Improving Image Reconstruction Capabilities in Neutron Tomography via Machine Learning

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Neutron tomography (NT) is an important non-invasive imaging technique that is particularly useful for characterizing hydrogenous and porous materials (see Figure 1). However, NT faces challenges such as lower-quality image reconstruction due to significant neutron scattering, lengthy scanning times, and limitations of conventional analytical and iterative reconstruction methods, especially with very thick material samples. Thus, this research aims to enhance NT image reconstruction by utilizing machine learning (ML) techniques, specifically artificial neural networks (ANNs). By incorporating experimental data and Monte Carlo simulations using the MCNP6.3 code, we will develop an effective ANN model capable of predicting material composition and object location with improved accuracy and efficiency despite a limited dataset. The study will focus on creating and training a multilayer perceptron network to process radiation transmission data and optimize reconstruction while minimizing streaking artifacts and computational costs. The proposed methodology is expected to greatly reduce acquisition and reconstruction times, which could improve upon conventional NT methods in terms of speed and precision.

Keywords: neutron tomography, neural networking, machine learning, Monte Carlo, MCNP

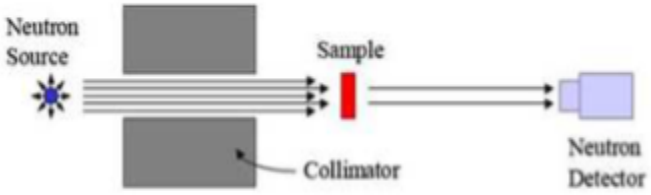

Figure 1 - Configuration for radiographic imaging system.