AbstractID: 8868 Title: Model-based deconvolution for 4D PET

Purpose: An inherent problem in four-dimensional (4D) PET imaging is the poor statistics in each phase, because the total coincidence events are divided into several phase bins during image acquisition. We propose in this work a simple but efficient image post-processing method to improve the 4DPET image quality.

Method and Materials: In this method, the entire acquired coincidence events are used for each individual phase to enhance their signal-to-noise ratios (SNRs). A summed 3D PET image is first obtained from the noisy 4DPET images, which represents the maximum SNR achievable. By deconvolving the 3D image with a deformable model derived from 4DCT, an improved 4DPET phase series can be obtained. For the best image quality, voice coaching was used to assure a regular and consistent breathing pattern during the course of PET and CT scans. The method was quantitatively evaluated with numerical and physical phantom experiments. Three clinical studies of pancreatic, lung and liver cancer patients were then carried out.

Results: Numerical simulations showed that the model-based 4D-PET deconvolution method converged monotonically to the “ground truth” within a few iterations, and the SNR of the physical phantom images showed an increase of 83% over the conventional 4D PET without sacrificing spatial resolution. Similar performance was also observed for the patient study.

Conclusions: We have developed a new method for improved 4D-PET imaging. A salient feature of the method is that the coincidence events acquired at different time points are considered simultaneously when reconstructing each phase-resolved image, leading to substantially improved 4D-PET images.