AbstractID: 6428 Title: Optimization of FDK Reconstruction Parameters to Minimize Aliasing and Reduce Metal Artifacts

Purpose: To maximize SNR, suppress metal artifacts and minimize backprojection times for FDK-based cone-beam CT (CBCT) reconstructions by optimizing binning, filtering and backprojection parameters, and to investigate the performance of new multi-core CPU's.

Methods and Materials: CBCT reconstruction times can be reduced by filtering and downsampling high resolution flat panel projection data to match the reconstruction matrix pitch, and by using nearest neighbor interpolation (NN) for backprojection. However, metal artifacts and noise aliasing may result. To investigate the tradeoffs involved, a frequency-domain noise power spectrum (NPS) model was developed. Phantom and clinical CBCT data were acquired using the On-Board Imager and reconstructed with a range of pre-processing and backprojection parameters while keeping image MTF constant. Image noise, including the amount of noise aliasing, and metal artifacts were evaluated. Reconstruction times were measured on Xeon workstations comprising either two single-core, dual-core, or quad-core CPU's.

Results: Two types of metal artifacts emerged. A moiré pattern is produced if insufficient projection data densities in the transaxial direction are maintained, while radial streaks are produced by insufficiently dense axial data. For best image quality aliased noise should be less than 5% of the total image noise, and projection data should be 1.5-2.0x denser than the reconstructed image matrix pitch for backprojection with bilinear interpolation. NN interpolation is not preferred. Although backprojection times increased by ~50% with these higher projection data densities, overall reconstruction times for relatively large image matrices (512x512x188, 675 projections), were <50 seconds using the quad-core workstation which is sufficiently fast for IGRT applications.

Conclusions: Optimal use of high data densities coupled with bilinear interpolation for backprojection can suppress some metal artifacts and minimize noise aliasing. New multi-core CPU architectures provide sufficient speed to make such reconstructions clinically practical.

Conflict of Interest: Employees of Varian Medical Systems.