Physical random number generator using isotropic radiation

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1. Introduction

We have developed a new type of physical random number generator using radioactivity of ^{241}Am. This generator has one ^{241}Am source, alpha-ray emitter, and two solid state detector systems. Recording alpha-particle counts in multi-scalers, it sends them to a computer, which treats these counts. This machine directly generates binary uniform random numbers. Several generators reported until now indirectly made uniform physical random numbers. An example is our generator with radioactivity ^{241}Am (Yoshizawa, Kimura, et al., 1999).

Random numbers, which were directly produced by generators, followed the Poisson distribution or the exponential distribution. These random numbers were transformed into uniform ones with computers. The new method shown in this report is applied to not only binary random numbers but also decimal ones. This method is on the basis of the principle that radiation from radioactivity is randomly and uniformly emitted in the solid angle.

2. Generator

Fig.1 shows the block diagram of the present generator. The generator consists of one radioactive source of ^{241}Am, two solid state detectors for alpha-rays, amplifiers, a clock pulse generator and a 4096 channel scaler. Each channel of the scaler records independently each signal from two detectors A, B and the clock pulse C as the numbers 1, 2 and 4, respectively. Therefore, concurrent occurrences of those signals can be recorded.

The simple method for this generator is that each scaler records one pulse from the detectors A or B. This number minus 1 gives a binary digit. Fig. 2 shows pulses of the simple method.

More complicated method is to count pulses from the two detectors and pulses from the clock generator. The number of clock pulses between two pulses from the detectors means time between two alpha particles. This method confirms randomness of alpha particle emission.

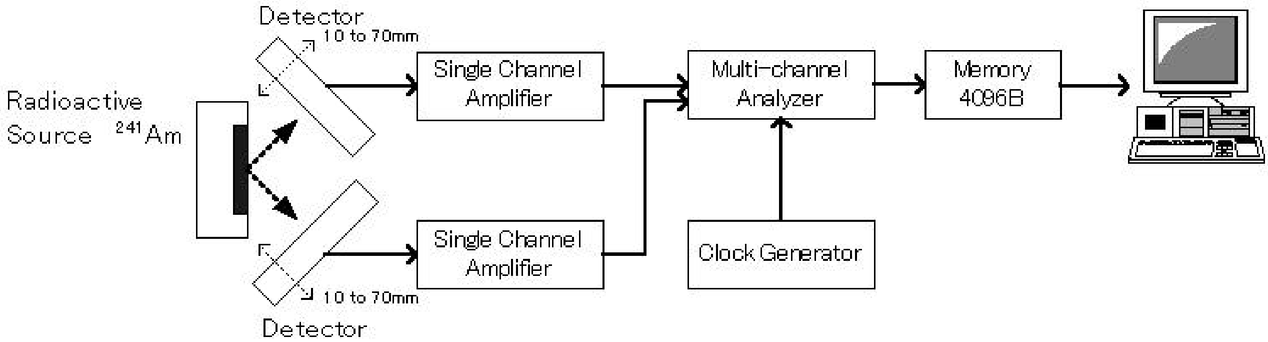

Fig. 1. Schematic diagram of random number generator.

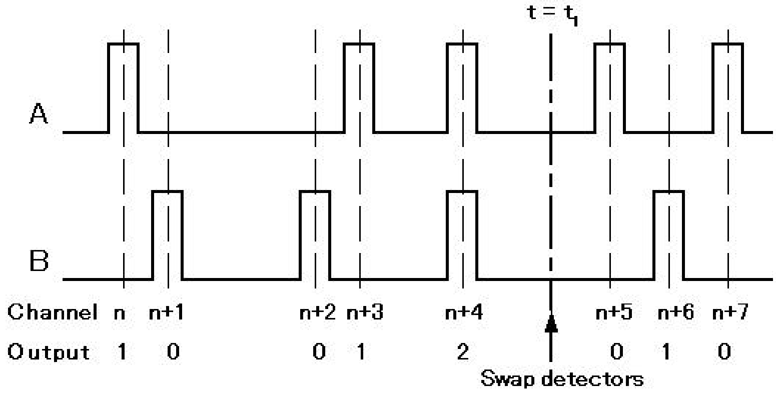

Fig. 2. Pulses recorded in 4096 channel scaler.

3. Discussion

Starting test measurements, we found that the electronic circuit is smoothly working for a few methods. But the counting rate is not so quick, because the ^{241}Am source of 0.1 mCi is not strong and distance between the source and detectors longer than 10mm are not short enough.

This method shown in this report is applied to not only binomial random numbers but also decimal ones. Since this method can directly generate uniform random numbers, this method fits the on line random number generation.

REFERENCE

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RÉSUMÉ

Nous présentons un système nouveau pour produire physiquement des nombres aléatoires usant des radiations isotropiques.