AbstractID: 13973 Title: Interplay study between respiration motion and dynamic MLC delivery for 4D IMRT plan

Purpose Interplay between MLC movement and organ motion can affect treatment dose. The study investigates interplay effect of 4D inverse planning and delivery, and discusses possible ways to reduce it.

Method and Materials: Three 4D phantom images were used in this study. Respiratory movement was in S-I direction with amplitude of 1cm, 2cm and 3cm. 4D inverse planning was accomplished with the prescription dose to the isocenter. The expected (planed) dose is weighted sum over all phases of motion. The delivery dose, however, depends on the starting phase and lasting time of each segment. Starting phase was selected randomly. With the target motion extracted from 4DCT images, we calculated position, phase and dose rate at point of interest for any given time. With an appropriate sampling rate, the dose was accumulated to mimic the treatment delivery in one fraction. Other fractions was simulated the same way. Here we did 100 simulations for each case and compared difference on point dose and equivalent uniform dose (EUD). We also studied time evolution of the delivery dose and its sensitivity on dose rate.

Results: The target point dose difference could be 6.3% (the maximum in one fraction). Tumor volume with point dose difference greater than +/-3% was less than 8%. EUD differs from the expected dose by less than 1% for 1cm and 2cm phantom in all simulations. For phantom with 3cm motion amplitude, the mean EUD reduced to 1% difference in 6 fractions. Reducing dose rate makes EUD variance and maximum point dose difference smaller.

Conclusion: The result suggests a small interplay effect in our 4D IMRT plans. Limiting number of segments, increasing minimum MU per segment and decreasing dose rate could reduce interplay effect.

Conflict of interest: The work is supported by Elekta.