AbstractID: 3170 Title: The impact of portal imager shifts and the assumption of rigid isocentricity on Megavoltage Cone Beam CT images

Purpose: Linear accelerators and the current flat panel positioners do not represent a rigid isocentric imaging system. To correct for this effect in the reconstruction process of Megavoltage Cone Beam CT, the group uses projection matrices that are obtained from geometric calibration. This project studies the effect of deviations in detector position from the calibrated geometry which may occur over time.

Method and Materials: To simulate the effect of portal imager shifts, we translated projection images before performing the reconstruction. Synthetic projection matrices that assume perfect isocentricity were also produced to study the utility of our geometric calibration. To accentuate the observed effects, we first used noise-free simulated projections of a CT phantom as well as reconstructions of small, high-contrast ball bearings. We also acquired anatomical images of a Rando head with an acceptable clinical dose (8 MU) to verify our capacity to identify the previously observed artifacts.

Results: A pure flat panel shift of 2 mm along the longitudinal direction causes the same shift in the reconstruction volume. A 2 mm shift in the lateral direction however, greatly degrades the image quality with streaking and half-moon shadow artifacts. The orientation of those artifacts depends on the start and end angle of the acquisition. Since most of the flat panel flex was previously measured to be in the longitudinal direction, the use of synthetic projection matrices caused a blurring of the image in the longitudinal direction.

Conclusion: The calibrated projection matrices play an important role at conserving the image quality around high contrast objects. A 2 mm lateral shift away from the calibration will likely be detectable in high contrast regions of anatomical images. Longitudinal shifts will not degrade the image but will cause a positioning error.

Conflict of Interest:
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