractions for 20 lung cancer patients, with contoured tumor volumes in each image. This data was used to develop a LWR model of the tumor progression throughout the treatment. A leave one out cross validation (*LOOCV*) technique was used to evaluate the performance of the model with varied combinations of days of patient data. For each patient, the model was run using the remaining patient data as training data, but with different test observations for each trial. Multiple simulations using random sampling without replacement were carried out to ensure that all possible combinations were tried. The best combination of days was determined by finding the mean predictive performance. Since this technique will eventually be used to make decisions about a patient's treatment, each prediction was accompanied by a measure of its uncertainty. A large uncertainty value indicates that the prediction is unreliable, most likely due to poor coverage of the training data.

Results: The LWR model did not always accurately predict the shape of the tumor response curve, but the model was accurate in its predictions made at the end of a patient's treatment. The average prediction error was 13%, and even tumor volume increases during the course of the treatment were correctly predicted.

Conclusions: The LWR modeling technique proved fast and fairly accurate when predicting the tumor volume at the end of treatment, and improvement is expected as additional data is added to the memory matrix. Future research will use expert opinion and data analysis techniques to determine which additional patient information will improve the model.