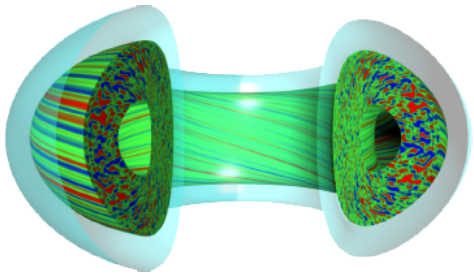

Contribution ID: **51** Type: **Regular Oral**

Progress in the Application of Machine Learning and Artificial Intelligence To Enhance EFIT Equilibrium Reconstruction for Fusion Data Analysis and Real-Time Applications

Thursday, 2 December 2021 12:55 (15 minutes)

Recent progress in harnessing novel machine learning (ML) / artificial intelligence (AI) algorithms to enhance EFIT equilibrium reconstruction for fusion data analysis and real-time applications is presented. This includes development of a ML-enhanced Bayesian framework to automate and maximize information from measurements and Model-Order-Reduction (MOR)-based ML models to efficiently guide the search of solution vector. A device-independent portable core equilibrium solver has been created to ease adaptation of ML enhanced reconstruction algorithms. An EFIT database comprising of DIII-D magnetic, motional Stark effect (MSE), and kinetic reconstruction data is being generated for developments of EFIT-MOR surrogate models to speed up the search of solution vector. A parallel Python framework is used to construct input and output vectors for communication with the equilibrium database and training of EFIT-MOR surrogate models. Approaches to improve portability between the OpenMP and GPU EFIT versions are being explored on Linux GPU clusters and the new NERSC Perlmutter to create a performance-portable GPU implementation for further optimization of ML/AI based reconstruction algorithms. Other progress includes development of a Gaussian-Process Bayesian framework to improve processing of input data, and construction of a 3D perturbed equilibrium database from toroidal full MHD linear response modeling with the MARS-F MHD code for developments of 3D-MOR surrogate models.
Work supported by US DOE under DE-SC0021203, DE-SC0021380, and DE-FC02-04ER54698.

Country or International Organisation

United States of America

Affiliation

General Atomics

Primary author: LAO, Lang (General Atomics)

Co-authors: Dr AKCAY, Cihan (General Atomics); Dr BECHTEL, Torrin (General Atomics); Dr LIU, Yueqiang (General Atomics); Dr MCCLENAGHAN, Joseph (General Atomics); Mr OROZCO, David (General Atomics); Mr SCHISSEL, David (General Atomics); Dr KRUGER, Scott (TechX); Dr HOWELL, Eric (TechX); Mr LEDDY, Jarrod (TechX); MADIREDDY, S (Argon National Laboratory); BALAPRAKASH, P (Argon National Laboratory); KOO, J (Argon National Laboratory); WILLIAMS, S (Lawrence Berkeley National Laboratory); LEINHAUSER, M (University of Delaware); Dr PANKIN, A (Princeton Plasma Physics Laboratory)

Presenter: LAO, Lang (General Atomics)

Session Classification: Thursday 2 Dec

Track Classification: Inverse Problems