

AbstractID: 3976 Title: Image registration of multi-frame PET data: A simulation study comparing individual versus collective frame registration techniques.

Purpose:

Image registration of a multi-frame data set in PET imaging has traditionally been performed by registering individual frames to a reference data set (IND method). In this abstract we propose, test and compare the results of a new approach that collectively register all image sets together (COL method) using a simulation study.

Methods:

A lung lesion was simulated as a hot sphere oscillating in a warm background. The oscillation represented a patient breathing cycle. Images of the sphere at different phases of the breathing cycle were generated by first forward projecting the true image of the sphere into sinogram space, adding Poisson noise, and reconstructing the result using ML-EM. The reconstructed images were then registered using IND and COL methods. The same registration optimization was used for both methods. The registration quality of both methods was evaluated by calculating the mean square error (MSE) between the estimated and true displacement of the sphere at each phase of the breathing cycle following registration as well as by visual inspection. The results were also compared to an image of the sphere at a single phase and to that without motion. The effect of several simulation parameters on the registration quality were considered: 1) number of bins/cycle (10, 20, 40, 80); 2) Sphere to background ratio (2, 4, 8); and 3) number of breathing cycles (1, 2, 4, 8).

Results:

The MSE of COL is smaller than IND for the different simulation parameters. The improvement of COL over IND decreases as the sphere to background ratio increases, the number of bins decreases, and number of cycles increases. Visual inspection of COL registration showed better quality when compared to IND.

Conclusion:

COL gives better registration results by making use of all of the individual frames rather than registering one image set to another.