Abstract

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Validation of Artificial Neural Network Systems for Neutron Detection in a Mixed Neutron-Photon Environment

The ability of stilbene organic scintillators to simultaneously detect gamma rays and neutrons can present great challenges in environments where one radiation type is more prevalent than another, such as in photon induced active interrogation (AI). The neutron count rates in such environments cannot be estimated with the desired accuracy using traditional charge integration (CI) methods. To address this challenge, an artificial neural network (ANN) system is developed. This system works in two steps. The first step is identifying photon, neutron, and piled-up pulses and the second step is to take the piled-up pulses and attempt to reclassify each part of these pulses.

The performance of the ANN system is validated using data collected from a spontaneous fission source; Cf-252. To replicate photon induced active interrogation like scenario, the neutron source is measured in presence of high photon field created using gamma check sources. The photon field is gradually increased by moving the gamma sources closer to the detector while maintaining fixed neutron source to detector separation. The results, from ANN and traditional CI, showed a constant neutron count rate while photon count rate increasing with gamma sources moving closer to the detector. At higher processing threshold (210 keVee), the neutron count rates from ANN agrees quite well than those obtained through the traditional CI methods.