ELECTROMAGNETIC SIGNAL INTEGRITY ASSESMENT BY NEURAL NETWORK ANALYSIS FOR THE RFX-MOD EXPERIMENT

R. S. Delogu, D.Terranova

Consorzio RFX, Associazione Euratom-ENEA sulla Fusione, Corso Stati Uniti, 4, I-35127 Padova, Italy

Corresponding author: rita.delogu@igi.cnr.it

ABSTRACT

The RFX-mod electromagnetic (EM) measurement system is constituted of 744 independent probes whose signals are electronically conditioned by an integration/amplification (I/A) section [1].
During the experimental sessions the probes integrity is verified by a series of post-shot check-algorithms by means of a software which determines if a probe is still working or not and corrects off-sets and drifts, but no method, apart from the visual inspection of a signal, is available to recognize if the corresponding channel in the I/A section is on the verge to fail.
For this purpose, a Neural Network (NN)-based approach has been applied. A NN is trained to forecast the time signal of the probes, and the weights of the connections are used to detect the quality of the I/A channel under test. With the classic approach the behavior of the whole NN is observed when presenting a new pattern. Here a geometrical synthesis algorithm [2] has been adopted to build a time-delayed Multi Layer Perceptron (TD-MLP). This algorithm allows building MLP NN, taking under control the approximation error of the target. The basic idea of the proposed approach is that the behavior of the channel going to break affects the weights of the neural network in such a way the incoming fault can be recognized.
The NN is trained in batch mode to forecast the probe signal, and the weights are analyzed. In the on-line implementation, the training of the NN is updated sample by sample within each pulse acquisition; therefore the low complexity of the algorithm is crucial for the suitability of the method. From this point of view, the geometrical synthesis [2] allows to update the neural network by modifying only a limited number of weights, in this way saving calculation time.
A set of signals is used to develop and to test the diagnostic system. A statistical analysis is performed in order to determine the features of the weights matrices most suitable for the diagnosis.
The procedure has been applied to detect the incoming faults in the I/A channels of EM signals and the results will be presented in the paper.

[1] N.Pomaro, F.Basso "Transducers and signal conditioners of the RFX new magnetic measurement system" Fusion Engineering and Design, 74 (2005) 721-726.
[2] S.Carcangiu, A.Fanni, A.Montisci "A constructive algorithm of neural approximation models for optimization problems", COMPEL vol. 28, no. 5, pp 1276-1289, (2009)