AbstractID: 9101 Title: Activity concentration degradation in positron emission tomography of objects in motion

Purpose: To determine the functional form of activity concentration degradation for objects in motion scanned with positron emission tomography (PET).
Method and Materials: A computational model was developed to simulate the behavior of spherical objects moving sinusoidally. Sinusoidal probability density functions (PDFs) of varying lengths were convolved with a noise-free disk, producing blurred, elongated shapes of the disk similar to those observed in PET imaging of thoracic lesions. Maximum values of the convolved images were determined, plotted as a function of PDF length, and fit using least squares criteria. PET scans of a NEMA IEC phantom oscillating sinusoidally were performed to compare with model results. Motion amplitudes varied from 0 cm to 3 cm at 0.5 cm intervals. The period of the oscillation was 4 s. No background activity was present. Each scan was acquired to 15 million counts to minimize statistical fluctuation. Maximum activity concentrations were determined for each sphere at each motion amplitude and fit using least squares criteria. The functional forms which best fit the data from the model and phantom data were compared.
Results: Model results suggest the degradation due to motion follows a logarithmic decline ($R^2 = 0.99$) after the amplitude exceeds the diameter of the object. Before this extent is reached, no degradation was observed. Phantom results support model predictions: The functional form which fit the phantom data best was a natural logarithm of motion amplitude ($R^2 = 0.97$ for sphere diameter 1.3 cm, $R^2 = 0.99$ for sphere diameter 1.0 cm).
Conclusion: Motion degradation of activity concentration follows a logarithmic function of motion extent. Modeling motion degradation could lead to development of a recovery coefficient for motion analogous to the recovery coefficient used to correct for partial volume averaging.

Conflict of Interest (only if applicable):