

Application of RTF Architecture in EAST Radiation Control Subsystem

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The Experimental Advanced Superconducting Tokamak (EAST) was built to demonstrate high-power, long-pulse operations under fusion-relevant conditions, which has ITER-like fully superconductive coils and water-cooled tungsten (W) mono-block structure. In order to construct distributed real-time subsystems for control and verify the performance of real-time framework (RTF) of ITER, the radiation control subsystem independent of the plasma control system (PCS) was designed and implemented based on the ITER RTF. To calculate the radiation power for PCS feedback control during discharge, this subsystem needs to communicate with the Central Control System for discharge information, acquire diagnostic signals to calculate the radiation power and exchange data with PCS during each control cycle, and store data to Mdsplus for further analysis. Besides, a friendly Graphics User Interface (GUI) is also necessary to set parameters. Corresponding to the above requirements, four RTF function blocks are designed, namely: communication function block, data acquisition function block, radiation calculation function block, and data storage function block. The communication function block can realize the slow data communication with Central Control System through Socket or fast data transmission with PCS through reflective memory network (RFM). The acquisition function block acquires 64 channels of absolute extreme ultraviolet (AXUV) signals synchronously in 20KHz using D-TACQ196 digitizer. The radiation calculation function block calculates the radiation power using AXUV signals and plasma boundary data which is read from PCS through RFM. All data generated by the acquisition and calculation function blocks are segmental saved in real time to Mdsplus tree in the data storage function block. The development of such subsystem in RTF architecture has been completed with the GUI written in Python. The benchmark test using history data was carried out, and the radiation calculation result is consistent with the historical data, which verified the effectiveness of each function blocks and the availability of hardware devices. In the 2021 EAST operation campaign, the subsystem will be applied for radiation power calculation, which is the first attempt of RTF on EAST.

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