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Machine Learning methods for forecasting error-field locking in tokamak plasmas CIHAN AKCAY, JOHN FINN, Tibbar Plasma Technologies, Inc, DYLAN BRENNAN, Princeton University — The resonant interaction of a rotating tokamak with an error field can lead to locking, one of the leading causes of disruptions. Here, we train a series of machine learning (ML) classifiers to predict locking events, as a real-time forecasting tool for disruptions. We use a simple coupled third order ODE model to represent the interaction of the magnetic perturbation with the error field, in order to rapidly generate the training data for the ML algorithms. This model qualitatively captures the characteristic locking and unlocking bifurcations. The dependent variables of the ODE are the magnitude of the reconnected magnetic flux, its phase relative to the error field, and the plasma rotation, all at the mode rational surface. These three *order parameters* completely characterize locked and unlocked states and form the features of the ML training. The *control parameters* are the magnitude of the error field and the rotation frequency associated with the momentum source that maintains the plasma rotation in the absence of a magnetic perturbation. We use ML methods to classify locked and unlocked states, and to estimate the probability of locking in the region of control parameter space with hysteresis, where both locked and unlocked states co-exist.

Cihan Akcay
Tibbar Plasma Technologies, Inc

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