AbstractID: 10530 Title: Optimal Phase Sampling on 4DCTs for Dose Accumulation

Purpose: Equal phase and amplitude sorting methods have been commonly used for 4D CT construction. However, effect of these sorting techniques on 4D dose construction has not been explored. In this study, we investigate an optimal sorting technique for 4D dose construction.

Method and Materials: An optimization model was formed using organ motion pdf and 4D dose convolution. The objective function for optimization was defined as the maximum difference between the expected 4D dose in organ of interest and the 4D dose calculated using a 4D CT sorted by a candidate sampling method. Sorting samples, as optimization variables, were selected on the respiratory motion pdf assessed during the CT scanning. Breathing curves obtained from patients' 4DCT scanning, as well as 3D dose from treatment planning, were used in the study. The equal phase and amplitude sorting methods were compared to the one optimized for each patient and the number of sorting samples varying from 2 to 20.

Results: The difference in 4D dose construction decreased rapidly as the number of sorting samples increased to 6. The equal phase sorting demonstrated the largest residual error in 4D dose construction, requiring minimal 10 phases in 4D CT to maintain the dose residual less than 1% of the expected dose. The equal amplitude sorting, on the other hand, had smaller residual in general compared to the equal phase sorting when the number of sorting samples was larger than 4. Finally, the optimized sorting could achieve acceptable residuals with using 4 ~ 5 sorting samples.

Conclusion: 4D dose construction can be improved by optimizing the sorting samples. Further increase in sorting phase number above 5 may not be necessary when using the optimal sampling point.

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