§6. HL-2A Tokamak Disruption Forecasting Based on an Artificial Neural Network

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Disruption in a tokamak is a sudden loss of confinement and subsequent transfer of plasma energy to the surrounding structure component. The force and heat loads, induced by disruption, may damage the machine walls and support structure. Thus, disruption prediction at a sufficient early time is important for taking measures to avoid the disruption or mitigate the unavoidable ones. Physically, disruptions have different causes, most of which have been identified but whose dynamics is not known in detail. Therefore, present experimental operation frequently relies on using human experience and often the disruption cannot be avoided or predicted and mitigated at all. As a result, some new methods are designed to forecast the plasma disruption. Most of them are based on the artificial neural network (ANN). For example, the off-line or on-line network disruption predictors have been developed in TEXT, ADITY, DIII-D, JET, JT-60U, and ASDEX-U. Using a time series approach in TEXT carried out early disruption prediction of ANN. The network trained with one disruptive and one successful pulse could predict the disruption 1ms in advance. The ADITYA tokamak prediction used a similar method, but the network has been extended to more input signals in order to improve the prediction capability of the system. As a result, it is able to give predictions 8ms before a disruption. In addition, the high β disruption boundary was modeled in DIII-D with more input signals and more neurals. In both JET and JT-60U, disruption alarms were trained to distinguish between pre-disruptive plasmas and stable plasmas. Moreover, the network of ASDEX-Upgrade was trained to calculate the time to disruption. All of them have gotten excellent results.

In the present work, we discuss firstly the attempt of disruption prediction carried out in the HL-2A tokamak, using artificial neural network. A new neural model is set up on the basis of the diagnostic signals' characteristics in the HL-2A plasma. It is able to relax the time and spatial resolution requirements of diagnostic signals. The results show the possibility of developing a neural network predictor that intervenes well in advance in order to avoid plasma disruption or mitigate its effects in the HL-2A tokamak.

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