Simulation & high performance computing - building a predictive capability for Fusion

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The Integrated Tokamak Modelling Task Force (ITM-TF) is charged with "coordinating the development of a validated suite of simulation tools for ITER and DEMO plasmas". The level of modelling needed in support of ITER operation and analysis is assumed to be much higher than on current devices and, in particular, validation of experimental proposals before acceptance is expected. In the longer term, the aim for DEMO is to be able to use modelling and simulation as an integral engineering tool in the design activity. This is a very challenging task which poses severe demands on the experimental validation and testing on existing devices of the developed codes and involves a broad range of activities. In addition to adopting different physics components, an infrastructure allowing for the transparent use of tools to model existing devices is needed.

The ITM-TF is developing an infrastructure where the validation needs, as being formulated in terms of multi-device data access and detailed physics comparisons aiming for inclusion of synthetic diagnostics in the simulation chain, are key components. As the activity and the modeling tools are aimed for general use, although focused on ITER plasmas, a device independent approach to data transport and a standardized approach to data management (data structures, naming, and access) is being developed in order to allow cross validation between different fusion devices using a single tool set. Extensive work has already gone into, and is continuing to go into, the development of standardized descriptions of the data (Consistent Physical Objects). The longer term aim is a complete simulation platform which is expected to last and be extended in different ways for the coming 30 years. The technical underpinning is therefore of vital importance. In particular the platform needs to be extensible and open-ended to be able to take full advantage of not only today's most advanced technologies but also be able to marshal future developments.

As a full level comprehensive prediction of ITER physics rapidly becomes expensive in terms of computing resources, the simulation framework needs to be able to use both grid and HPC computing facilities. Hence data access and code coupling technologies are required to be available for a heterogeneous, possibly distributed, environment. The developments in this area are pursued in a separate project - EUFORIA (EU Fusion for ITER Applications) which is providing about 15ppy per annum from 14 different institutes.

The range and size of the activity is not only technically challenging but is providing some unique management challenges in that a large and geographically distributed team (a truly pan-European set of researchers) need to be coordinated on a fairly detailed project level. The 2009 Work programme of ITM-TF organizes 240 individuals from 24 different associations providing about 60ppy in total. Remote participation and collaborative tools and facilities as the ENEA sponsored Gateway have proven indispensable to meet this challenge.

The current status of ITM-TF and EUFORIA is presented and discussed.

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