Contribution ID: **169** Type: **Poster**

EX/P3-12: Real-time Model-based Reconstruction and Control of Tokamak Plasma Profiles

Wednesday, 10 October 2012 08:30 (4 hours)

A new paradigm for real-time plasma profile reconstruction is demonstrated in the TCV tokamak. Predictions based on physics models are merged with available real-time diagnostic data to construct a self-consistent profile state estimate compatible with a time-dependent model of transport processes in the plasma. This is enabled by a new RApid Plasma Transport simulatOR (RAPTOR), implemented in the new TCV real-time control system. RAPTOR simulates the radial current diffusion including the ohmic coil transformer voltage and non-inductive sources in real-time, while the plasma physically evolves in the tokamak. This makes available an extensive set of quantities which are normally not known in real-time such as the bootstrap current fraction, safety factor, magnetic shear and loop voltage profiles. This approach represents a generalization of existing approaches for real-time equilibrium reconstruction with measurement-constrained current density profile, as transport physics knowledge is now included in the reconstruction.
The same rapid transport code is also used in predictive mode, including a model of the electron temperature evolution, for off-line studies of optimal actuator trajectories during plasma ramp-up scenarios. Constraints are included in the optimization to reflect realistic operational limits. These studies show that a plasma current overshoot combined with appropriately timed heating are beneficial for rapidly reaching a stationary q profile with flat central shear. The demonstration of this new paradigm paves the way for further integration of real-time tokamak plasma simulations for prediction, scenario monitoring, disruption avoidance and feedback control.

This work was supported in part by the Swiss National Science Foundation

Country or International Organization of Primary Author

Netherlands

Primary author: Mr FELICI, Federico (Netherlands)

Co-authors: Dr DUVAL, Basil (CRPP-EPFL Association Euratom-Suisse); Mr HOMMEN, Gillis (TU Eindhoven/FOM-DIFFER Association Euratom-FOM); Dr MORET, Jean-Marc (CRPP-EPFL Association Euratom-Suisse); Prof. STEINBUCH, Maarten (Eindhoven University of Technology); Prof. DE BAAR, Marco (TU Eindhoven/FOM-DIFFER association Euratom-FOM); Dr SAUTER, Olivier (CRPP-EPFL Association Euratom-Suisse); Mr VOORHOEVE, Robbert (Eindhoven University of Technology); Dr CODA, Stefano (CRPP-EPFL); Dr GOODMAN, Timothy (EPFL - CRPP)

Presenter: Mr FELICI, Federico (Netherlands)

Session Classification: Poster: P3

Track Classification: EXC - Magnetic Confinement Experiments: Confinement