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New Image Quick-Look System for Subaru Telescope Data Archive

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Abstract. We present an image quick-look system adopted for the Subaru telescope data archive system *(STARS)*. The quick-look image is based on a data format which is defined within the FITS framework and enables us to store several pieces of information derived from the original (raw) image together with the compressed image. The quick-look image is produced at the base facility at Hilo soon after the observation data are transferred from the summit. Archive users can browse the quick-look image and spectra/profiles with their preferred image format and resolution.

1. Introduction

Most observational instruments for the Subaru telescope produce large and sometimes complicated data. For example, Suprime-Cam (Subaru Prime focus Camera) produces data with a size of 16MB×10 for a single exposure and HDS (High Dispersion Spectrograph) produces images of complex echelle spectra whose locations are stored in an ASCII table extension (Baba et al. 2000). It

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is not easy to browse and check such large/complex data with existing browsers. We encounter this difficulty especially when we search for data from the archive. Preview images of smaller size are usually used to circumvent the difficulty. However, an image format based on simple compression as used in most data archival systems is not satisfactory to evaluate the quality of the original data.

To solve this problem, *STARS* (the Subaru Telescope data Archive System) (Takata et al. 2000) has implemented a new quick-look system. The system is comprised of two parts, "Quick-look image Producer" *(QP)* which generates the Quick-Look Images (QLIs) from the original images, and "Quick-Look Image Server" *(QLIS)* which processes the QLIs and displays them on web browsers. In this paper, we describe the outlines of them briefly.

2. Format of the QLIs

The format of QLIs is defined within the FITS framework, which enables us to store several kinds of information derived from the original data, such as image statistics, typical profiles and spectra, into a single FITS-formatted file efficiently. Users can browse and examine QLIs using FITS browsers, if the browsers support all features of the FITS format.

To store the information of the original data into QLIs efficiently, we classified the original data into three categories, "Calibration" (C-mode), "Image" (I-mode) and "Spectra" (S-mode) and defined different QLI formats for each category. Because QLIs for I- and S-mode are needed to be visually inspected, a simple compressed image of the original data is stored as the primary array of the FITS formatted QLI. However, for C-mode, simple compressed images are not very useful. Therefore, we adopted a three-dimensional array of the statistics (mean, standard deviation, minimum and maximum calculated in every submatrix of 64×64 pixels) in the original image for a primary image of the C-mode QLI. The first plane (mean) of the C-mode QLIs can be interpreted as a highly compressed image. We also added typical profiles from the original (C-mode) image into a binary table extension (BTE) to compensate for the low resolution of the statistics array. For the S-mode data, one-dimensional spectra are the most essential information. S-mode QLIs have spectra extracted from the original data, according to locations recorded in the ASCII table extension of the raw data, as an binary table extension.

The structure of the QLIs are summarized as below.

`I: Image`	`HDR*`	`Compressed image (NAXIS=2)`		
`S: Spectra`	`HDR*`	`Compressed image (NAXIS=2)`	`HDR`	`spectra (BTE†)`
`C: Calibration`	`HDR*`	`Statistics matrix(NAXIS=3)`	`HDR`	`profiles(BTE†)`

`*HDR: Header, †BTE: Binary table extension`

3. Quick-look Image Producer (QP)

QP is written in Fortran90 using the CFITSIO (Pence 1999) subroutine library.

The flow of the program is as follows:

1. Determines the mode of the QLI (C/I/S) from the FITS header keywords (`INSTRUME`, `DATA-TYP`, `OBS-MOD`, etc.) of the original image;

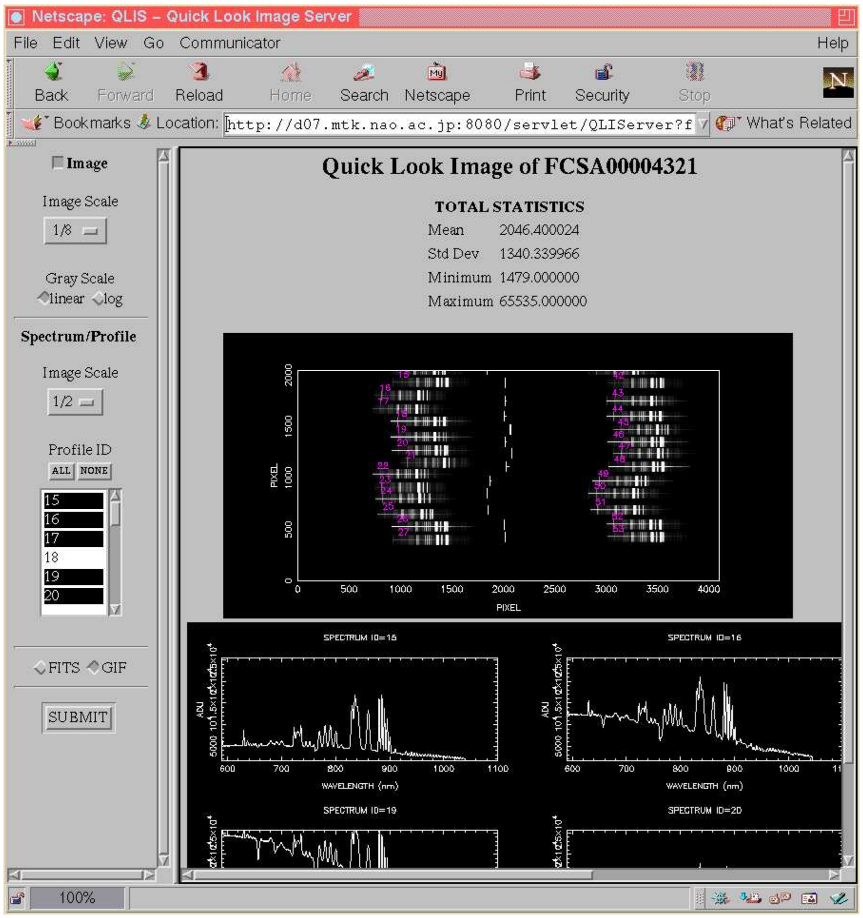

Figure 1. QLIS web page displaying a QLI of an image of FOCAS test data. The primary image and several spectra are selected and displayed on the web browser.

2. Makes the compressed image by sampling pixels and scaling the pixel values to 8-bits (for I or S mode), or makes the statistics matrix (for C mode) and then writes them in the primary array;
3. Extracts typical profiles (for C mode) or spectra (for S mode) and writes them into the binary table extension as a variable length array. The spectra are extracted according to the information written in the ASCII table extension of the original image;
4. Produce a process log and generate a return code to `stdout`.

QP is triggered when the observation data are transferred from the telescope to the base facility at the Hilo campus by STARS. The return code is marked in the STARS database and is checked daily to see that the QLI is generated correctly.

4. Quick Look Image Server (QLIS)

QLIs produced by QP have a maximumsize of about 500 kB after `gzip` compression. While much smaller than the original data, it is still large for browsing via computer network. Moreover, standard web browsers cannot display images of FITS format. Quick Look Image Server (QLIS) transforms a FITS formatted QLI into a GIF imagea, or a smaller FITS image, according to the user's request, and displays it on the web browser.

Figure 1 shows the QLIS web page displaying the data of FOCAS (Faint Object Camera And Spectrograph) test data. When QLIS is first triggered by "QLI" button on the web page of STARS, QLIS creates a GIF image from the primary data of the QLI and displays it on the web browser. Then the user can choose a preferred image format (GIF/FITS), the image size, and spectrum IDs to be shown by HTML/FORM. If the FITS format is selected, a FITS browser using a Java Applet is evoked. in this case the user can manipulate the FITS image dynamically.

5. Future Plan

At present, QLIs in this format are available only for Suprime-Cam, HDS and FOCAS data but it will be extended progressively to other instruments. Some special treatments may be needed for the IR instruments.

Image manipulation functions of QLIS will be enhanced to allow users to magnify the image, extract an image section, etc.

We are also developing a simple standalone viewer to browse images and spectra/profiles of QLIs stored on users' local disks. Because existing FITS browsers such as FV and SAOimage cannot display the profiles/spectra in the binary table extension, this standalone browser may be useful in data reduction stage.

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