MyView2, a new visualization software tool for analysis of LHD data

Chanho Moon*, Mikirou Yoshinuma, Masahiko Emoto, Katsumi Ida

National Institute for Fusion Science, 322-6 Oroshi, Toki-city, Gifu 509-5292, Japan

ABSTRACT

The Large Helical Device (LHD) at the National Institute for Fusion Science (NIFS) is the world's largest superconducting helical fusion device, providing a scientific research center to elucidate important physics research such as plasma transport, turbulence dynamics, and other topics. Furthermore, many types of advanced diagnostic devices are used to measure the confinement plasma characteristics, and these valuable physical data are registered over the 131,000 discharges in the LHD database. However, it is difficult to investigate the experimental data even though much physical data has been registered. In order to improve the efficiency for investigating plasma physics in LHD, we have developed a new data visualization software, MyView2, which consists of Python-based modules that can be easily set up and updated. MyView2 provides immediate access to experimental results, cross-shot analysis, and a collaboration point for scientific research. In particular, the MyView2 software is a portable structure for making viewable LHD experimental data in on- and off-site web servers, which is a capability not previously available in any general use tool. We will also discuss the benefits of using the MyView2 software for in-depth analysis of LHD experimental data.

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1. Introduction

The helical confinement device has distinctive merits of steady-state operation for fusion reactors. The Large Helical Device (LHD) began fusion experiments at the National Institute for Fusion Science (NIFS) in late March 1998 [1]. During an experimental campaign, many types of advanced diagnostic devices were used to measure the confinement plasma characteristics, and these valuable plasma physics data were registered every year over approximately 7,000 discharges in the LHD database. Furthermore, the Analyzed Data Server (Kaiseki Server) system supplies the analyzed physical data in order to retrieve various types of data in the same manner from the LHD database [2–7]. On the other hand, the LHD project has a long history of collaborations with scientists from a wide variety of laboratories and universities both inside and outside of Japan. Several years ago, the visualization tool NIFScope was developed for support for collaborating scientists and all scientists at LHD [8]. However, the NIFScope is insufficient for in-depth analysis data because the ability of computers at that time was insufficient for such in-depth analysis of physical data at the same time in detail. For collaborators in particular, the NIFScope is not

available for MacOS operating systems, and can operate only on the LHD web server.

In order to improve the efficiency for investigating plasma physics in LHD, we have developed MyView2, a new data visualization software which consists of Python-based modules that can be easily set up and updated. MyView2 provides immediate access to experimental results, cross-shot analysis, and a collaboration point for scientific research. In particular, the MyView2 software is optimized for study of the plasma physics of the LHD by collaborators.

This paper introduces this new MyView2 viewer software for LHD analyzed data, for it greatly assists in investigating the physical experimental data of the LHD for researchers. The MyView2 software provides researchers with a guide to viewing LHD experimental data from off-site locations. The detailed explanation is found in Section 2, and an example of how to use the MyView2 software for investigating plasma fluctuations is discussed in Section 3.

2. MyView2 software

MyView2 is a personal application, and it has been developed especially for collaborators so that they can view and retrieve the necessary data soon after their visit to NIFS. A key advantage of the MyView2 software is that it can be used anywhere after completion of the experiment in LHD. When collaborators use the
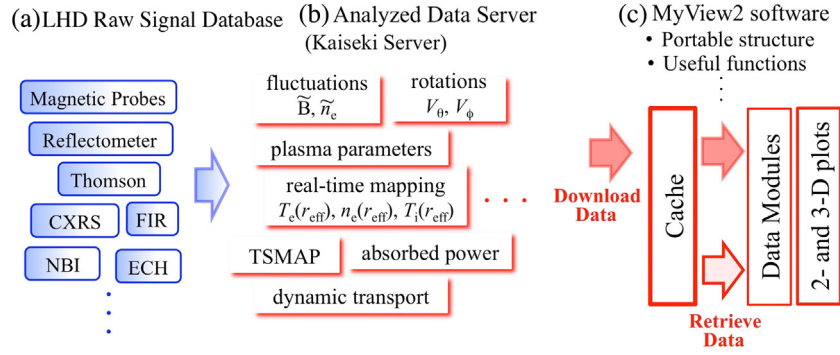
Fig. 1. The flow diagram of how to visualize the LHD experimental data using MyView2 software: (a) the LHD raw signal database, (b) the Analyzed Data Server, and (c) the simplified MyView2 software structures.
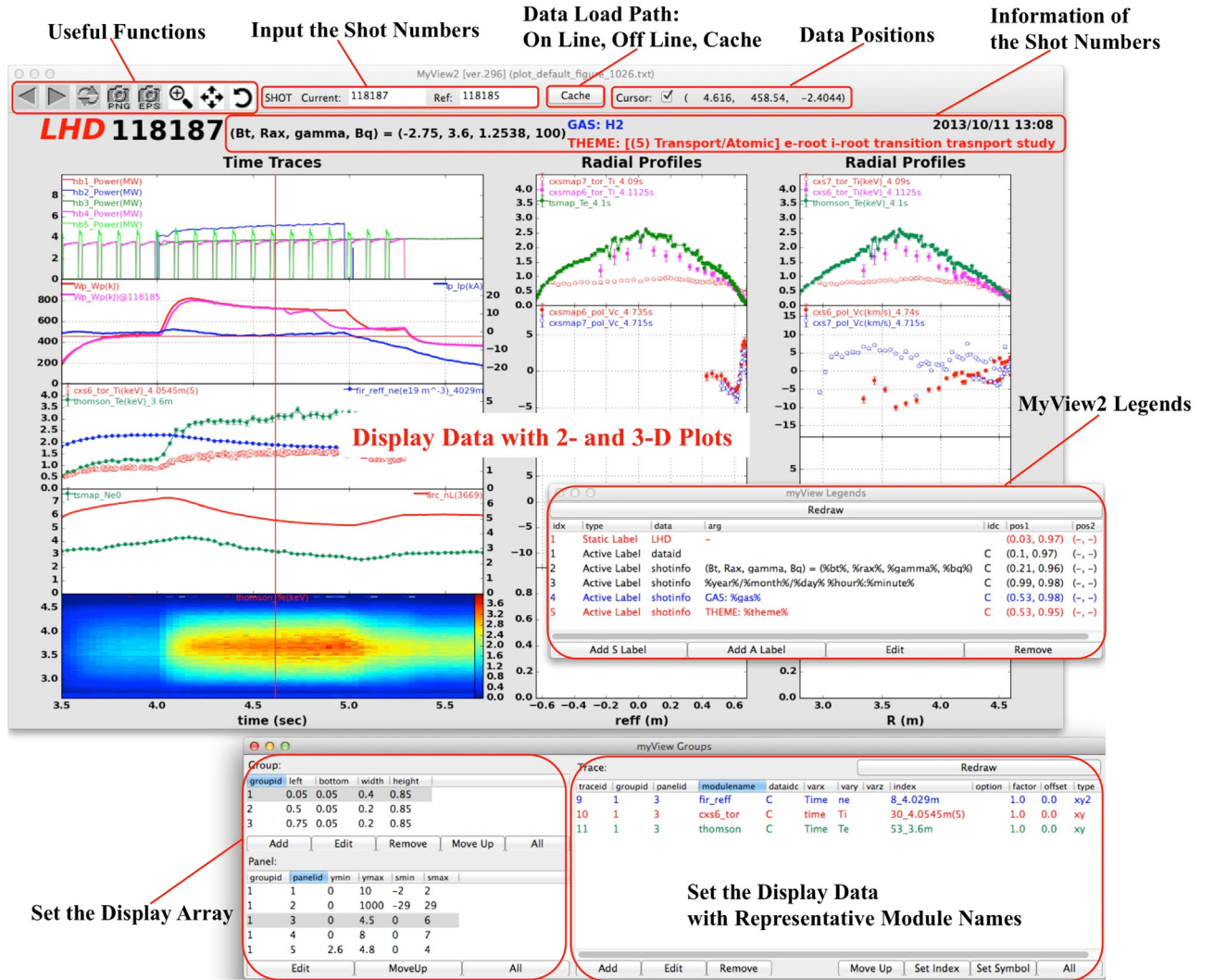

Fig. 2. MyView2 software main window with representative plots.

MyView2 software, they can automatically download and save the LHD experimental data in their local operation device.

MyView2 is able to simultaneously display the valuable physical data during the LHD experiments. For example, the magnetic fluctuation of magnetic probes and the density fluctuation of the reflectometer can be visualized rapidly using the MyView2 software for the last plasma experiment result. During the plasma fluctuation-related experiment, quick summary data is necessary for deciding the subsequent experiment conditions for obtaining physical data of higher value.

2.1. Portable software structure

Python is one of the most powerful, portable, and convenient programming languages, and is also distributed as open source code. In particular, the Python 2D plotting library, Matplotlib,