by fixing the shadowgram to-pinhole-distance and also the pinhole-to-decoded image distance. By this method we are able to obtain MPCA image by a single exposure. There arise, however, few problems, such as how to eliminate the multiple noise images superimposed on the focused final decoded image. In this study, in addition to the optical decoding, RI-tomograms were obtained using a min.-computer. In decoding, floating computations were done, and using coordinsted transformation formula by linear obbildung. Computed with optically decoded images, the computer made level cutting, Background cutting, Smoothing, Oblique display etc. far easier, and tomogram at each depth are identical as those theoretically expected.

Image Processing for Correction of Septum Penetration of Collimator

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In imaging high energy γ-ray emitters with a conventional multi-hole collimator designed for medium energy γ-rays, the point spread function of the system is often associated with a starlike broad response due to the septum penetration, and the obtained images show appreciable artifacts. This paper presents a method of removing such artifacts by computer processing.

The image processing is made by convolution of a measured image and a correction function, the latter being determined by an iterative method from the point spread function as follows. If we assume that the point spread function is expressed by

$$p(x, y)=ka(x, y)+(1-k)b(x, y)$$

where $a(x, y)$ is a sharp peak and $b(x, y)$ the broad response and $k(<1)$ a constant, the correction function, $F(x, y)$ is given by

$$F(x, y) = \frac{1}{k}\delta - \frac{1-k}{k^2}b + \frac{(1-k)^2}{k^3}b^{(2)} - \frac{(1-k)^3}{k^4}b^{(3)} + \cdots$$

where $\delta(x, y)$ is the Dirac delta function and $b^{(n)}$ is the n-time convolution of $b(x, y)$ by itself.

The signal to noise ratio in detecting a small lesion of A dps in a uniform background activity of B dps/cm^2 is given by

$$S/N=(A^2B/T)^{1/2}(\varepsilon k)^{1/2}$$

where T is the counting time and ε the efficiency of the collimator assuming no septum penetration. $(\varepsilon k)^{1/2}$ is a "figure of merit" of the collimator.

Formulation of the septum penetration of parallel multi-hole collimator is presented, and the figure of merit of the collimator for positron annihilation radiation (0.51 MeV) is evaluated.

Computer Processing of the Scintigraphic Image Using Digital Filtering Techniques —Examination of cut off frequency—

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Removing noise and extracting necessary information is undoubtedly important for increasing diagnostic ability. We have clinically utilized digital filtering techniques of FIR digital filters with good success.

In this paper, we examined the correlation between the cut off frequency of a digital filter and the processed image, especially about the detectability of the space occupying lesions. Using a phantom, which contains round space occupying lesions of 1 cm and 2 cm diameter and is filled with ^{198}Au-colloid 300 μCi, a radionuclide image is obtained by a scintillation camera. The image is then processed with FIR and IIR digital filters in one and two dimension with various cut off frequency. The cut off frequency of FIR and IIR digital filters shows the same value as 1/29 in case of 1 cm in diameter space occupying lesion and as 2/29 in case of 2 cm in diameter, (29 cm means the diameter of the crystal of the scintillation camera), when the space occupying lesion vanishes in the processed image. This results suggest that the information of space occupying lesion may vanish when the cut off frequency is l/r (l=diameter of space occupying lesion, r= diameter of the scintillation camera).

And the space occupying lesion is clearly visualized in both FIR and IIR filters when the cut off frequency is $\frac{l}{29}\times\frac{6}{5}$, which suggests the optimum cut off frequency may be $\frac{l}{29}\times\frac{6}{5}\sim\frac{l}{29}\times\frac{7}{5}$, because the noise may be maximally removed with passing the adequate information of the space occupying lesion.

Imaging of Positron Emitting Radionuclides by a Gamma Camera and Its Image Processing

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Experimental results are presented of imaging positron emitting radionuclides by a conventional gamma camera attached with an existing parallel multi-hole collimator and of correcting images by an iteration method. When a medium-energy collimator is used for positron annihilation radiations or high energy gamma rays, it results in the point source response of a starlike pattern due to the radiations strongly penetrating septa in the directions along the minimum septal thickness in the array of holes of the collimator. The point source response, therefore, consists of mainly two components: one is the sharp component due not to the penetration and the other the broad component due to the penetration.

For instance, the fractions of the sharp and broad component are about 0.37 and 0.63, respectively, with the collimator, which has 1800 holes of 6 mm in diameter by 80 mm long with septal thickness of 2 mm, for a ^{18}F-point source located at 12 cm from the face of collimator. Relative count density in the broad component is less than 10% of the peak count density.

The point source response can be corrected to remove the broad component by an iterative method (see 23). The third iteration with a filter derived from the point source response results in the corrected point source response with the reduced broad component less than 2% of the peak count density.

Detection Limit of Lesions in Section Scintigraphy

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In the computed transverse axial emission tomography, reconstructed images are often associated with appreciable amount of noise due to limited dose of activity given to a patient and finite counting time. This paper presents an expression suitable to evaluate the amount of noise for a given activity distribution.

In the image reconstruction with the one-dimensional convolution method, the observed projections are corrected by taking a convolution with a certain correction function, $g(s)$, and these corrected projections are back-projected to a reconstruction plane. It can be shown that the variance $V(\bar{r}_1)$ of the noise associated with the reconstructed image is given by the convolution of the activity distribution $a(\bar{r})$ with a function $N(|\bar{r}-\bar{r}_1|)$, where $N(r)$ is given by

$$N(r)=\frac{1}{2\pi}\int_0^{2\pi} g^2\,(r\sin\omega)\,d\,\omega$$

The function $N(|\bar{r}-\bar{r}|)$ is named here "error