Overview of real-time disruption prediction in JET: applicability to ITER

J. Vega1, A. Murari2, S. Dormido-Canto3, D. Alves4, G. Farias5, J. M. López6, R. Moreno1, A. Pereira1, J. M. Ramírez3, G. A. Rattá1 and JET-EFDA Contributors *

JET-EFDA Culham Science Centre, Abingdon, OX14 3DB, UK
1 Laboratorio Nacional de Fusión. CIEMAT, Madrid, Spain
2 Consorzio RFX, Padova, Italy
3 Dpto. Informática y Automática. UNED, Madrid, Spain
4 Instituto de Plasmas e Fusão Nuclear – Laboratório Associado, IST, Lisboa, Portugal
5 Pontificia Universidad Católica de Valparaíso, Valparaíso, Chile
6 Universidad Politécnica de Madrid. CAEND UPM-CSIC. Madrid. Spain

*See the Appendix of F. Romanelli et al., Proceedings of the 24th IAEA Fusion Energy Conference 2012, San Diego, USA

Avoidance and mitigation of disruptions are crucial problems in ITER and are becoming increasingly relevant at JET with the installation of the new ITER-Like Wall (ILW). This work describes the evolution of our research line regarding disruption prediction at JET and the potential applicability to ITER. Three main research topics have been tackled. The first one has been the development of a real-time Advanced Predictor of DISruptions (APODIS) able to operate during the total duration of a discharge and capable of predicting any type of disruption (ITER relevant). APODIS was trained with 8360 discharges (of which 474 disrupted) corresponding to C wall campaigns and it was installed in the JET real-time network to be used in ILW experiments. After the first 3 JET ILW campaigns (991 discharges), the success rate of the predictor is 98.36% (alarms are triggered, on average, 426 ms before the disruptions. The minimum time in JET to take mitigation actions is 30 ms). The false alarm and missed alarm rates are 0.92% and 1.64% respectively. The second research topic is related to the fact that ITER cannot wait for hundreds of disruptions to train a predictor. In order to address this issue, we have developed two different types of predictors from scratch (ITER relevant). These predictors start operating from the first disruption and show a success rate of 94%, a false alarm rate of 2% and an average warning time of 654 ms. The last research topic has been the development of predictors whose outputs provide, together with the alarm, the estimated time until the disruption (ITER relevant). The success rate is 99.1%, the false alarm rate is 1.88% and the time to disruption is 164±60 ms. The maximum and minimum prediction times are respectively 359 ms and 128 ms.