

## Recent Advances in Quantitative PET Imaging

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Nowadays, Positron Emission Tomography/Computed Tomography (PET/CT) imaging is widely used for quantitative oncologic imaging and illustrated as a robust imaging modality in diagnostic, recurrence evaluation, treatment planning, and patient follow-up. As in recent treatment strategies, personalized patient imaging is emphasized, the accurate quantitative analysis of PET/CT imaging seems a super important issue. However, it is well known that the data acquisition procedure and choice of a proper reconstruction algorithm can be led to accurate patient-specific interpretation and quantification. The administration of activity, scan time per bed position, and the size of overlaps for bed positions are important parameters to reach the acceptable image quality. However, quantitative PET imaging highly depends on reconstruction algorithms, so currently the majority of researchers and companies focus on improving the reconstruction algorithms using new techniques such as deep learning and noise modeling.

Traditionally, the Ordered Subset Expectation Maximization (OSEM) algorithm is widely utilized for the reconstruction of PET images. It is clear that using appropriate iteration number, subset, and post-processing filters are vital for accurate PET image reconstruction. Smaller pixel sizes can be used in PET images to show the smaller lesion, although higher noise can be seen. In order to improve the spatial resolution, Point Spread Function (PSF) modeling was applied to reach a better resolution since almost ten years ago.

The essence of more than 30 years of research in the field of PET imaging shows that Standardized Uptake Value (SUV) is still the best parameter for reporting tumor metabolism. So, all engineers in recent years have been trying to find algorithms to improve the accuracy of SUV calculated from the PET images. In this direction some techniques such as Time of Flight (TOF) and more recently Bayesian Penalized Likelihood (BPL) algorithm have come to the attention. The amazing property in BPL is bringing both image quality and quantitative accuracy in one shut. We can use higher iteration numbers to get high accuracy of SUV values while keeping image quality still suitable for visual interoperation.

Recently by introducing digital PET technology by hardware engineers, where using Silicon Photomultipliers (SiPM) instead of Photomultiplier Tube (PMT), the contrast and also Signal to Noise ratio (SNR) have been dramatically improved in PET images. As a consequence of recent digital technology, better timing resolution and TOF acquisition can be achieved.

In next couple of years, it is expected that by the combination of different reconstruction strategies such as TOF, BPL, PSF, and also deep learning more accurate quantitative imaging can be achieved and the physicians can closely monitor tumor response to therapy. In this situation tuning patient preparation and scan acquisition parameters seem to be important and can be reconsidered by physicians and physicists as new imaging guidelines