INL/CON-24-76110-Revision-0

Utilizing Physics-Informed Synthetic Data to Train a Digital Twin for Predicting Reactor Operations

January 2024

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Prepared for the
U.S. Department of Energy
Under DOE Idaho Operations Office
Contract DE-AC07-05ID14517

Understanding techniques to strengthen the nuclear nonproliferation regime is crucial in reducing the creation of nuclear weaponry on the basis of advancements in the nuclear energy industry. Prior to construction of a nuclear power plant, it is necessary to understand the proliferation potential of the plant's reactor. Digital twins serve as a unique solution to recognizing reactor behavior indicative of nuclear proliferation. The following research conducted serves as a validation to training a digital twin on synthetic data fabricated via means of reactor physics simulations based on parameters of Idaho State University's AGN-201 reactor. The synthetic data is utilized to train a long short-term memory (LSTM) recurrent neural network model. The accuracy of the predicted data is measured against real operational data to verify the reliability of the synthetic data creation methods and if these methods should be used in the future to inform inspectors of a reactor's proliferation capabilities.