Contribution ID: **62** Type: **Talk**

High-Resolution Heterogeneous Digital PET Brain Phantom based on the BigBrain Atlas

Wednesday, 23 May 2018 09:30 (20 minutes)

In positron emission tomography (PET), the evaluation of image reconstruction algorithms needs realistic simulated data sets where the ground truth is known and the image quality and the quantification errors can be evaluated. In the context of brain imaging, qualitative and quantitative assessments of the radiotracer uptake in anatomical regions, such as the striatum or the cortical grey matter, are important to study brain disorders. Therefore, brain phantoms that emulate brain scans are then needed to assess the accuracy of reconstruction and post-processing algorithms. However, most of the available digital brain phantoms are usually of limited spatial resolution making them not ideal to evaluate quantification errors due to the partial volume effect (PVE). In addition, they are piece-wise constant and usually generated from segmented MRI images of the brain. As a result, quantitative errors can be underestimated when doing regularized MR-guided reconstructions. In this work, a method to create high-resolution heterogeneous digital phantoms based on the BigBrain atlas is presented. A realistic [18F]FDG digital phantom that overcomes the problems of the current PET digital brain phantoms, particularly for the simulation of simultaneous PET-MRI datasets, was created using the proposed method. In the latter, the histology images and a tissue classified volume of the BigBrain atlas are used to define the high-resolution structures of the phantom. Then, the uptake in different regions of the brain is estimated using the Hammersmith brain atlas and a reconstructed image of real data from an [18F]FDG study. The phantom was evaluated by simulating a brain scan and reconstructing the data set with MLEM and MR-guided MAP algorithms. The reconstructed images were compared with real data and a phantom created from the Brainweb atlas. The proposed phantom could account for the heterogeneities in the [18F]FDG uptake, while this was not possible with the standard phantom. Furthermore, the MR-guided reconstructions of the proposed phantom obtained a modest partial volume correction compared to the Brainweb phantom that agrees with the performance of MR-guided reconstructions for the real data. The complete dataset including the [18F]FDG phantom, a pseudo CT, a μ-map and a T1-weighted image will be available online. In addition, the simulated sinograms will be also available in order to have a realistic brain dataset that can be used as a reference to assess image reconstruction methods.

Primary author: BELZUNCE, Martin A. (King's College London)

Co-author: Prof. READER, Andrew J. (King's College London)

Presenter: BELZUNCE, Martin A. (King's College London)

Session Classification: Session 10 - Software and Quantification: other