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Development of real time framework for parallel streaming data processing

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This paper presents the KSTAR (Korea Superconducting Tokamak Advanced Research) real time framework for parallel streaming data processing framework (RT-ParaPro). RT-ParaPro is a framework used to develop programs that simultaneously process streaming data transmitted over a real-time network and send data over a network and archive them in real time. In most fusion experimental devices, each device processes the data needed for real-time control and transmit them to the PCS in real time via the network. In KSTAR, Reflective Memory (RFM) and ITER Synchronous Databus Network(SDN) are used as a real-time network. Through these network, KSTAR devices acquire the data for real-time control, process it, and share processing results with other devices through this network. By using RT-ParaPro, it is possible to simplify the configuration of a program that performs a series of processes and shorten the development time. As opposed to other real-time frameworks that focus on real-time control, RT-ParaPro is specialized in the parallel data processing, archiving and transmission of data over a real-time network. This framework consists of pairs of thread and buffer which implements parallel producer/consumer design pattern. Each thread is able to set the attributes needed to have real-time properties (CPU affinity, period, policy etc). Each thread is configured to share data using a ring buffer. Control thread controls each thread in accordance with user command or shot sequence. Control thread also manage life cycle of each threads by using control Finite State Machine (FSM). This framework is configured to send parameters and commands via EPICS channel access. and each thread is configured to be synchronized through an event for thread synchronization. By using this framework, LHML, which determines whether plasma is L-mode or H-mode in real time by using machine learning, and RFM Archiving system, which stores various RFM channel data to Mdsplus, has been developed and operated in KSTAR. To evaluate the real time performance of this framework, we tested the consistency of thread period by varying the period of the thread (1kHz,2kHz,5kHz,10kHz,100kHz). The test shows that the thread control period is consistent. The period of the thread has a jitter of about 176 usec not only in the low control cycle rate (1kHz) but also in the control cycle rate of 100kHz.

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