AbstractID: 3020 Title: A Shuttling Window Method of Improving Intrafractional Errors for Intensity Modulated Stereotactic Body Radiation Therapy

Purpose: Intensity Modulated Stereotactic body radiation therapy (SBRT) uses multiple intensity modulated beams to deliver a large dose in limited fractions with on-board imaging/stereotactic guidance. Despite active organ motion managements such as abdomen depression or rigid frame alignment, random residual errors in the order of a few mm are still observed. In this study, we aim to develop a shuttling window delivery technique to minimize such errors.

Method and Materials: Our method allows the MLC leaves to shuttle back and forth to accumulate the dose sequentially throughout the target volume instead of delivering a large dose to parts of the target volume. Our rationale is to avoid deleterious misfiring events from large dose depositions. A sequencing method is developed to minimize the beam-on and leaf travel for implementing the shuttle delivery. Phantom measurements were performed for simulated and patient cases. A home-made phantom was used to simulate random intrafractional errors of 0-5 mm with 0.5 mm resolution. Comparison between the prescribed dose distributions and the error-intrinsic dose distributions were carried out using chi-square confidence level analyses.

Results: The shuttling window technique significantly reduced random dose errors and improved the agreements between the prescribed and the delivered dose distributions. As the number of the shutting cycles increases, the average dose variance decreases. The most gain for the technique was harvested when the shuttle number approaches five. Despite extra leaf motions, no significant increase in the treatment time was observed (e.g. < 1 minute for a 10-minute beam). The increase in the leaf travel distance of the shuttling delivery was largely compensated by increased leaf speed during each cycle.

Conclusion: We demonstrated an effective approach for reducing residual intrafraction errors for intensity modulated SBRT deliveries.