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Physics Informed Neural Networks for Neutron Transport in Large Sample Prompt-Gamma Activation Analysis

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Prompt-Gamma Activation Analysis (PGAA) measurement facilities for large samples have been intensively researched within the last years. Here, the interaction of the neutron flux field and the sample cannot be neglected. This leads to a nonlinear relation between the peak count rates and the elemental masses. Therefore, it is necessary to use an iterative evaluation procedure in this case. Within each iteration a full neutron transport simulation of the facility is required. Monte-Carlo methods enable accurate simulations of the neutron flux but they are also computationally expensive. Even though deterministic neutron transport calculations offer improved performance, the neutron transport simulations remain a computational bottleneck for the entire evaluation procedure. Neural Networks offer a promising alternative to classical methods. Once trained, the cost for executing a neural network is very low. In this talk, Physics Informed Neural Networks (PINNs) as solvers for the neutron transport equation are introduced. Instead of using large amounts of training data, these networks include physical information, in this case the neutron transport equation, in the training process. The potential benefits of the application of PINNs for large sample PGAA will be discussed, as well as future challenges.

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