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Quantitative evaluation of SRT for PET imaging: Comparison with FBP and OSEM

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Abstract

SRT is a new, fast, algorithm for PET imaging based on an analytic formula for the inverse Radon transform. Its mathematical formulation involves the numerical evaluation of the Hilbert transform of the sinogram via an approximation in terms of 'custom made' cubic splines. Here, we present a comparison between SRT, filtered backprojection (FBP) and ordered-subsets expectation-maximization (OSEM) with 21 subsets at various iteration numbers (1, 2, 4, 6 and 10) using simulated and real PET projection data.

For the simulation studies, we have simulated sinograms of an image quality (IQ) phantom and a Hoffman phantom with an implanted tumor of various tumor-to-background ratios. Using these sinograms, we have created realizations of Poisson noise at five noise levels. In addition to visual comparisons of the reconstructed images, we have determined contrast, bias and radioactivity concentration ratios for different regions of the phantoms as a function of noise level. For the real-data studies, sinograms of an IQ phantom has been acquired from a commercial PET system. We have determined RCR and contrast for the various lesions of the IQ phantom.

In all simulated phantoms, the SRT exhibits higher contrast and lower bias than FBP and OSEM at 2 iterations (clinical protocol) at all noise levels. The contrast and bias of OSEM approach the values of SRT after 6 iterations. However, the SRT reconstructions exhibit higher coefficient of variations (COV). In real studies, SRT exhibits better contrast and RCR in all spheres over both FBP and OSEM at the clinical protocol of 21 subsets and 2 iterations. This improvement increases as the diameter of the relevant spheres in the phantom decrease.

In conclusion, SRT is an analytical algorithm with clearly improved quantification characteristics over FBP and the clinical protocol of OSEM. Since SRT increases the noise in the reconstructed image, further investigations are needed to determine appropriate applications for the algorithm.

Key words: Image reconstruction-analytical methods, PET, filtered backprojection, ordered-subsets expectation-maximization, OSEM.