Measurement of Resoluing Time for Gramma Camera—Computer System and Correction for Dead Time Loss of Counting-rate

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Recently, a dynamic function studies using gamma camera-computer system is becoming more and more popular. There are two important factors to be considered in the case of quantitative dynamic studies using a gamma camera, that is (1) a dead time loss of counts and (2) non-uniform sensitivity over the camera detector. We present here the results of investigation on the former factor.

Our gamma-camera is a delay-line type scintillation camera of large crystal diameter (Toshiba JCA 202), and computer system is TOSBAC 3400 DAC on-line system. The resoluting time of this camera measured by Tanaka et. al.[1] who found the following relationship between true counting-rate and displayed counting-rate.

$N=RNo \exp(-\tau c\, No)$

where No is the true counting-rate

N is the displayed counting-rate (scaler counts)

R is the fraction of count to be displayed to the true count, τc is the dead time of the camera.

According to the measurement made by ^{57}Co point source, $R=0.65$ and $\tau c=5.5$ sec were obtained.

The value of R is dependent upon the radionuclides, the energy windows of the pulse height analyzer and collimators of the camera. Moreover, when the radionuclide is in a patient's body, R must be quite different from that of the point source. Consequently, the values of R are experimentally determined by measuring the energy spectrum of Z signal of the gamma camera under clinical measuring conditions.

The dead time loss between displayed counts of the camera and collected counts in the memory of the computer was investigated by measuring counting-rate stored in the memory as a function of displayed counting-rate of the camera.

For a histogram mode and a list mode of data acquisition, the following equations were experimentally found;

Histogram mode:

$$\frac{N}{M}=1+N\tau=\frac{1}{1-M\tau}$$

List mode:

$$\frac{N}{M'}=\frac{1+N\tau}{a}=\frac{1}{a-M'\tau}$$

where M is counting-rate collected in the computer memory by histogram mode.

M′ is counting-rate collected in the computer memory by list mode, when $M' \geq$ 16000cps.

τ is effective dead time of the computer system ($=10\ \mu$sec) a is a fraction of data acquisition rate to input counting rate ($=0.85$)

M′ is limited to the maximum counting-rate of 16000cps because transfer speed of data in the core memory to the magnetic disc sets the upper limit.

In the case of dynamic imaging with histogram mode, the minimum time per frame is limited by the transfer speed of data in the core memory

to the disc. The minimum times are 800 msec and 100 msec for 64×64 and 32×32 image cells/frame respectively.

An empirical formula correction of counting loss due to overall dead time of the camera-computer system are derived for routine use in dynamic function studies. For example, when 5000 cps/frame is collected by the histogram mode with ^{99m}Tc, $^{(R=0.45)}$ the true counting-rate is about 5700 cps/frame which means the correction factor of 14%.

(1) E. Tanaka, N. Nohara, N. Kumano, and M. Kakegawa, Medical Radioisotope Scintigraphy vol. 1 P. (1973) IAEA, Wien

Scintigram Processing and Treatment by Remote Computer Using Telephone Line

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A terminal I/O typewriter was set in our hospital which was connected by telephone line to TOSBAC 40 TSS set in Tokyo University Hospital about 4 km apart from our hospital.

The capacity of TOSBAC 40 TSS which we have not seen will be reported by the members of Computer Division of University Hospital. In this report, we state the program for processing and treatment of scintigrams by the telephone line computer system.

Program consists of three main parts; they are character selecting, smoothing and separation.

The character demonstrates the element of 4mm×5mm of scintigrams by the count level. The count rate is divided into ten equal levels between maximum and minimum count rate. The characters in each level are selected manually, and if the selection is avoided, each level is typed as (#), (#O), (=X), (#), (*), ('), (+), (.), ( ), from highest level.

Separation program prints out the minified scintigram (1/2×1/2) with two coordinates in upper and lower sides of scintigram. By selecting two coordinates, the scintigram is divided into two areas and prints out the number of element in certain level, accumulated number of element each two areas and the ratio of activity between two areas.

Smoothing program is weighted average of 13 points neighbouring a certain point and the weight is manually selectable in each neighbouring 12 points.

Each program can be skipped or returned easily.

By these programs, liver spleen ratio, right and left ratio of lungs or thyroids, the effect and correctness of smoothing techniques are examined.