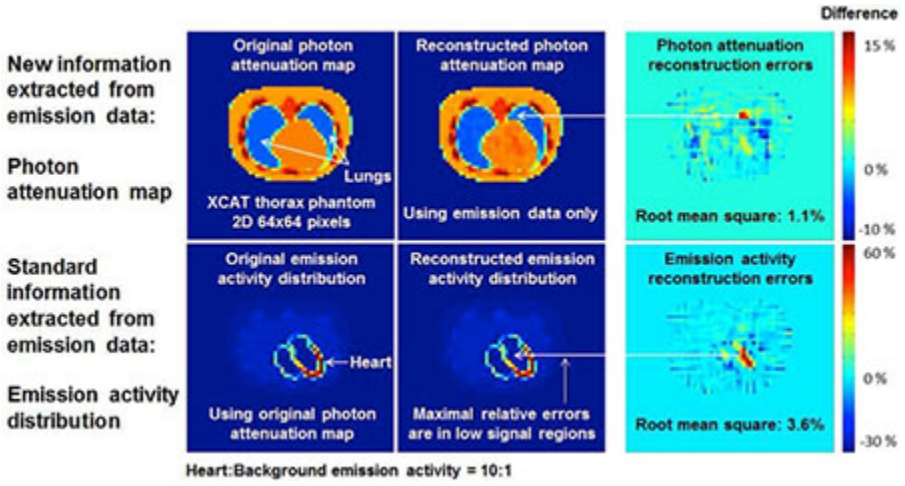
Docket #: S14-196

Real-time, Transmission Scan-free Attenuation Correction in PET

Stanford researchers have developed a statistical method to map tissue activity distribution and photon attenuation, correcting for attenuation in real time without a transmission scan, using Positron Emission Tomography. Quantitative PET requires the intra-patient photon attenuation map, typically obtained via a priori transmission scan, which increases scan time, increases radiation exposure for the patient, and requires dedicated equipment. In addition, a transmission scan is unavailable in combined PET and Magnetic Resonance Imaging (PET/MRI) scanners. Using the Maximum Likelihood Expectation Maximization (MLEM) algorithm, researchers are able to map joint tissue activity distribution and estimated photon attenuation in PET.

Stage of Research

The model, which is appropriate for efficient Graphics Processing Unit (GPU) based implementation, was tested with a thorax phantom. The joint emission activity and photon attenuation root mean square reconstruction errors were 3.6% and 1.1% respectively. The typical reconstruction errors had negligible global influence on the quality and accuracy of the reconstructed images.



Joint reconstruction of emission activity distribution

Rows: top – photon attenuation map, bottom – emission activity distribution. Columns: left – original phantom, center – joint MLEM reconstructed images, right – reconstruction errors.

The arrows from the right to the central column point to low value regions, which contain typical large image reconstruction errors. The heart activity, and the non-uniform photon attenuation due to the lungs, ribs and spine are clearly visible in the reconstructed images.

Applications

- Efficient and accurate, real-time photon attenuation correction from PET data.

Advantages

- Efficient, accurate and real-time photon attenuation correction
- Reduces need for transmission scan and additional exposure to ionizing radiation
- Available for integrated PET/MRI scans

Publications

- Mihlin, Alexander, and Craig S. Levin. "GPU formulated MLEM joint estimation of emission activity and photon attenuation in Positron Emission Tomography." 2014 IEEE Nuclear Science Symposium and Medical Imaging Conference (NSS/MIC). IEEE, 2014.
- Mihlin, Alexander, and Craig S. Levin. "An MLEM method for joint tissue activity distribution and photon attenuation map reconstruction in PET." Nuclear Science Symposium and Medical Imaging Conference (NSS/MIC), 2013 IEEE. IEEE, 2013.

Patents

- Published Application: 20170032545
- Issued: 9,858,691 (USA)

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