Turku PET Centre Modelling report TPCMOD0028 2004-05-20
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Study on basis function methods reliance on θ_3 parameter limits

Introduction

The basis function method [Gunn et al. 1997] has been used for generation of arametric binding potential (BP) images from PET data. The purpose of this study was to determine the effects of changing θ_3 parameter limits in the estimated binding potential values.

Materials and Methods

The idea in basis function method is that by fixing θ_3 parameter we get a linear model equation of the form

$$C_T(t) = \theta_1 C_R(t) + \theta_2 C_R(t) \otimes e^{-\theta_3 t}.$$

This means that the estimation is done n times so that θ_3 parameter is given each value from some series $[x_1, x_1+\delta, x_1+2\delta, \ldots, x_1+n\delta]$. The best fit is selected after all n estimations are finished based on the object function value.
It has been noticed that selection of values x_1 and $x_1+n\delta$ (especially x_1) has a significant effect on the BP estimates that we get. So we are trying to establish the means to select limits $[x_1, x_1+n\delta]$ so that we get good results.

The reliance between BP and θ_3 is inversely proportional:

$$BP = \frac{k_2}{\theta_3 - \lambda} - 1.$$

Thus raising the lower limit of θ_3 should cause smaller values at the right end of BP distribution.

Results and discussion

In appendix A this effect is tested with image simulated from [^{11}C]raclopride data and in appendix B with a fantom image. According to these studies it is clear that basis function method is very dependent on the θ_3 limits. This problem should be dealt with some kind of mechanism that would advise the user to choose god limit values or it might be possible to determine own limit values for each radiopharmaceutical.

References

1. Gunn, R. N., Lammertsma, A. A., Hume, S. P., Cunningham, V. J.: Parametric Imaging of Ligand-Receptor Binding in PET Using a Simplified Reference Region Model, *Neuroimage* 1997; 6:279-287.