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Machine learning plasma profile prediction for model-predictive control at DIII-D[1] JOSEPH ABBATE, Princeton Plasma Physics Laboratory, WILLIAM CONLIN, Princeton University, KEITH ERICKSON, Princeton Plasma Physics Laboratory, EGEMEN KOLEMEN, Princeton Plasma Physics Laboratory, Princeton University — At DIII-D, operators are able to control plasmas through a variety of "actuators" during shots: from neutral beams that heat and rotate the plasma, to coils which induce plasma current. Experimental proposals entail physicists specifying a desired plasma "state" of interest, which can be described by profiles of density, temperature, pressure, safety factor (q), and rotation. Operators and physicists usually work together to pre-specify a "path" of actuator signals through time that will successfully realize the state, using feedback control for realtime adjustments. However, the process of finding a successful actuator path is difficult and entails a lot of trial-and-error. "Model-predictive control" could make this process more efficient, saving physicists time and ensuring more successful physics experiments during future DIII-D campaigns. In model-predictive control, a realtime model predicts the way the plasma state will evolve given various settings on actuators, then chooses settings which yield the plasma state closest to the physicist's desired end-state. Realtime physics models are not always accurate for regimes of interest. We therefore developed a machine-learning model which generates a single prediction in under 100 microseconds, using only realtime diagnostics. Comparisons of predicted and measured profile evolution during various realtime experiments at DIII-D are made, and the algorithm used by the model to select the actuator path in realtime is discussed.

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