AbstractID: 11201 Title: Voxel-based Kinetic Analysis Method utilizing ROI Fragmentation

Purpose:

Kinetic analysis is important for accurate quantification of PET images. As it is typically done on the region of interest (ROI) level, it does not preserve spatial information of the tracer uptake. We developed a novel method for voxel-based kinetic analysis on various spatial levels, which overcomes problem of high voxel noise level in dynamic PET images.

Methods and materials:

The proposed method starts with an ROI-based kinetic analysis with the standard least-squares method. Then a series of optimizations on sub-regions is performed, where estimated parameters from the super-region are used as initial guesses and *a-priori* values for Bayesian parameter estimation procedure on sub-regions. Procedure is repeated until sub-regions consist of a single PET image volume element. The method was tested by comparing the model estimated parameters with the true parameters on a mathematical phantom. Several different *a-priori* weighting schemes were tested on human cancer patients, dynamically imaged with FLT PET. Tracer kinetics was modeled with a two-compartment four-parameter kinetic model. Spatial variation of the kinetic parameters on parametric images was quantified.

Results:

Adding Bayesian part in the objective function greatly reduces spatial variation of kinetic parameters making images to appear smoother. On the other hand, the accuracy of parameter estimation is not compromised, as shown through phantom simulation studies. The reduction of spatial variation of kinetic parameter was found to be the most distinctive for k_3 parametric images, where variation was reduced approximately 6-fold and the least evident for $k_i=k_1k_3/(k_2+k_3)$ parametric images, where the reduction was approximately 2-fold.

Conclusion:

The proposed method is unique because it does not incorporate population-based prior knowledge, but develops prior knowledge by kinetic analysis on different spatial levels. It reduces spatial variation in parametric images, which reduces sensitivity to image registration errors, while quantitative accuracy is not decreased as with digital filtration.