# AbstractID: 8391 Title: Image Reconstruction and Image Fusion (PET/CT)

PET data acquisition can be performed either in 2D mode with the use of septa or in 3D mode in the absence of septa. While 2D acquisitions have less contributions of scattered radiation and require less reconstruction time, 3D acquisitions have increased sensitivity allowing either the injected activity or scanning time to be reduced. Filtered backprojection (FBP) has traditionally been used for tomographic reconstruction of both 2D and 3D PET projection data. While FBP can provide an unbiased solution, there is typically a degradation in image quality due to the presence of noise. Iterative reconstruction methods have been developed which explicitly use the correct (Poisson) statistical model for the acquired projections data in order to improve image quality. However, iterative reconstructions have the disadvantage of requiring greater computational time. Techniques such as Fourier rebinning (FORE) have been developed to rebin 3D acquisitions into 2D sinograms, which can then be reconstructed with either 2D FBP or iterative methods. Ordered subset expectation maximization (OSEM) is an accelerated method that provides the benefits of statistical reconstruction within the reconstruction time constraints of a clinical environment. Attenuation-weighted OSEM (AWOSEM) introduces a statistical weighting of projection data to further reduce image artifacts. PET image reconstruction also requires corrections for a number of physical effects including random coincidences, photon attenuation, and scattered radiation. The principles and clinical examples of PET data corrections and reconstructions including FBP, OSEM, and AWOSEM will be presented .

Multi-modality image fusion is useful for combining information from different structural and functional imaging modalities. Software methods have been well established for image registration of multi-modality brain images. However, there are limitations to using these methods in non-brain clinical oncology studies such as the need for non-rigid transformations due to differences in patient positioning and scanner bed profiles, internal organ shifting, and physiologic changes that occur between separate scanning sessions.
A hardware fusion approach has been developed to address these limitations by combining PET and CT imaging in a single device. The development of the first prototype PET/CT scanner and the subsequent commercially released scanner will be presented. The clinical evaluation of the both devices and the use of PET/CT in cancer diagnosis, staging, and treatment will be discussed.

The objectives of this presentation are to:

1. Present the differences in 2D versus 3D image acquisition
2. Present the corrections for random coincidences, scatter radiation, and photon attenuation in image reconstruction
3. Describe different reconstruction algorithms including FBP, OSEM, and AWOSEM
4. Demonstrate the principles of image fusion
5. Outline the development of PET/CT
6. Present applications of PET/CT in oncology