Blind Deconvolution in Quantitative Brain PET Studies with SUV Parametrization

Albert Guvenis, Erman Kibriti
Institute of Biomedical Engineering Bogazici University, Istanbul
albert.guvenis@ieee.org, ermankibritoglu@gmail.com

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Background Quantification in Positron Emission Tomography (PET) is essential for achieving high precision in diagnosis, physiological parameter estimation, disease staging as well as prognosis. Many difficulties are known to cause errors in quantification. Of these, PVE is primarily caused by the limited spatial resolution of the camera and causes values to appear lower then their actual magnitudes. Many of the proposed solutions require the determination of the point spread function (PSF) of the camera. Purpose The present work aims to address this problem, namely, the the recovery of the activity concentrations or SUV's when the PSF is unknown. A second objective was to focus on brain PET imaging where the lack of accurate quantification is known to have a significant impact in neurological and oncological studies. Methods and Materials We have used an iterative blind deconvolution method which does not require the PSF to be known a priory. We applied the algorithm on realistic brain PET images with known ground truth. These images are obtained by extracting anatomical models from T1-weighted MRI studies, assigning Time Activity Curves to brain regions based on real PET scans and then using Monte Carlo simulations for a known scanner model. Data are reconstructed using a standard 3D filtered back projection algorithm. These images (The PET SORTEO database) are available online. Experimentation with different iteration numbers and blur extent has resulted in recovery coefficients that approach 0.85 while the RC for the images before deconvolution were found to be as low as 0.57 for different brain regions. Conclusion Blind deconvolution with parameter optimization has resulted in significant improvement in the recovery coefficients (RC's). This may have a substantial effect on the diagnostic reliability of neurological and oncological diseases of the brain. Further work is planned for the evaluation of these effects.