Resolution Improvement of the Positron Computerized Tomographic System with Hardware Approach and Superresolution Technique

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ABSTRACT

A new detector array scheme for the positron camera for the improved image resolution and a method for the resolution improvement of the undersampled projection data from ring positron camera are proposed. Computer simulation results are presented and problems and limitations are discussed.

SUMMARY

The currently existing positron cameras of the ring type for the computerized tomography have the limited resolution mainly due to the finite detector size which limits the sampling. Finer sampling by the continuous scanning like X-ray CT is usually difficult due to the distinct structure of the positron camera. (1)
To improve the resolution, following two approaches have been studied, i.e, hardware and algorithmic approaches.

1. Hardware Approach with the New Detector Array Scheme

A new detector array structure of positron camera with which the resolution limitation can be improved to the desired limits by increased sampling is proposed and tested. The brief description of this new scheme is as follows ;

The circular ring detector array is divided into two halves and these two rotate in the opposite direction to each other within the distance of one detector width. During the rotating angular scan, the desired sampling is achieved. (This scheme we will term as an Half-Ring Rotating System.)

2. Superresolution Approach with Papoulis Iterative Scheme (2,3)

On the other hand, if the resolution can be improved by mathematical

manipulation, finer image can be obtained even with the presently available circular ring stationary positron cameras.

Following is a software approach which has been proposed by Papoulis ;

The extrapolation of the band-limited function f(t) can be achieved from a finite segment

$$g(t)=f(t)p_T(t) \qquad p_T(t)=\begin{cases} 1 , & |t|<T \\ 0 , & |t|>T \end{cases}$$

of f(t), and it was proved that some finite number of iterations will reproduce the analytic function f(t) from g(t). Using Papoulis iteration scheme, the resolution improvement of the undersampled projection data can be considered as a dual problem. For this application, the projection data is assumed to be space-limited (as a dual of band-limitation) and a part of its Fourier transform which has negligible aliasing component is assumed as the finite segment of the spatial frequency spectrum to be used for the extrapolation in frequency domain.
The above two proposed methods are investigated by computer simulation and the results are presented.

REFERENCE

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