AbstractID: 11108 Title: Estimation of Imaging Geometry Parameters of a Multiple Source Digital Tomosynthesis System Using a Standard Cone Beam CT calibration phantom

Purpose: To describe and evaluate a calibration procedure to compute the imaging geometry parameters (IGPs) of a stationary multiple source digital tomosynthesis (DTS) system mounted on a medical linear accelerator (linac) equipped with a cone beam CT (CBCT) imaging system. DTS reconstructed image quality depends on the precise computation of IGPs. The novelty of the proposed method is that it employs the same calibration phantom used for calibrating the CBCT imaging system. This offers two major advantages as opposed to using different phantoms: 1) It ensures both the imaging systems (CBCT and DTS) reference a common machine isocenter. This is of critical importance for 3D image guidance during radiation therapy. 2) It ensures a seamless workflow while calibrating the medical linac. Owing to the unconventional nature of source-detector configuration employed by the DTS system, the DTS projections of a conventional helical bead geometry calibration phantom are characterized by bead occlusion, distortion and missing information. Therefore calibrating the multiple source DTS system with the standard CBCT calibration phantom is a non-trivial task **Materials and methods:** Projections of the calibration phantom, which contains radio-opaque tungsten beads, are obtained using each of the individual x-ray sources. An ideal model of the projection geometry is used to obtain reference projection images of the calibration phantom for each of the x-ray sources. IGPs are perturbed using an optimization scheme in order to minimize the difference between acquired projection images and the model. **Results:** The algorithm is able to detect changes in the source and detector positions with accuracy of approximately 0.3 mm. Considerable improvements are seen in the reconstructed image quality as a result of using precise IGPs in the reconstruction algorithm. **Conclusion:** We have demonstrated a robust method of performing geometry calibration for both regular and irregular source geometries.

Research sponsored by Siemens Healthcare