Evaluation of Fourier Transform Method with a Digital Filter in Compartment Analysis of RI Tracer Kinetic

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Compartmental analysis has been in wide practical use for tracer kinetic studies using RI in biological system, because the data of radioactive process may be frequently represented by a linear combination of negative exponentials of the form:

$$f(t)=\sum_{i=1}^{n} A_i \exp(-\alpha_i t)$$

Here, n, A_i and α_i represent a number of compartments, the initial size and decay constant of compartment i respectively.

In this analysis these parameters n, A_i and α_i are of great importance in biological or physical field. To estimate them, a modified method of Fourier transform method with a digital filter applying the maximum likelihood method was developed and the improvement of S/N ratio by this method was comfirmed by experiments using test functions as compared with the Gardner's original method.

Fourier transform method is insensitive to small random errors and the result of the analysis is shown in the form of a spectral graph in which a number of peaks indicates that of compartments and the abscissa value at the center of each peak represents the decay constant α_i, while the height of the peak is proportional to A_i/α_i.

A comparison of this method and a newly developed maximum likelihood method revealed the Fourier transform method with the digital filter is a good method to estimate the number of compartments and α_i, although this method is less accurate than the maximum likelihood method. Applications of this method to clinical data (e.g. washout curves of ^{133}Xe in brain and liver) were also reported.