

AbstractID: 14010 Title: Treatment beam's-eye-view speed-modulated CBCT Imaging used in a triple imaging modality to track moving tumors during treatment

**Purpose:** To track the target trajectory during the treatment based on the pre-treatment CBCT projection images when the gantry is selectively slowed down at the treatment angles, the synchronized 3D surface imaging and the EPID in movie mode.

**Methods and Materials:** A gantry-speed device slows down the CBCT gantry speed (2min/360degrees) by half for a 6 degrees arc centered on the MV treatment beam, allowing us acquire twice as many frames within the treatment arc (22frames/5.5fps). The treatment arc is chosen to accommodate a typical full breathing period (4s). A CBCT kV beam-on trigger is used to acquire 3D surface images using the AlignRT cameras. Phantom experiments were performed using a programmable respiratory motion platform. During the treatment delivery, MV imaging was performed in movie mode (3fps) while the surface cameras tracked the chest-wall component. A mutual information algorithm was employed to compare the kV and MV images.

**Results:** CBCT reconstruction was performed using every other frame when in the slow treatment arc for correct reconstruction. The longer scanning times were translated in ~10-15% additional CBCT dose when 4 beams were used. For simple trajectory, the kV and MV images were phase correlated ~98% of the time for the high contrast tumor and ~92% for the low contrast tumor. Phase knowledge provided by the surface cameras increased the later kV-MV correlation to ~97%. Patient-like trajectories were tested where the most irregular trace (3mm baseline-shift) showed a moderate kV-MV correlation, enabling one to interrupt the treatment for a second on-line baseline correction.

**Conclusion:** The selective beams-eye-view slow-arc CBCT technique in conjunction with surface cameras and MV imaging has been demonstrated to be an effective tool for tumor tracking due to its treatment time immediacy and minimal impact on treatment flow.