Flying-Spot Scanner with Omni-directional Scanning for Two-Dimensional Processing of Radioisotope Images II

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In the 11th annual meeting of the Japanese Society of Nuclear Medicine, we proposed the principle of the two-dimensional analog R.I. image processing and a method to realize it by use of a flying spot scanner and also gave the preliminary results of the device. At that time, the functions of the device were not satisfactory in such respects as (1) non-uniformity of the flying spot system, (2) poor spatial resolution and (3) base-line shift in electronic system. The effect (1) arises partly from the dependence of optical solid angle subtended by focus lens on the position of flying spot and partly from the non-uniformity of half prism, which was used to devide the flying spot in two ways for purpose to compare two films. The latter can be avoided by abolition of the half prism. As to (2), the improvement of high frequency characteristics of the electronics made the spatial resolution satisfactory, so that the processings of the X-ray film data are now feasible. The effect (3) can be reduced by adoption of D.C. coupling wherever possible or by the improvement of the low frequency response of the electronics, where condenser couplings are indispensable, by adoption of D.C. restorer or by increase of the time constant. As a result of these improvements, the following processings and displays operate satisfactorily; (1) blurring and deblurring, (2) density display, (3) bird's eye view, (4) shaded view and combination of these functions. In this meeting are presented the processed data obtained from the film of the liver phantom taken by scintillation camera and those from the film of X-ray exposure. There exists some trouble in metrical handling of the data such as iso-count contour map or iso-count density spectrum etc, because of base line shift and non-uniformity of the optical system, which are left for future study.

The characteristics of the converging collimator

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To take a transmission scintiphoto with a gamma-ray point source and to superimpose X-photo onto scintillation image, a diverging collimator was used in inverted position, and by convincing its usefolness after several fundamental tests, we order made a 1261 hole 56 cm focees converging collimator. Its resolution, sensitioity and effect to gamma-ray spectra and etc were studied in comparison with a parallel hole, pin-hole, diverging hole collimator of Phogamma/III camera. Resolution test was performed using a line source phantom. Sensitioity test was performed with a flat and round area source. The chauge in gamma-ray spectra was

also tested. These tests were performed in the air and water.

Resolution: the best resolution was obtained with a pinhole collimator, and the secend best was with the converging collimator.

Sensitioity: the least decrement of sensitivity by increasing the collimator-source distance was demonstrated with the converging collimator.

No noticeable change in gamma-ray spectra was observed in the air and water, and specially the decrease of photopeak area was small in the converging collimator.

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Fundamental Study on the Performance of Scintillation Camera Based on Delay-line Time Conversion

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The performance (uniformity, potential resolution and detectability of space occupying lesion) of the delay-line scintillation camera were studied.

Uniformity of sensitivity

The uniformity of sensitivity was satisfactory in regard to ^{57}Co, ^{203}Hg and ^{198}Au, but not to ^{125}I. In case of ^{57}Co, the uniformity was $\pm 10\%$ within 22.5 cm diameter along X and Y axis of the crystal area.

Potential resolution

In case of ^{99m}Tc, the resolution distance (F W H M) obtained with 4000 hole collimator were 8 mm on the surface of collimator, 12 mm at 10 cm's distance, and 17 mm at 20 cm's distance. Similarly, as to ^{203}Hg, the resolution distance were 8 mm, 13 mm, and 18 mm, resdectively. The resolutions of ^{131}I by the use of 1000 hole collimator at the distance of 5, 10, and 20 cm were 14, 18, and 25 mm along X and 13, 16, and 24 mm along Y axis, respectively. The resolutions of ^{198}Au likewise studied at the distance of 5, 10, and 20 cm were 14, 18, and 26 mm along X and 13, 17, and 26 mm along Y axis.

Detectability of space occupying lesion

An experiment was done using 4 kinds of nuclide (^{99m}Tc, ^{203}Hg, ^{131}I and ^{198}Au). Detectability of ^{99m}Tc was best of four nuclides. In a water phantom of 5 cm deep, spherical defect of 1.0 cm diameter was detected at the phantom surface, and 1.5 cm diameter at the phantom bottom as for ^{99m}Tc. In a water phantom of 10 cm deep, defects of 1.5 cm and 3.0 cm diameter were detected at the phantom surface as well as bottom.