AbstractID: 14226 Title: Noise Characterization of a Clinical Flat-panel Cone-beam Computed Tomography (CBCT) System

Purpose: To quantitatively characterize the noise performance of a neurointerventional c-arm based flat-panel cone-beam computed tomography (FP-CBCT) system with an aim of exploring the feasibility of performing cerebral blood volume (CBV) calculations.

Method and Materials: Five CBCT scans of ~11 cm diameter water phantom positioned at the isocenter were acquired at 120kVp and reconstructed to 512^3 matrix with 0.33mm voxels. Central Regions of Interest (ROIs) of 193^3 matrix corresponding to $\sim(63mm)^3$ were extracted from each scan. Spatial uniformity was determined using the standard deviation (SD) in Hounsfield Units (HU) and repeatability was measured using the root-mean-squared deviation (RMSD) of mean signal and using the coefficient of variation (COV) of SD metrics. 3-D noise power spectra (NPS) were computed with and without subtraction of the average ROI volume from each ROI, which allowed determination of structural noise.

Results: Mean signal and SD determined from $(193)^3$ matrix and averaged over the 5 scans were 9.3HU (range: 8.4-10.3; RMSD=0.5) and 19.1HU (range: 19.05-19.15; COV<0.3%). Mean signal determined from $(193)^2$ matrix in each axial plane along the cone-beam direction indicated small variations (< 5HU). NPS analysis indicated high noise power at zero-frequency, suggestive of aliasing effects. Increased noise power was also observed along the axes, which were not associated with fixed-pattern structural noise.

Conclusion: Variability in mean signal across multiple scans and its difference from theory suggest the need for improved HU calibration. While the observed noise (SD) suggest the potential feasibility of performing CBV calculations with FP-CBCT, methods for noise reduction may improve the quantitative accuracy of such studies. Supported in part by NIH R01CA128906 and R21EB007767. Contents are solely the responsibility of the authors and do not represent the views of NIH, NCI, or NIBIB.

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