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Physics and Machine Learning Based Approaches to Stability Analysis and Control on DIII-D RORY CONLIN, JOSEPH ABBATE, Princeton University / PPPL, KEITH ERICKSON, PPPL, ALEXANDER S. GLASSER, EGEMEN KOLEMEN, Princeton University / PPPL — We have developed a neural network to predict the evolution of plasma profiles on confinement time scales (200 ms) using experimental data from DIII-D. This machine learning model can be used to predict future values of the profiles in real time using available diagnostic measurements and a set of proposed actuator inputs. This predictive model can be used for real time model predictive control of the plasma profiles. We demonstrate a first of its kind controller using this neural network and show its ability to accurately control the profiles in tests on DIII-D. We also demonstrate the use of real time physics based stability analysis using a parallel implementation of the STRIDE code, and its use for predicting ideal MHD instabilities. When combined together, the physics based stability analysis and machine learning based controller allow for the possibility of actively controlling the plasma to mitigate and prevent instabilities before they happen. Work supported by US DOE under DE-FC02-04ER54698, DE-AC02-09CH11466 and DE-SC0015878.

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