AbstractID: 13841 Title: Real Time Tumor Tracking during VMAT Treatment

Purpose: Intra-fraction variability of lung tumor position during radiotherapy treatment may cause large dose discrepancy especially for VMAT delivery. Purpose of this work is to reconstruct tumor 3D motion trajectory during VMAT delivery in real-time based on concomitant CBCT projection images and detect motion irregularities to quantify them for further treatment decision.

Method and Materials: A tool was designed to reconstruct lung tumor 3D trajectory during VMAT delivery in real-time. Our method allows us to detect and quantify abrupt inter-frame motion during treatment. Tumor 2D position in CBCT projection image is obtained from its registration to certain phase of 4DCT DRR. To assess the efficacy of our method, we developed a lung-like phantom moving in pre-determined motion patterns from regular to complex (a Lujan model and three real tumor trajectories). The complex tumor trajectory included an intentional abrupt change in position as well as baseline shifts, amplitude and period variations. Detected trajectory based on our method was compared with the tumor actual trajectory for two tumors, one regular in shape with good contrast (tumor1) and one irregular in shape with poor contrast to adjacent material (tumor2).

Results: Experiments show good accuracy in phantom study. For tumor1, reconstructed mean position is (-0.36$\pm$ 0.4, -0.1$\pm$0.6, -0.2$\pm$0.5) mm from actual mean position. For tumor2, reconstructed mean position is (-0.34$\pm$0.9, 0.0$\pm$0.2, -0.1$\pm$0.2) mm from actual mean position. When tumors move under abnormal patient breathing curve, the intentional position shift can be detected, which shows the potential of our tool in clinical usage.

Conclusion: We successfully developed a tool that can be used to track tumor trajectory during VMAT delivery in real-time. Our technique allows us to characterize tumor's motion during treatment and enables one to adjust or stop treatment when tumor motion is out of pre-established tolerance range.

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