Programs for On-Line Data Acquisition and Processing of a Scintillation Camera

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The paper describes four kinds of programs for on-line data acquisition and processing of digital data from a scintillation camera. The computer employed is TOSBAC 3400 DAC on-line system which has been installed in our institute.

The first program collects X and Y position pulses of 6 bits each and forms two-dimensional digital image into core memories of 4,096 words which can be displayed on the CRT as a static image of 64×64 image cells.

The second program performs dynamic image gathering in which X and Y pulses from the camera are collected as a two-dimensional digital image mentioned above, but timing signal from a timer, in the timer is used to interrupt the data gathering. One method of the data gathering uses two regions of core memories of 1,024 words (32×32) and one region collects digital image, while the collected image in the another region is being transfered to a magnetic disk and then cleared to zero. Switching of the two regions is made by an external interrupt of timing signal. Another method uses one region of core memories of 4,096 words (64×64) and the timing signal is used to interrupt the data gathering in order to transfer the collected data onto the disk.

The third program is made to obtain dynamic image of two different energies in which X and Y pulses of 7 bits each and energy information of 1 bit as well as timing pulses of 8 bits are written to a 24-bits word of core memory sequentially and then transfered to the disk.

The fourth program is used for the cross-section image obtained from rotating a tilted collimator, and patient bed synchronously. In this mode of data acquisition, X and Y pulses and angular position are simultaneously collected into core memory during the patient measurement.

These programs will be in full operation at the end of this year when a new Delay-Line camera is installed.

Digital Computer Processing Program for Scinticamera Data

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In order to improve visualization of camera image and to increase accuracy in diagnosis, we use some digital computer processings. There have been published many reports concerning our image processings, which we are using systematically; such as data out put of net counts, data smoothing, determination of optimum window for interest regions, enhancement, differentiation and conversion to logarithmic pattern. As the results of these studies, we found that the enhancement and differentiation, which are performed after smoothing and optimum window setting, were more effective and appropriate than without these preprocessings. In case of pancreas visualization, we compared digital image subtraction with division, using the dual-radioisotope technique (^{198}Au-colloid ^{75}Se-methionin); and we noticed that the dual-image division method was better than subtraction method.

The digital out puts of scinticamera include many useful informations for clinical diagnosis, particularly for dynamic study.

Therefore, the above-mentioned techniques are now applied in our laboratory to kidney dynamic studies, such as perfusion, secretion, excretion and also difference in dynamics upon the postual change etc. And also these fundamental image processings are very useful and necessary for dynamic data processings.

A High Resolution Gammacamera

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A new Gammacamera with high position resolution capability is developed. The gammacamera is based on the delay line position computing circuit, and its out view is the same as standard type gammacamera GCA-101. Using the delay line position computing circuit, the output signals from PMT's which are far from the scintillation event in the NaI (T*l*) crystal contribute very little to position signals and high position resolution capability can be obtainable. The intrinsic position resolution (FWHM) is 8.5 mm for ^{99m}Tc. Ordinal bar phantom studies for intrinsic resolution show this camera resolves 3/16 inch (4.7 mm) bars separated by a like distance.

The system resolution of a garmmacamera is determined by two factors, one is the intrinsic resolution of the detector and the other is resolution capability of collimator.

To improve the system resolution of the camera high resolution collimator for 140 KeV is developed. The optimum geometric structure is determined theoretically.

Applying new fabrication techniques, the collimator has the position resolution of 8 mm at 100 mm far from the collimator surface and exhibits the detecting sensitivity 1.25 times as great as ordinal 4000 hole collimator.

Combining the high resolution collimator to the new gammacamera system resolution of 11.5 mm is obtainable.

To clarify the performance of the camera and the collimator, scintigrams of IAEA Liver Slice phantom are taken.

Nonlinear Image Processing in Radioistope Scintigraphy

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The problem of increasing the resolution of a radioisotope scintigram can be formulated as the solution of a convolution type integral equation, but solving this integral equation is extremely difficult if noise is present in the data.

In order to overcome this difficulty, we previously investigated the "Least Squares Deconvolution Method" in which the expected squared difference between observed and processed image distribution was minimized.

In this report two practical nonlinear tech-