AbstractID: 13803 Title: Simultaneous estimation of beam geometry and radiation/imaging isocenter coincidence in cone-beam CT-guided radiation therapy

Purpose: To simultaneously characterize the geometric pose of an on-board CBCT imaging system and measure the relative positions of the imaging and treatment machine radiation isocenters. **Method and Materials:** The method is based on an existing technique (Cho, et al, Med Phys *32(4)*, 968), which utilizes CBCT projections of a fiducial phantom to calculate the source and detector positions and orientations as a function of gantry angle. The algorithm was modified to localize the phantom pose relative to the kV source trajectory, and to transform beam geometry parameters from the phantom to imaging isocenter coordinate system. The method was applied to both CBCT and MV EPID projections acquired during the same imaging session without moving the phantom. The calculated positions of the phantom relative to the CBCT and EPID projection isocenters provide the relative displacement of the imaging and treatment isocenters. Two additional CBCT imaging experiments were then performed with the phantom displaced known distances. **Results:** Calculated CBCT geometric parameters were consistent over the three experiments, even with the phantom displaced from the machine isocenter by 10mm or misaligned with the gantry rotation axis by 1°. The CBCT beam parameters were close to nominal with small variations with gantry angle, with the exception of a 1 mm detector offset parallel to the gantry axis. Displacement of the CBCT imaging isocenter from the treatment isocenter was found to be (0.07, 1.24, 0.05 mm) in the (L-R, A-P, S-I) direction. **Conclusion:** The method's output can assist in mitigation of geometric distortion-related CBCT image artifacts and simultaneously provides the imaging-to-treatment isocenter offset.

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