Contribution ID: **50** Type: **not specified**

Improving Spatial Resolution with Ultrafast TOF in PET

Sunday, June 5, 2022 3:30 PM (15 minutes)

The benefits of time-of-flight (TOF) in positron emission tomography (PET) have long been recognized and later clearly demonstrated in terms of sensitivity and image contrast-to-noise ratio. However, the impact on spatial resolution is generally considered negligible, if not detrimental due to the trade-offs that must be made to optimize the detector coincidence time resolution (CTR). As progress is being made to ultimately achieve 10 ps CTR, the TOF resolution will eventually enable reconstruction-free positron imaging. Nevertheless, we have demonstrated that when the TOF resolution along the tubes of response (TOR) becomes similar or better than the intrinsic spatial resolution of the PET scanner, it may be advantageous to reconstruct the images with an iterative algorithm to enhance resolution. This is because the better localization along the TOR can compensate for the orthogonal blur induced by the scanner intrinsic spatial resolution by using measurements from the different TOR orientations. Simulation results show that ultrafast TOF can mitigate the lower bound in spatial resolution induced by the detector size and the discrete nature of the PET reconstruction scheme. Furthermore, our simulation results show that the ultrafast TOF reconstructed response resulting from the annihilation photon acollinearity tends towards a much sharper 1/r distribution than the expected 0.0022D Gaussian, which reduces the impact of one of the physical limits of spatial resolution in conventional PET. A potential application of reconstructed ultrafast TOF imaging would be the design of clinical scanners achieving image spatial resolution beyond the predicted classical theoretical limit. Another challenge that must be addressed with ultrafast TOF is the noisy data resulting from the required finer TOF discretization. New reconstruction schemes enforcing the parametrization of emission properties might be considered to tackle the bias induced by low counts acquisitions.

Primary author: Prof. LECOMTE, Roger (Université de Sherbrooke)

Co-authors: Dr TOUSSAINT, Maxime (Université de Sherbrooke); Mr LOIGNON-HOULE, Francis (Université de Sherbrooke); Prof. DUSSAULT, Jean-Pierre (Université de Sherbrooke)

Presenter: Prof. LECOMTE, Roger (Université de Sherbrooke)

Session Classification: Technologies for ≤100ps TOFPET resolution: AI, Image reconstruction

Track Classification: AI, Image reconstruction