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A New Multiplexing Method for SiPM Using a Deep Learning Architecture

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Many studies have been conducted to reduce the number of SiPM readout channels in the nuclear medicine systems. We recently proposed a shaping resistive network using artificial neural network, which can reduce the output channels to one channel. This method generates output signals with different decay time and combines them into a single output. The single output is separated back into their original signals using deep learning. However, it has difficulty in signal separation since decay time difference alone cannot clearly represent the features of each channel. To solve the problem, we proposed a new multiplexing method for SiPM using a deep learning architecture. The method can be divided into two parts: 1) the pre-processing circuit that produces distinct features for each channel and 2) the deep-learning architecture that separates the summed signal into their original signals. The signal separation performance of the method was evaluated by comparing it with shaping resistive network. Using a singles pixel detector (GAGG-SiPM), the proposed method showed a mean absolute percentage error of 0.61% in photopeak voltage before and after deep learning. Energy resolution improved by 0.94 percent points (%p) compared to original signal. On the other hand, the shaping resistive network has a mean absolute percentage error of 1.02%, twice as large as the proposed method. And energy resolution was poorer by 1.07%p than before. In addition, this method can sufficiently discriminate signals even with a short signal length difference compared to shaping resistive network. These results show that the proposed method has better signal separation performance than the previous method. During the presentation, we will apply the method to a SiPM array to verify multiplexing performance.

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