

Review of a data-driven adaptive disruption predictor for mitigation based on a nearest centroid approach

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Any disruption mitigation system requires a trigger to trigger the corresponding remedial actions. Such trigger is the final step of a chain of events. This chain starts with an alarm that recognises an incoming disruption followed by interlocks protecting particular systems (for example, plasma heating systems). This contribution is a review of a specific disruption predictor that is installed in JET. The predictor uses only one signal, the mode lock normalised to the plasma current (NML), and its feature space, in which the separation frontier between disruptive and non-disruptive behaviour is linear, is two-dimensional. The linear frontier is defined based on two centroids, where each one summarises the disruptive and non-disruptive behaviours of past discharges, respectively. From a conceptual point of view, the predictor recognises a disruptive behaviour when large differences between consecutive samples of the NML appear. The predictor is installed in the JET real-time network from June 2019 (in open loop). The real-time predictions analysed so far confirm the following positive characteristics: fully deterministic (the running time of the algorithm for each prediction is less than 10 μ s), not based on a simple threshold but on differences of amplitudes, easy physics interpretation (not a black-box), success rates above 96%, false alarm rates about 4%, most of the alarms very close to the disruption (26% of alarms within 10 ms) and average warning times of about 100 ms (can be smaller if assertion times are set-up). Off-line analyses with several databases (JET with C-wall, JET with ILW and JT-60U) have shown full compatibility with an adaptive development from scratch with about 10 re-trainings when tested in more than 1200 discharges. Re-trainings are performed after missed alarms. These properties make the predictor a potential candidate to be used as disruption predictor in ITER for mitigation purposes.

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