Evaluations of a High Speed Gamma-Camera Based on Variable Sampling time Method

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This paper proposes a principle of "variable sampling-time method" which possibly realizes a high speed Anger camera. In this system, current pulses from detector head are shortened to a pulse width, t_c (typically 0.125 μs) and integrated by gated integrators. The integrated singals are usually sampled after a certain waiting period t_w (0.75 μs), but the sampling is automatically hastened by the succeeding pulse if it occurs during the above waiting period. The integrators are immediately reset within a short period t_r (0.1 μs), and are ready to accept the second pulse. The sampled signals are hold for a certain period t_d (0.6 μs) to perform position computation.

The formula expressing the count-rate characteristics of this system is derived assuming that pulse pile-up rejection circuit is provided. Numerical evaluations show that the system can be operated at an input-rate as high as 3–4 Mcps, and the maximum detected rate is about 420 kcps (input-rate=2.5 Mcps) when the window fraction is 0.5. The spatial resolution is a function of count-rate. At a low count-rate, there is no resolution loss since most of the signals are sampled after relatively long waiting period, t_w. As count-rate increases, the spatial resolution gradually decreases due not only to the shortening of the integration period but also to the effect of noise due to all preceeding pulses. An analysis shows that the spatial resolution is decreased by 3.8, 7.3, 17, 32, and 56%, respectively, at input-rates of 100, 200, 500, 1,000, and 2,000 kcps.

Analysis of Spatial Resolution of Scintillation Camera (II)

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Spatial resolution of a scintillation camera (LFOV gamma camera, Searl Inc.) was analyzed on the basis of data obtained using point source and line source.

A plastic plate with holes of 1 mmϕ and polyethylene tube of 1 mmϕ both filled with ^{99m}Tc-pertechnetate were used as point source and line source, respectively. Counts measured were sufficiently large, so that statistical error could be neglected. A computer (Scintipac 200 or 201, matric size 64×64 or 128×128) was mainly used for data output.

When parallel high resolution collimator was used, the profile of spatial resolution was in triangular shape at 20 cm distance from the source. However, Gaussian type profile was obtained at 0 cm distance from the source.

The full width half maximum (FWHM) of the profile was smallest, when converging high resolution collimator was used. No significant difference was observed between FWHM of the profile obtained using the point source and that obtained using the line source. FWHM for the point source placed in a phantom (Mix D) was about 1 mm larger than that for the point source placed in the air. The samllest distance between two point sources distinguishable on X-ray or poraloid film was nearly identical to FWHM.

We wish to continue this type of study for more detailed analysis of spatial resolution of scintillation camera.