AbstractID: 10396 Title: A Hybrid Strategy Using Discriminant Analysis for Prostate Intrafraction Motion Management

Purpose: Prostate intrafraction motion has been shown to be patient specific; however most current compensation strategies are population wide. We evaluate the feasibility of applying margins based on a subpopulation of patients with similar intrafraction motion characteristics and of predicting group membership within the initial treatment fractions.

Method and Materials: 22 prostate patients from a hypofractionated radiotherapy protocol with online CBCT image guidance and kV fluoroscopy measurements of intrafraction motion were divided into small and large motion groups using k-means clustering of the 90th percentile of vector displacement during treatment delivery. Group margins were computed containing 90% of measured prostate displacements at treatment delivery. Descriptive statistics from the intrafraction motion in the AP and SI-axes and rectal filling status were used to predict group membership after 2-10 fractions using a perceptron linear discriminant function.

Results: ~75% of patients (17/22) were categorized as having relatively small intrafraction motion, with ~25% (5/22) having large motion. Population margins were 1.7, 4.0, and 3.9 mm in the RL, AP, and SI axis. When classified into groups, margins for the small motion group reduced to 1.6, 2.9, and 3.0 mm and for the large motion group increased to 2.0, 6.4, and 6.0 mm in the RL, AP, and SI-axes respectively. The percentage of patients correctly classified after 2, 3, 4, 5, 6, and 10 fractions was 65%, 85%, 90%, 90%, 95%, and 95% when both motion characteristics and rectal filling status were used. Omitting rectal filling status decreased the ability to correctly classify patients with large motion.

Conclusion: Discriminant analysis may be used to incorporate intrafraction motion measurements from initial fractions into prostate margin calculation with reasonable accuracy, leading to margin reductions in the AP and SI-axes for ~75% of patients and increased coverage for ~25%.