AbstractID: 11764 Title: On the synchronization of 3D surface cameras with fluoroscopic imaging

Purpose: To investigate the feasibility of using three-dimensional surface imaging cameras as an external surrogate of target motion through a temporal synchronization with kV imaging.

Method and Materials: A gate controller, connected between kV fluoroscopy and AlignRT (Vision RT Ltd, London) computers, was triggered with kV beam-on and reflected in AlignRT output data. First, phantom experiments were performed using a programmable respiratory motion platform (sinusoidal curves, 12-18 BPM). The platform included a chest-wall component (A-P amplitude = 1 cm) tracked with the surface camera, while the object translated superior-inferior was fluoroscopically tracked (300 frames, frequency ~5.5 fps). Accuracy of tracking the chest-wall platform was assessed. Increasing the complexity of experiments, tumor displacement curves from three patients were simulated. Our approach was further validated by imaging a free-breathing lung cancer patient over 11 fractions with simultaneous AlignRT and kV (300 frames/session, ~55 seconds).

Results: For simple sinusoidal curves, measured amplitude (peak-to-peak) was 1.005 ± 0.003, 1.013 ± 0.003 cm, 1.003 ± 0.005 cm for 12, 15, and 18 BPM, respectively, demonstrating excellent agreement with the expected chest platform amplitude of 1.0 cm. Period measurements were within 0.2% of expected for the surface cameras, and within 0.9 % of expected for fluoroscopy. Using simulated patient data and the motion platform, the latency between the surface tracking system and fluoroscopy was determined by performing linear regression between the peak time from AlignRT and fluoroscopy. For the three patient cases studied, latency was found to be 0.65 ± 0.03 seconds. Moderate agreement was observed between the diaphragm, tumor, and abdomen tracked for the patient studied.

Conclusion: The utility of surface imaging cameras for tracking while synchronized with fluoroscopy has been demonstrated. Additional patient studies are warranted for further validation, which may facilitate gated radiation therapy treatments using surface imaging cameras as the external surrogate.