O. RCT, ECT and Cyclotron

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THEORETICAL EVALUATION OF SCATTERED COINCIDENCE IN POSITRON COMPUTED TOMOGRAPHY.
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Scattered coincidence events are one of the major causes of background which deteriorates the image quality in positron tomography. Components of the scattered coincidence in projections and their effect on reconstructed images are evaluated analytically for a uniform cylindrical phantom. The scattered projection critically depends upon the detector ring diameter, phantom diameter, energy discrimination level, etc, but is roughly approximated by a cosine function when the object diameter is about 20 cm. The scatter component in the reconstructed image has highest density at the image center although the density is effectively reduced by subtracting a constant background determined from the value at outside of the object before the attenuation correction. The ratio of the scatter fraction in the image to that of counts in projections is evaluated with or without the background subtraction.

Comparison with experimental data obtained with a head positron tomograph, POSITOLOGICA, showed reasonable agreement. It was also revealed that, even for a broad distribution of the scatter projection, attenuation correction may yield appreciable artifacts in the image if there is a large discontinuity in attenuation in the subject.

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RELATIONSHIP BETWEEN SPATIAL RESOLUTION AND SENSITIVITY OF POSITRON EMISSION COMPUTED TOMOGRAPHS USING BGO DETECTORS.
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Bismuth germanate(BGO) used for detectors in positron emission computed tomographs has a relative cross-section of Compton-scattering 56% and photoelectric effect 44% to 511 keV photons. Since photons Compton-scattered in a BGO crystal near the surface have a large probability of escape from the crystal, the escape events are increased as the crystal width is decreased. This results in loss in sensitivity. To evaluate the loss in sensitivity as a function of crystal width an edge response of BGO crystal to 511 keV photons is theoretically derived by using a simple model. The model is that two sufficiently large BGO cuboids are joined together at their side surfaces and that incident photons interact either in photoelectric absorption or in Compton-scattering followed by absorption in final. The theoretical edge response is in good agreement with an experimental response within error of 2% of total events. Relative sensitivity has been obtained for various crystal widths by taking into account the edge response at the both sides of the crystals. The sensitivity is 0.66 for 6 mm wide crystals and 0.83 for 15 mm wide crystals.

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CHARACTERISTICS OF THE MULTIPLE PINHOLS CODED APERTURE(MPCA) AND LOW-NOISE MPCA METHOD.
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The tomographic images obtained by the commonly used MPCA method require only a single exposure. From the resultant shadowgram, it is possible to obtain a tomographic image of any required depth. In contrast with methods such as the RCT method, there is no need to rotate either the patient or the detector. However, the reconstructed tomographic image obtained by the MPCA method is characterized by side lobe noise of a magnitude that is dependent on the arrangement of the pinholes and the intervals between them. This noise greatly reduces the quality of the image. In the present study, a comparison was made between the commonly used MPCA method and an experimental method using the MPCA mask and opening the pinholes one a at time, thus obtaining a number of shadowgrams that is equal to the number of pinholes. Using the experimental method, the resultant tomographic images were characterized by a reduction of side lobe noise and were of a high quality. The tomographic images obtained by the commonly used MPCA method were subjected to image processing and also showed greatly reduced side lobe noise. Both the commonly used MPCA method and the low noise MPCA method were applied to phantom objects and clinical cases. The results of a comparative study with regards to image quality are reported.

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EVALUATION OF PERFORMANCE CHARACTERISTICS OF AN ECT SYSTEM (UNIVERSAL GAMMA CAMERA).
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The purpose of this study is to evaluate performance characteristics of SPECT using Universal Gamma Camera(Toshiba GCA 401-5) which was designed to take conventional planar image, whole body image and ECT without replacing the scan table. Image data are collected in magnetic tapes using a microcomputer(SORD Mark Ⅵ),which are transfered to a computer system(Eclipse S/200)attached to CT/T(GE Inc.) for image reconstruction and display.

The results can be summarized as follows: 1) In phantom study the smallest cold spot resolved was 9mm at optimal conditions. 2) The smaller the rotating angle the better the image quality, when the total counts collected was identical. 3) The line spread function using a line source(1mmφ)revealed 18mmφ FWHM in air and 19mmφ in water with little effect by the difference of depth. 4) When data were collected in the same angle, there is no difference in resolution and quality of images between stepwise and continuous rotation. 5) The absorption of γ-ray by scan table was about 10%, which caused approximately 6% decrease in relative count rates on the lower margin of the 20cm phantom on bed relative to the upper margin.