Machine Learning for Radiographic Source Optimization at Linear Induction Accelerators*

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Abstract: Adaptive machine learning (AML) techniques are being designed to use noninvasive diagnostic measurements to address the challenge of predicting the radiographic spot size, which depends on the accelerator performance and the conversion target.

The penetrating radiography provided by the Dual Axis Radiographic Hydrodynamic Test (DARHT) facility is a key capability in executing a core mission of the Los Alamos National Laboratory (LANL). A new suite of software is being developed in the Python programming language to support operations of the of two DARHT linear induction accelerators (LIAs). Historical data, built as hdf5 data structures for over a decade of operations, are being used to train machine learning models to assist in beam tuning. Adaptive machine learning (AML) techniques that incorporate physics-based models are being designed to use noninvasive diagnostic measurements to address the challenge of predicting the radiographic spot size, which depends on the time variation in accelerator performance and the density evolution of the conversion target. Pinhole collimator images recorded by a gamma ray camera (GRC) provide a direct measurement of the radiograph imaging quality but are not always available. A framework is being developed to feed results of these invasive measurements back into the accelerator models to provide virtual diagnostic measurements when these measurements are not available.

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