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Development of a Java-Based Image Browser System for the Subaru Telescope

Hajime Baba

Kyoto University, 606-8502, Japan

Naoki Yasuda, Shin-ichi Ichikawa, Masaru Watanabe

National Astronomical Observatory of Japan, 181-8588, Japan

Toshihiro Horaguchi

National Science Museum, Tokyo, 169-0073, Japan

Masaru Hamabe, Wako Aoki

University of Tokyo, 181-8588, Japan

Tomohiko Ozawa

Graduate University for Advanced Studies, 181-8588, Japan

Abstract. We have developed a Java-based image browser system for the Subaru telescope. The system will be used for a quick inspection of the archived images from remote institutes and of the observed images at a telescope operation room. The browser system supports functions to show spectral traces, statistics, etc., as well as an image itself to help users to easily evaluate the image quality. The browser system has been developed to reduce network traffic between a server and clients. The images, which are compressed for rapid transfer, are generated with care for each observational instrument in order to minimize the loss of the information.

1. Introduction

The Subaru Telescope[1] is equipped with three optical instruments which all have large-format (2k×4k) CCDs. They are operated under various observational modes: direct imaging with the *Subaru Prime Focus Camera* (*Suprime-Cam*, Miyazaki et al. 1998), echelle spectroscopy with the *High Dispersion Spectrograph* (*HDS*, Noguchi et al. 1998), and direct imaging, long-slit/multi-slit spectroscopy, polarimetry, and spectropolarimetry with the *Faint Object Camera and Spectrograph* (*FOCAS*, Iye et al. 1997).

[1] `http://www.subaru.nao.ac.jp`

These images will be archived in the *Subaru Telescope Archive System* (*STARS*, Takata et al. 1996). Because of the large size of individual frames, it is almost unrealistic for remote archive users to preview these archived raw images over the network, thus we need to prepare compressed images for remote browsing. Furthermore, we have to consider the fact that 2-D images do not always convey necessary and sufficient information for assessment of image quality; 1-D profiles or traces must be much more meaningful for spectral images, and even 0-D scalars, i.e., statistics of the pixel counts, may be sufficient for dark frames.

The usefulness of 1- and 0-D information applies similarly to image browsing in an observation room. If we consider that the number of frames obtained with these instruments will amount to more than several hundred per night, effective observations require a quick (automatic) display of 2-D images and their associated 1- and 0-D information so as to minimize the loss of actual observation time.

For these purposes we have developed an extended image browser system, which is hereafter referred to as the *OZEKI* system, for the Subaru Telescope. The system offers functions of processing 2-D images to draw and display 1- and 0-D information. For archiving it also includes a function that compresses raw 2-D image, draws 1- and 0-D information, and attaches them to the 2-D image to create a composite and compressed FITS file.

2. *OZEKI* System and Data Flow

OZEKI is to be used for the following three purposes with the Subaru Telescope (Fig. 1).

OZEKI/A	-	Quick look image (QLI) browser for archived images
OZEKI/B	-	Image browser for observed raw images
OZEKI/C	-	Performance evaluation tool for observational instruments (high speed version)

OZEKI/A consists of a data server and a QLI producer. QLIs are FITS files containing a 2-D image, a 1-D profile/trace, and a 0-D scalar, i.e., statistics of the image. The file size is moderately reduced and compressed to a few hundreds of kB from that of the original image for archiving. The reduction scheme depends on the instrument and/or observation mode with which the original image was taken, so that the essential information of the original image can be conserved as much as possible. Before the original image files are moved to a mass tape library and cleared from hard disks, QLI is created. The original image is separately processed by STARS so that its header information and ASCII Table Extension may be extracted to create files referred to as HDI and ATE files, respectively. When a request is submitted from a client to the *OZEKI/A* data server (via STARS), the server returns QLI, HDI, and ATE to the client, with the QLI further reduced to an appropriate size, if necessary, depending on the client machine performance and/or network capacity. The reduction rate can be explicitly specified from the client as well. QLI is displayed in the browser main window on a client machine.

OZEKI/B is essentially the same as the data server and the client of *OZEKI/A*, with the difference that the data which it receives is the original image that has just observed with the telescope.

OZEKI/C is a diversion of *OZEKI/B* for the special purpose of evaluating performance of observational instruments with visual inspection of the image data.

The browser windows for HDS are illustrated in Fig. 2. Besides the CCD images in the main window, spectral traces with rough wavelength calibration are automatically computed using HDI and ATE and are displayed in another window. This feature is useful particularly for inspecting multi-slit and echelle spectra taken with FOCAS and HDS, respectively. HDI and ATE can be also browsed upon request.

OZEKI is written in Java. We have used JDK 1.1.6, Swing 1.0.3, Horizon 1.3.1b, FITSWCS 2.4, Ptplot 1.3p1, and Horb 1.3b1p11a, with our original extension on Horizon so as to treat ASCII table extension and improvement on Ptplot to run speedily.

3. Present Status and Future Development

OZEKI is runnable in stand-alone mode as of October 1998. The following items are under development for the 'prototype' of *OZEKI*, as of December 1998;

- Server/client architecture
- Invocation foreign software (e.g., IRAF)
- Performance improvement

Next, we intend to plug *OZEKI* into STARS.

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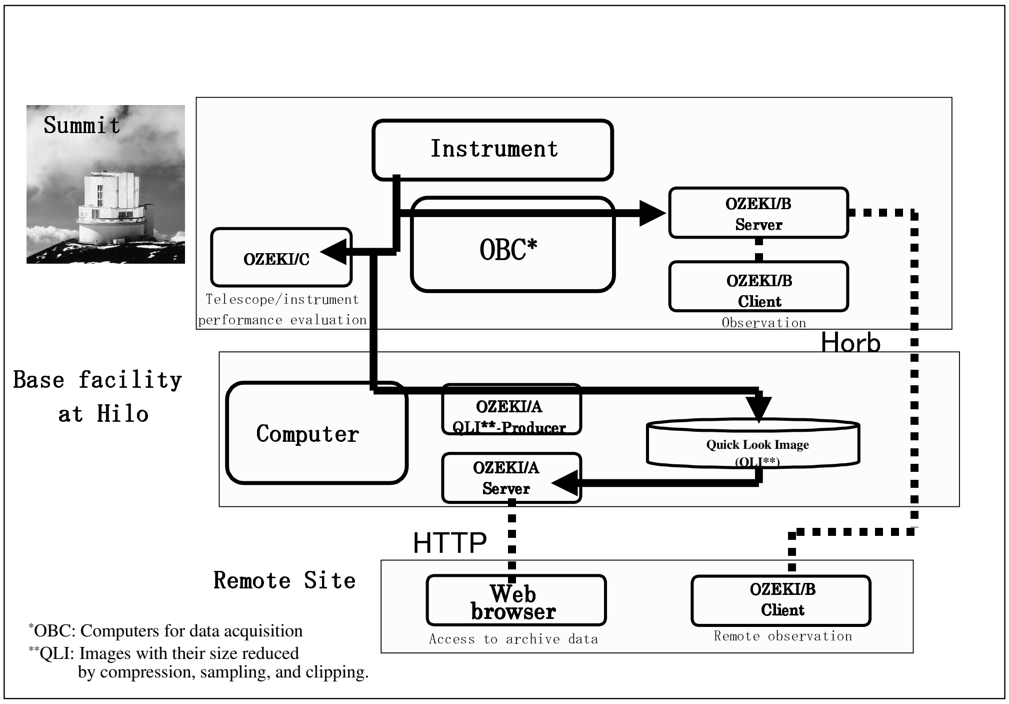

Figure 1. Data flow for OZEKI system

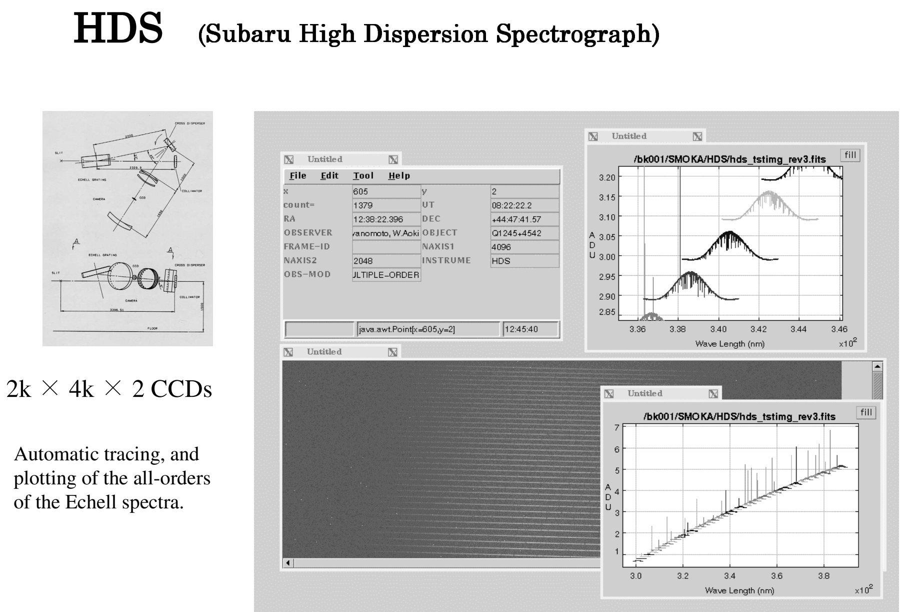

Figure 2. OZEKI windows for HDS