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Frontiers in disruption prediction to address a fundamental problem for the safe operation of ITER and DEMO

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Disruptions are one of the most dangerous instabilities in Tokamak plasmas. If disruptions turn out to be unavoidable and impossible to control, Tokamaks would not be candidates to nuclear fusion reactors. The prediction of this kind of instabilities is a first step to deal with disruptions. Disruption predictors are binary classifiers that split a multi-dimensional parameter space into two regions (disruptive/non-disruptive) by means of a separation frontier. Real-time classifiers follow the plasma evolution with typical periods of ms and when the plasma is identified in the disruptive zone, an alarm is triggered. This article is an overview of the evolution of the state-of-the-art in disruption prediction during the last decade. Five aspects are analysed: conceptual design of predictors (from classical inductive/deductive classifiers to anomaly detectors), confidence measures (from bare predictions to probabilistic predictors with error bars), physics interpretability of separation frontiers (from extremely complex equations to linear separation frontiers), decision-making support about disruption handling (from disruption time predictors to specialised alarms for avoidance, prevention and mitigation) and implications for ITER and DEMO.

Biography

Jesús Vega was born in Madrid (Spain) in 1958. He is Full Professor at CIEMAT (Centro de Investigaciones Energéticas Medioambientales y Tecnológicas) in Madrid. His R&D activities are involved in the field of nuclear fusion, mainly in two nuclear fusion devices, JET (Joint European Torus, the largest fusion device in the world, located at Culham, UK) and TJ-II (located at CIEMAT). In particular, Prof. Vega teams have been involved in the prediction and classification of disruptions in tokamaks by means of machine learning methods. Jesús Vega is co-author of about 250 peer reviewed articles and has directed 13 PhD Thesis.