AbstractID: 4878 Title: Time delay study of a CT simulator in respiratory gated CT scanning

Purpose: To evaluate the time delay in respiratory gated CT scanning and its effect to motion synchronized radiotherapy.

Materials and methods: In this study, we presented a technique to measure the time delay of AcQSim CT simulator (Philips Medical Systems) using Varian's Real-Time Positioning Management (RPM) system (Varian Medical Systems). A respiratory gating platform (REF 91150, Standard Imaging, Inc.) was first set at the position of amplitude maximum (Phase 0). Then a ball of 1.3 cm diameter was put on the platform and set at the CT laser. A single axial-scan was acquired across the center of the ball without motion. Then the motion was turned on and single axial-scans gated at different phases were acquired with a very narrow gating window. The time between the phase giving a good estimate of the ball and Phase 0 is the overall delay time. The delays were also verified using metal balls of 1.5 mm diameter initially set at the amplitude minimum (Phase 180).

Results: We found that for AcQSim CT, the overall delay for a single axial-scan (with 1s-scan time) is 1.75s. For multiple axial-scans, the overall delay is 1.75s for the first scan and 0.75s for the subsequent ones. This demonstrated that the CT mechanical startup delay is 1s. After the first axial-scan, the overall delay per scan is less because CT gantry continuously spins and no mechanical delay exists. We call the overall delay without the mechanical part the scanning delay, which basically equals to half the scan time (0.5s for 1s-scan time) plus the gating pulse triggering delay (250 ms).

Conclusion: It is the scanning delay rather than the triggering delay that should be compensated when doing motion synchronized radiotherapy. The current interface between the RPM system and the AcQSim CT does not compensate for this delay.