Abstract Submitted
for the DPP20 Meeting of
The American Physical Society

Scenario trajectory planning for NSTX-U using machine-learning-accelerated models and genetic optimization[1] MARK BOYER, Princeton Plasma Physics Laboratory, JASON CHADWICK, Carnegie Mellon University, STAN KAYE, Princeton Plasma Physics Laboratory — Between-shots and real-time actuator trajectory planning will be critical to achieving reliable high performance scenarios in present-day tokamaks, ITER, and beyond. A requirement for this effort is the availability of models that are accurate enough for useful decision making and fast enough for optimization algorithms to meet between-shots and real-time deadlines. While integrated modeling codes are progressing toward the accuracy and completeness needed for these applications, they are too computationally intensive for this purpose. To address this, a novel accelerated simulation capability has been developed for NSTX-U by applying machine learning techniques to both empirical data and TRANSP simulations, enabling profile and equilibrium predictions at real-time relevant time scales. The approach includes machine learning surrogates for high-fidelity TRANSP modules that accelerate calculations by orders of magnitude while maintaining fidelity. For quantities not accurately modeled by TRANSP modules, machine learning is applied to an experimental database to create empirical models. Initial results trajectory optimization using the learning-based model are presented, including a strategy for mitigating the effect of leaving the validity range of the model.

[1]Supported by the US DOE Contract No. DE-AC02-09CH11466 and US DOE funding for the Summer Undergraduate Laboratory Internship (SULI) program.

Mark Boyer
Princeton Plasma Physics Laboratory

Date submitted: 29 Jun 2020

Electronic form version 1.4