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Design, integration and testing of the ITER magnetics diagnostics embedded processing system

The ITER magnetics diagnostics will condition, validate, and supply magnetic sensors outputs to key operational systems, including the plasma control system (plasma position, shape, vertical velocity and MHD instabilities); the interlock system (plasma current for machine protection) and the data-archiving system for post-pulse data analysis (study of the plasma physics).

A combination of bespoke electronics, FPGA signal processing and the MARTe2 framework are at the core of the embedded system. Magnetic sensor output signals are acquired by integrator boards, real-time processed and validated on a system-on-a-module by a tightly coupled FPGA and a four ARM Cortex-A53 Processing System (PS).

The PS runs several instances of the MARTe2 framework in asynchronous multi-processing configuration. Three independent MARTe2 instances are devoted to the integrator signal processing, to the platform telemetry and management and to the publishing of the data in the real-time networks. Two porting versions of MARTe2 were specifically developed, one running on bare-metal and the other using the FreeRTOS operating-system. The first implements integrator data processing, while the latter provides supervisory and telemetry access. Several software components were developed to allow the asymmetric multi-processing and sharing of data between the different cores, as well as the required coherency and synchronisation mechanisms.

This paper describes the detailed design of the embedded Processing System, including the interface with the FPGA, the real-time data processing algorithms, the network interfacing, and the inter-processor data sharing components. This work also includes the most relevant implementation details and is concluded with a survey of the performance measurements.

Minioral

Yes

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No

Are you a student?

Yes

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