AbstractID: 11569 Title: Geometrical verification of real-time tumor tracking using Electronic Portal Imaging Device (EPID)

Purpose: We have developed a novel method to verify the geometrical accuracy of real-time tumor tracking. An Electronic Portal Imaging Device (EPID) is used as a virtual phantom system.

Methods and Materials: This virtual phantom system uses virtual target motion in the absence of a moving phantom and fluoroscopic mode of EPID for monitoring the motion of the tracking aperture. The expected apertures are designed from real-time detection of tumor motion, and the delivered apertures are monitored from the EPID system. These two apertures are compared for geometrical accuracy of a real-time tracking technique. The virtual phantom system was tested with several tracking patterns with irregular motion. Target motion was designed for an oval-shaped tumor with 40 mm and 55 mm in diameters for four cases: (1) stationary; (2) rigid-body two-dimensional (2-D) displacement with a period variation from 3 to 10 s and 20-mm peak-to-peak distance in the superior-inferior direction and 10 mm in the left-right direction; (3) 2-D displacement with deformation, and (4) 2-D displacement with both deformation and rotation. In the continuous acquisition mode of EPID, MLC aperture images were acquired at ~8 Hz. Root-mean-square (RMS) deviation between the designed and delivered aperture motions were calculated for each case.

Results: The RMS deviation is 0.005 mm for the stationary case, 0.5 mm for the 2-D displacement, 0.7 mm for the 2-D displacement with deformation, and 0.7 mm for the 2-D displacement combined with both deformation and rotation.

Conclusion: The EPID-based virtual system can measure geometrical accuracy of real-time tumor tracking without a moving phantom. Besides, it can be used even for complex target motion (*i.e.*, 2-D displacement combined with deformation and rotation), which is not possible with any existing moving phantom. Therefore, this EPID-based virtual system shows great potential as a quality-assurance process to verify real-time tumor tracking.