Foreword

Selected papers from the Third IAEA Technical Meeting on Fusion Data Processing, Validation, and Analysis

Guest Editor

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The Third International Atomic Energy Agency (IAEA) Technical Meeting on Fusion Data Processing, Validation, and Analysis (FDPVA) took place at the IAEA headquarters in Vienna, Austria, May 28–31, 2019. FDPVA brought together more than 60 scientists and engineers from 19 IAEA member states, the European Commission, and ITER Organization who work on data analysis and machine learning methods for the processing of fusion data, collected either from experimental diagnostics or from plasma simulations. FDPVA was chaired by D. Mazon (CEA) and organized by S. M. Gonzalez de Vicente (IAEA) as scientific secretary.

At FDPVA, 47 presentations were given by representatives from 23 institutions in 16 member states. Sessions were devoted to the following topics: (1) uncertainty propagation of experimental data in modeling codes; (2) data analysis lessons learned, best practices, and proposals for ITER; (3) regression analysis: profiles, scaling, and surrogate models; (4) learning in nonstationary conditions for experimental design and predictions; (5) inverse problems; (6) image processing; (7) causality detection in time series; (8) synthetic diagnostics, integration, verification, and validation; (9) deep learning; and (10) a final session for discussion and conclusions. In addition, a training course titled, "A Brief Overview of Probability Theory in Data Science" was provided on Monday, May 27, by G. Verdoolaege (Ghent University, Belgium). Complete information can be found on the FDPVA website at https://nucleus.iaea.org/sites/fusionportal/Pages/3rd%20TM%20on%20Fusion%20Data%20Processing/General-Information.aspx.

At FDPVA, new developments in fusion research and development applications in the following areas were discussed: inversion techniques, such as tomography; magnetic topology reconstruction, such as equilibrium reconstructions; system identification; scaling laws determination and their accuracy for extrapolation from current machines to fusion reactors; model-based algorithms for control applications; and identification of spurious and undesired events, such as disruptive phenomena or hot spots in infrared images using sophisticated mathematical techniques like neural networks and support vector machines.

Discussions also focused on the potential use of these techniques for ITER, in particular on their relevance to the first ITER plasma. The use of IMAS (Integrated Modeling & Analysis Suite) infrastructure—a convenient platform that allows implementation of different simulation codes in the same format—and synthetic diagnostics that could be coupled with this structure, in order to test the different mathematical approaches developed by the meeting participants, were explored in detail. Recent results and progress in the development of new tools will be discussed during the next meeting on the topic, scheduled for 2021.

In the meantime, please enjoy this special issue of *Fusion Science and Technology*.