Use of dynamic reconstruction for parametric Patlak imaging in dynamic whole body PET

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Abstract. Dynamic Whole Body (DWB) PET acquisition protocols enable the use of whole body parametric imaging for clinical applications. In FDG imaging, accurate parametric images of Patlak K_i can be complementary to standard SUV images and improve on current applications or enable new ones. In this study we consider DWB protocols implemented on clinical scanners with limited axial field of view with use of multiple whole body sweeps. These protocols result in temporal gaps in the dynamic data which produce noisier and potentially more biased parametric images, compared to single bed dynamic protocols. Dynamic reconstruction using the Patlak model has been previously proposed to overcome these limits and shown improved DWB parametric images of K_i. In this work we propose and make use of a spectral analysis based model for DWB dynamic reconstruction and parametric imaging of Patlak K_i. Both dynamic reconstruction methods were evaluated and compared against 3D reconstruction based parametric imaging from single bed dynamic protocols. This work was conducted on simulated data and results were tested against a real FDG dynamic dataset. We showed that dynamic reconstruction can achieve levels of parametric image noise and bias comparable to 3D reconstruction in single bed dynamic studies, with the spectral analysis model offering additional flexibility and further reduction of image noise. Comparisons were also made between step and shoot and Continuous Bed Motion (CBM) protocols, which showed that CBM can achieve lower parametric image noise due to reduced acquisition temporal gaps. Finally, our results showed that dynamic reconstruction improved VOI parametric mean estimates but did not result to fully converged values before resulting in undesirable levels of noise. Additional regularisation methods need to be considered for DWB protocols to ensure both accurate quantification and acceptable noise levels for clinical applications.