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Time-to-Disruption Estimation Using LSTM Networks

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The application of machine learning methods has aided to improve the accuracy of disruption predictors in the last 15 years. However, these models are normally just a trigger and they do not provide a crucial piece information: the remaining time to the disruption. This is detrimental for their practical utility in order to develop efficient control actions.
This study tackles this limitation by employing Long Short-Term Memory (LSTM) recurrent neural networks to estimate the time from the detection of a precursor until disruption occurrence based on the alarms activated by an existing predictor trained with data from the Joint European Torus (JET). To this end, first, we trained the LSTM system on two intervals: "mitigation"(for imminent disruptions) and avoidance/prevention (for alarms triggered with a warning time > 100 ms), achieving classification accuracies above 87%. Second, a more detailed classification into three timeframes (mitigation, avoidance and prevention) further demonstrates the robust detection capabilities of the classification system, as detailed in the confusion matrix of Figure 1.
This methodology can improve the outcomes of existing predictive models by providing essential supplemental information. This strategy can be applied into any other machine learning-based disruption predictor.

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Session Classification: Prediction & Avoidance

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