On the transfer of adaptive predictors between different devices for both mitigation and prevention of disruptions

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Abstract:

Notwithstanding the efforts exerted over many years, disruptions remain a major impediment on the route to a magnetic confinement reactor of the tokamak type. Machine learning predictors, relying on adaptive strategies, have recently proved to achieve very good performance. Even if their last generation implement a 'from scratch' approach to learning, i.e. they can start predicting after the first example of each class (safe and disruptive), it would be extremely useful to profit from the experience of previous devices, when new machines come on online, to reduce excessive errors at the beginning of the learning process. In this paper, adaptive predictors, based on ensemble classifiers, have been operated on a series of AUG campaigns and then they have been deployed on several JET campaigns with the ILW, all together covering more than order of magnitude in plasma current. The criteria to normalise the signals and to translate the parameters of the predictors from one device to the other are discussed in detail. With regard to mitigation, the overall performance, both in terms of success rate and false alarms, are quite positive (98% success rate and only 1.9% false alarm rate). Encouraging results have also been obtained for prevention (94.2% success rate and only 7.7% false alarm rate), by providing as inputs to the classifiers appropriate profile indicators. Even if they require significant refinements, adaptive predictors, capable of capitalising on the experience of smaller devices, have therefore become a serious candidate for deployment in the next generation of machines.