Preface

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Biographical notes: Jesús Vega received his MSc in Physics from Universidad Complutense, Madrid, Spain and PhD from Universidad Nacional de Educación a Distancia, Madrid, Spain. He is working on nuclear fusion at CIEMAT, Madrid, Spain and he is very involved in the EURATOM Research Programme on fusion projects, mainly in the TJ-II stellarator and in the JET tokamak. He is the Head of the Data Acquisition Unit of the Spanish Fusion National Laboratory by Magnetic Confinement. In addition, he is the European Coordinator of the EFDA Data Analysis and Calibration Techniques Working Group. His previous research activities include plasma diagnostic techniques with soft X-ray radiation. At present, his research is focused on both remote participation systems and advanced data analysis methods. The latter is related to intelligent data retrieval methods and data mining techniques for massive databases in fusion.

This special issue is made up of contributions to the *FLINS 08 Conference*, principally from the special session devoted to 'New frontiers in data analysis methods for nuclear fusion: the transition from JET to ITER'. The main objective has been the promotion of advanced and innovative analysis techniques. In this respect, this special issue also contains articles from the fission community.

Owing to the complex nature of fusion plasmas, thousands of signals have to be acquired for each experiment in order to progress with the understanding that is indispensable for the final reactor. Data acquisition and analysis require solutions to reduce the sheer amount of data by different compression techniques and adaptive sampling frequency (Murari *et al.*).

Real-time processing needs the use of intelligent measurement instruments to implement similar waveform recognitions systems for the online extraction of knowledge from signals (De Arcas *et al.*).

Data retrieval based on pattern recognition is a central point in the massive databases of fusion devices. The search for long patterns has been optimised to find similar patterns in a fault-tolerant way (Pereira *et al.*).

Sometimes, as a consequence of the ill-conditioned nature of the measures, analytical solutions are not possible. This happens, for instance, with free unfolding in neutron spectroscopy. The energy spectra reconstruction cannot be done analytically and neural networks are applied (Ronchi *et al.*).

Monitoring of sensor operation is important to detect anomalies and reconstruct the correct values of the signals measured. This can be done with the aid of auto-associative regression models but with the difficulty of having to manage a large number of signals. A novel procedure has been proposed to obtain robust ensemble-aggregated outputs (Baraldi *et al.*). Two applications have been taken into account by considering the reconstruction of simulated signals of the Swedish Forsmark-3 boiling water reactor and the Finnish pressurised water reactor.

Human reliability analysis is a method to use for a particular safety assessment that is still a difficult problem. The quantitative evaluation of the results of simulations in terms of crew performance and human error probabilities is quite a difficult task. A fuzzy expert system for systematically assessing crew performance on a case study (a scenario of an incomplete scram in a boiling water reactor) has proved the feasibility of the method (Zio *et al.*).

The particle swarm optimisation with random keys model is applied for the in-core fuel optimisation of Angra 1. It is applied to a benchmark for combinatorial optimisation (Meneses and Schirru).

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