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Development of a Java-based Quicklook Image Browser for Echelle Spectrograph

H. Baba[1], N. Yasuda[2], S. Ichikawa[2], W. Aoki[2], M. Taga[2], T. Horaguchi[3], M. Hamabe[4]

Abstract. We have developed a quick and easy data evaluation system for use with the observations of the Subaru telescope High Dispersion Spectrograph (HDS). The system, named OZEKI/B, is based on a general purpose image browser, NAOimage, which is a newly developed core system utility. OZEKI/B is optimized to HDS and is expected to secure maximize the efficiency of observations.

1. Introduction

The Subaru telescope (Kaifu 1998) has a high dispersion echelle spectrograph, HDS (High Dispersion Spectrograph, Noguchi et al. 1998), which uses an echelle grating with cross-disperser and is located on the Nasmyth focus. Typical spectral resolution will be 100,000.

It is very important for efficient observations to evaluate data quality as soon as possible the data is produced. However, an echelle image has many spectra, and each spectrum is not parallel to the CCD column or row. These complicated echelle images prevent observers from obtaining a quick and proper evaluation of the data.

Also, the focus of the spectrograph is very important. The support staff of the spectrograph must tune the focus during the setup phase many times, so this feature is very useful. The observer needs to confirm the focus for each observation using this tool.

For these purposes, using Java we have developed a new image browser, OZEKI/B, that provides an efficient quicklook of echelle images. The browser runs on the instrument control and data acquisition computer in the observation room.

[1]Department of Astronomy, Kyoto University, Kyoto 606-8502, JAPAN

[2]National Astronomical Observatory of Japan, Mitaka, Tokyo 181-8588, JAPAN

[3]National Science Museum, Tokyo 169-0073, JAPAN

[4]Institute of Astronomy, The University of Tokyo, Mitaka Tokyo 181-8588, JAPAN

2. NAOimage - Generic Java-based Image Browser

The basic display functions of OZEKI/B are based on NAOimage, a general purpose FITS image browser. We recently developed NAOimage with JDK1.2 under Solaris 2.6.We utilize the Java-based FITS I/O package of Tom McGlynn[1], and the FITSWCS package (Greisen & Calabretta 1995) from the NCSA Horizon group.[2] Note that McGlynn's FITS I/O package does not support ASCII table extensions so we have modified the package to support these tables.

The browser has basic features for displaying FITS images: manipulating colormaps; extracting profiles along arbitrary lines that are specified with the mouse; zooming, panning and blinking; viewing FITS headers; and reading out coordinates (including WCS).

3. Extension NAOimage to HDS Quicklook

3.1. ASCII Table Extension

The FITS file format produced by HDS contains ASCII table extensions. In the table, there are parameters that describe echelle order information on the CCD plane. A sample table is as follows:

Table 1. Sample ASCII Table Extension produced by HDS.

Order	x	y	WL	x	y	WL	x	y	WL	Incl.	Disp.
197	1	5	298.714	2048	52	300.812	4096	98	302.910	0.000	0.003
196	1	39	300.238	2048	86	302.347	4096	133	304.456	0.000	0.003
195	1	73	301.778	2048	120	303.897	4096	167	306.017	0.000	0.003
...											

The first number is an order number. The following three parameters are pixel (x,y) and the corresponding wavelength of a start point expected on the CCD. In a similar way, the next two sets of three parameters correspond to the middle and end points, respectively. The other two parameters are the slit inclination and dispersion. The table format is determined as a result of discussions between instrument developers, the instrument control group and the data archive group.

3.2. Extraction of the Spectral Orders

Our browser has a special feature for extracting a trace of the specified order of spectrum including the roughly estimated wavelength scale. It retrieves the trace along the order using the parameters from the ASCII table extension. If users want to look a trace of the 197th order of the spectrum, the system gets

[1] http://members.home.net/mcglynn/java/

[2] http://imagelib.ncsa.uiuc.edu/imagelib/Horizon/Horizon.html#FITSWCS

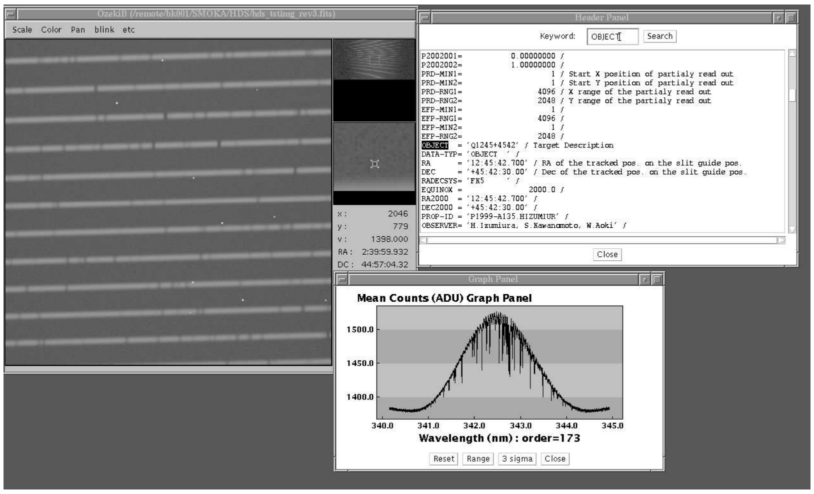

Figure 1. Snapshot of our quicklook image browser. Echelle 2D image (each stripe corresponds spectral order), FITS header and the trace of an arbitrary order number are shown.

a profile along the line which starts at (1,5) and ends at (4096,98). This works smoothly for a quick evaluation during normal observations or engineering work.

Figure 1 shows the OZEKI/B window showing the object image. The user selects the spectral order on the image and clicks on an arbitrary point along the order. Spectral traces with rough wavelength calibration are automatically computed using ATE, and are displayed in another window. Header information is also available. The slit width can be changed as necessary.

3.3. Supporting Focus Adjustment of the Spectrograph Camera

Another feature of OZEKI/B is the support of focus adjustment for the spectrograph camera. Figure 2 shows a snapshot of camera-focusing mode. The observer selects emission lines on the comparison image interactively, and then the system writes the position of the selected lines to a data file. This file also includes header to represent basic information such as date or frame ID and the status of the instrument. An external program which evaluates the focusing position uses the position file, and provides feedback to the instrument control system.

4. Future Work

The Okayama Astrophysical Observatory (OAO) 188cm telescope has HIDES (HIgh Dispersion Echelle Spectrograph, Izumiura 1999). The FITS files which are produced by HIDES have a similar format to those produced by HDS. We can apply our system to HIDES with only slight modification. Also, the Subaru telescope has other instruments that we intend to support with our system. One more development for NAOimage is that we plan to use it for the online

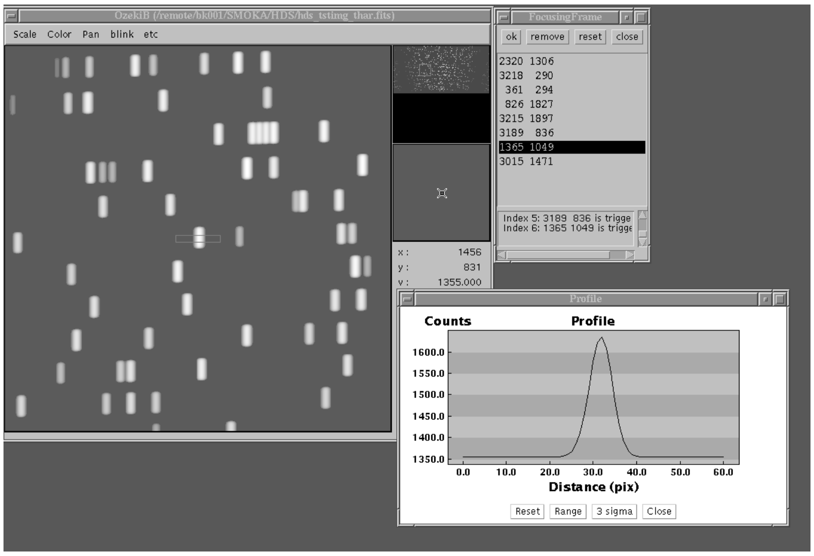

Figure 2. Snapshot of camera-focusing mode. Comparison image, list-box of selected positions, and profile of the selected emission line are shown.

observation log system. Moreover, we need to support mosaic images as HDS has two CCDs.

This browser will make possible of effective HDS/HIDES observations with on-site quick evaluation of data quality.

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