

§13. Ultra-Wideband Data Acquisition and Real-Time Data Streaming in LHD Steady-State Experiments

Nakanishi, H., Ohsuna, M., Kojima, M., Nonomura, M., Imazu, S. (Pretech Corp.)
LABCOM Group

In the 8th campaign of LHD experiment in 2004-2005, the steady-state plasma discharges had been practically held, and their longest duration went over one hour. The LHD data acquisition system, namely LABCOM system, had established a new world record of the acquisition data amount 84.0 GB in a single plasma discharge, which broke by far the previous record of 3.16 GB/shot in LHD's 7th c.

Drastic Growth of LHD Plasma Diagnostics

Most of this data amount has been produced by the new real-time digitizers, therefore, the world record has also proved their practical usefulness very well. In recent few years, we has been preparing for the brand-new digitizer systems that can continuously run in steady-state operations. (See Fig. 1).

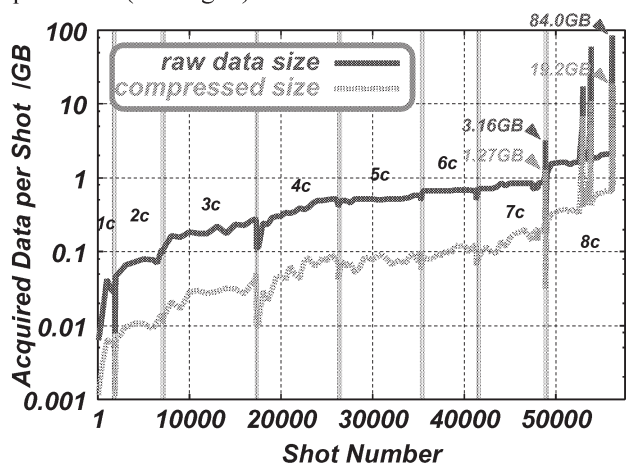


Fig. 1 Growth of shot-by-shot acquisition data amount in LABCOM system: At the end of 8th campaign, normal, i.e. short-pulse discharges produced about 2.5 GB/shot constantly.

Simultaneously with the growth of total data amount, we also have to deal with the increasing number of plasma waveforms with longer time duration. In LHD case, the real steady-state plasma experiments have much accelerated the technological shift from conventional batch processing digitizers to real-time capable ones. At the end of 8th campaign, LHD has 15 real-time diagnostics in addition with the present 30 CAMAC ones. In normal, short-pulse experiments, therefore, total 45 diagnostics were operated even though we had 30 in 7c.

Wide-band real-time data acquisitions using Yokogawa WE7000 and NI PXI/CompactPCI are now 15, compared to 30 conventional CAMAC. In the last two

campaigns, drastic increase of total number of diagnostics and made by those real-time DAQ (See Fig. 2). They also gave some prominent peaks of acquired data amount during the steady-state plasma challenges of LHD.

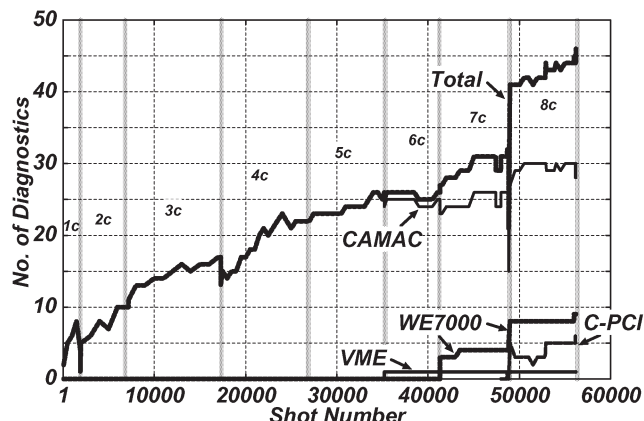


Fig. 2. Growth of number of LHD diagnostics by digitizer kind: In the last 7th and 8th campaigns, a drastic increase occurred by WE7000 and C-PCI digitizers.

Real-Time Data Streaming System

For the ultra-wideband data acquisition, such as high-resolution cameras and multi-channel fluctuation measurements, we have continued R&D for so-called "fast data streaming" systems in recent few years¹⁾. In the 8th campaign, some parts of their functions, such as real-time acquisition and saving, have started their operations. For example, laser imaging interferometer¹⁾ successfully acquired continuous 80 MB/s raw data from PXI digitizer front-end and stored them into host PC.

The remaining function to be implemented was the data streaming server programs with the real-time data monitoring (displaying) clients. Before the beginning of the 9th campaign, we have finished the implementation of this function, as shown in left-hand part of Fig. 3.

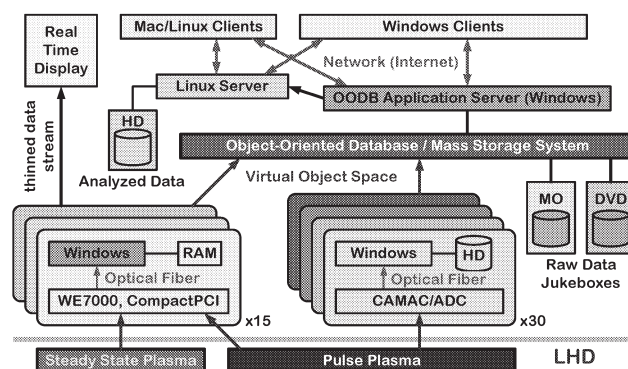


Fig. 3 Schematic view of real-time data acquisition systems (left) and conventional batch ones (right): All the data are equivalently retrieved from data storage.

Reference

- 1)Nakanishi, H. et al., Fusion Eng. Des. **56-57** (2001) 1011
- 2)Tanaka, K. et al., Rev. Sci, Instrum. **72** (2001) 1089