Abstract Submitted
for the DPP20 Meeting of
The American Physical Society

Machine learning modeling and analysis of temperature and density profiles on NSTX and NSTX-U[1] JASON CHADWICK, Carnegie Mellon University, MARK D. BOYER, Princeton Plasma Physics Laboratory — Accurate real-time fusion plasma modeling is critical to implementing reliable control systems in present-day and future tokamak reactors. Physics-based approaches such as TRANSP can accurately model profile evolution of tokamak plasmas, yet are too computationally intensive for use in real-time controls. To address this, a machine learning based approach to modeling density and temperature profiles has been developed and tested on the NSTX experimental database. The model predicts the shape of the electron density and temperature profiles based on scalar quantities that can be measured and/or predicted in real-time, e.g, plasma boundary shaping and plasma current. This approach is orders of magnitude faster than comparable TRANSP predictions and shows potential for use in optimization algorithms. Different neural network architecture designs are evaluated for accuracy and the number of samples required for model convergence is determined. Challenges in predicting scenarios beyond the training space, such as predicting future shots based on past data, are discussed and potential solutions are tested.

[1]U.S. Department of Energy SULI program

Jason Chadwick
Carnegie Mellon University

Date submitted: 09 Jul 2020

Electronic form version 1.4