AbstractID: 9182 Title: Adaptive Fractionation Therapy— I. Basic Concept and Strategy

Purpose: Patients' internal configurations, such as relative tumor-OAR distance, vary day-to-day and the variations are well quantified via daily images. We develop a strategy that adapts fraction size for a better therapeutic ratio by taking advantages of such variations.

Method and Materials: Intuitively, the fraction size should be smaller when OAR is far away from tumor and smaller otherwise. Adaptive fractionation therapy (AFT) is an on-line adaptive technique that implements such intuition to gain optimal OAR sparing. Changes of internal structures are classified as different configurations according to their feasibility to the radiation delivery. The configuration is identified via daily image before each fraction delivery. The current fraction size is optimized via dynamic linear programming with lower and upper bounds on fraction size and fixed cumulative tumor dose used as constraints.

We use extensive simulations of thousands of treatment courses with 40 fractions per course to test the presented technique and strategies.

Results: The gains of OAR sparing depend on the variations on configurations and the fraction size bounds. The larger the variations and the looser the bounds are, the larger the gains. Compared to the conventional fractionation technique with 40x2Gy, for a typical 20% variations on tumor-OAR configurations and [1Gy, 3Gy] fraction size bounds, the gains of OAR sparing with adaptive fractionation using a fine a priori model are around 5-6Gy, or 9-18% depending on mean OAR-tumor distance. Even for a coarse a priori model, the gains are still as large as 4-5Gy, or 7-16%.

Conclusions: AFT is a simple form of on-line adaptive technique that takes advantage of daily internal structure variations quantified from daily image. It does not require much human interaction except to identify the configuration. The potential gains are significant. Extensive simulations validated the efficiency and robustness of the presented technique.