AbstractID: 8951 Title: Propagation of correlated noise in CT reconstruction

Purpose: The ability to estimate noise in complex CT images has great utility, but filtered backprojection reconstruction results in nonlocal, nonstationary random noise in an image. The variance propagation method proposed by Chesler has been used recently, but it was derived for the continuum and does not account for effects of noise correlations when used in discrete systems. Several alternative approaches have been developed for making accurate noise maps for a CT image.

Methods & Materials: Numerical data were prepared with MATLAB software, using both parallel and fan beam CT geometries. Variances were calculated by repeated simulations, as well as two implementations of Chesler's method for propagating uncorrelated noise. The propagation of correlated noise was implemented by operating on subsets of widely separated projection rays, combining efficiency and accuracy. The dependence of variance distribution on kernel bandwidth and scanner geometry was measured.

Results: The correlated-noise algorithm was in excellent agreement with repeated simulation calculations. For parallel geometries, noise distribution had a common shape for all reconstruction kernels, with differing scale factors. The two uncorrelated noise algorithms provided the correct spatial form of the noise, but required empirical scaling factors. In fan beam geometry, the distribution of the noise was kernel dependent, and uncorrelated noise algorithms had discrepancies on the order of 10-20%.

Conclusions: Several methods for noise estimation were examined. The approximate Chesler method is fast (same time as one reconstruction) and can be scaled for parallel beam geometries, but is subject to errors for fan beam geometries. Variance calculations from multiple simulations are unbiased but have errors whose standard deviations decrease as the inverse square root of the number of reconstructions. The correlated-noise algorithm achieves exact results in a time of 30-40 reconstructions.

COI: None