DEVELOPMENT OF RECOGNITION METHODS for precursors in vector signals

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Requirements to data processing systems grow with the development of methods and techniques for diagnostics of high-temperature plasma parameters. Data processing task is substantially more complicated when the result should be formed in real time and used in loopback control circuit of some important equipment of the plasma machine. A similar situation occurs in the task of the controlled quench of the plasma discharge and to prevent or suppress the development of runaway electron beams. Based on processing of signals set of tokamak diagnostics one must to generate a signal in real time to start the plasma quench system or to suppress runaway electron beams, i.e. actually detect precursor trigger in diagnostic signals. On the one hand, the sooner will be generated start trigger, the lower the requirements to the systems of plasma quench and suppression of runaway electron beams, on the other hand, there is requirement to ensure an acceptable level of false alarms and misses of a time prediction system of a disruption [1, 2].

At various plasma devices are already in use such systems. The most striking example of such a system is APODIS, applied to the JET tokamak [3]. APODIS system predicts the plasma disruption due a few milliseconds to a probable event. The basic version of the system used at the input 7 of the diagnostic signals. Processing scheme consists of two layers of classifiers that are based on support vector machine. Each of the classifiers is trained using a database of training examples.

The support vector machine is a classification algorithm to distinguish between two classes of objects in n-dimensional feature space. Training procedure of this classifier is reduced to a quadratic optimization problem which is solved heuristically and can achieve a minimum value of a predetermined objective function. Additional mapping of source data in feature space are used for the construction of non-linear classifiers.

The report examines the possibility of using as input not only the registered signals, and calculated values, which are functionally dependent on the directly measured data. This allows you to adjust the classifications according to data which more fully describes the physical processes underlying the predicted events. Construction of functional dependencies is performed using the method of symbolic regression, which is the scheme for constructing a regression model by trying arbitrary superpositions of functions in a given set. Such data processing schemes are used in other fields, for example, during processing of an electroencephalographic signals [4].

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References

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