



Contribution ID: 95

Type: **not specified**

T-15MD tokamak plasma control platform architecture

Monday, 17 September 2018 11:00 (2 hours)

A key feature of the developed T-15MD tokamak Plasma Control System (PCS) is its ability to rapidly design, test and deploy real-time shot scenario algorithms. PCS platform consist of two levels:

1. High application-specific level: model development and linear approximation, calculation of the experiment scenario, controllers design and experiment simulation (Mathlab Simulink RT high-performance computer);
2. Process control level: real-time control of plasma parameters (National Instruments hardware running LabView RT operating system).

In the Hardware-in-the-Loop simulation mode communication between the levels (1) and (2) is realized by the reflective memory (RFM) "star" topology network and the middleware S-function package within Simulink RT environment. RFM providing a deterministic real-time method of sharing memory between the systems. The proposed architecture of the platform allows to perform testing and configuration of the PCS before plasma shots, which increases the efficiency of the experiments while reducing costs. In future, the plan is to use the high-performance computer Simulink RT to perform real-time calculations of plasma reconstruction and equilibrium in the magnetic control loop, implementing PCS data exchange in the RFM network. It is planned to develop infrastructure for simplified integration and testing of third-party control algorithms and plasma-physical codes.

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Session Classification: P1

Track Classification: Plasma Engineering and CODAC