

AbstractID: 5323 Title: Analysis of the point spread function of isocentric digital tomosynthesis (DTS)

Purpose:

This project presents an analysis of the point spread function (PSF) of isocentric digital tomosynthesis (DTS). DTS is a limited angle 3-dimensional reconstruction from cone beam projections, with high resolution for excellent imaging of both bony anatomy and soft tissue. Its major application is on-board imaging. The scans can be acquired during a single breath hold, thus eliminating respiratory motion artifacts without gating techniques.

Method and Materials:

The geometry of a linear accelerator (Clinac 21EX from Varian) equipped with a kV on-board imager and CBCT capability was used. We simulated projection data sets of a single point source (PS) for different total scan angles from 26° to 58°. The PS was located along the horizontal axis through the isocenter from the kV x-ray source to the detector (z -axis). DTS reconstructions were generated from the simulated projections, using a standard Feldkamp technique. The full width at half maximum (FWHM) of the resulting PSF was computed along the z -direction in stacks of DTS slices.

Results:

The PSF shows a bow-tie shape in the z -direction. The spread of the blurring function increases for larger scan angles. Furthermore, the FWHM decreases as both distance from the detector and the scan angle increase. FWHM values ranged from ~2.5mm to ~5mm near the kV source, and from ~5mm to ~11mm near the detector, as the scan angle was varied. For a typical 44° scan, the FWHM varied from ~3mm when the PS was moved 20cm towards the source away from the isocenter, to ~6mm when was moved 24cm towards the detector.

Conclusion:

The blurring effect of isocentric DTS is dependent on the total scan angle and the point of interest. These characteristics will provide guidance to imaging techniques using DTS for clinical applications. This project is partially supported by Varian Medical System.