AbstractID: 6944 Title: Reducing intra-fraction organ motion effects using segment size constraint in direct aperture optimization

Purpose: In IMRT delivery, an important issue is intra-fraction organ motion, which causes significant degradation of the delivered dose. Some simulation researches have showed that organ motion effects could be significantly reduced by increasing the segment size. In this study, a direct aperture optimization based commercial inverse planning system was modified to assess the clinical impact of creating optimized plans with segment size constraints (SSC). Our study seeks to answer what price in static plan quality one has to pay to avoid dose degradation in moving targets?

Method and Materials: IMRT plans with and without SSC were optimized for two abdominal cases using static CT images. The MLC travel direction is aligned with the projected motion direction and SSC penalizes all MLC leaf openings smaller than twice the projected motion amplitude. Static plans were recalculated with a sinusoidal target motion with 1cm amplitude and 4second period.

Results: In both cases with and without SSC, PTV volume covered by 95% of the prescribed dose (V95) was less than 1%, indicating that SSC had little effect on static plan quality. After incorporating target motion, V95 was improved by applying SSC, with the degree of improvement depending on the particular case. For case 1, V95 improved from 84.5% to 93.3% by adding SSC. Further study shows that dose coverage of peripheral PTV regions improved more significantly with SSC than central regions. In all plans, differences of the doses to the critical structures were within a few percent. By adding SSC, the treatment plan was more tolerant to target motion.

Conclusions: Our study showed that when segmental IMRT plans were delivered to a moving target, SSC improves delivered dose conformity (V95) as much as 9% without significantly sacrificing static plan quality. Peripheral PTV shows more improvement in dose coverage with SSC than central regions.