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Application of Nonnegative Tensor Factorization for neutron-gamma discrimination of Monte Carlo simulated fission chamber's output signals

For efficient exploitation of research reactors, it is important to discern neutron flux distribution inside the reactor with the best possible precision. For this reason, fission and ionization chambers are used to measure the neutron field. In these arrays, the sequences of the neutron interaction points in the fission chamber can correctly be identified in order to obtain true neutron energies emitted by nuclei of interest. However, together with the neutrons, gamma-rays are also emitted from nuclei and thereby affect neutron spectra. The originality of this study consists in the application of tensor based blind source separation methods to extract independent components from signals recorded at the fission chamber preamplifier's output. The objective is to achieve software neutron-gamma discrimination using Nonnegative Tensor Factorization tools. For reasons of nuclear safety, we first simulate the neutron flux inside the TRIGA Mark II Reactor using Monte Carlo methods under Geant4 platform linked to Garfield++. Geant4 simulations allow the fission chamber construction whereas linking the model to Garfield++ permits to simulate drift parameters from the ionization of the filling gas, which is not possible otherwise.

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