Astronomical Data Analysis Software and Systems VI
ASP Conference Series, Vol. 125, 1997
Gareth Hunt and H. E. Payne, eds.

The ESO VLT CCD Detectors Software

Antonio Longinotti

European Southern Observatory, Garching bei München, D-85748 Germany, E-mail: alongino@eso.org

Abstract. Charge Coupled Devices (CCD) are currently by far the most widely used type of detector in astronomy. At the ESO Very Large Telescope (VLT), on mount Paranal in Chile, about 40 technical CCD cameras will be in operation for auto-guiding, field viewing, and wavefront sensing, as well as more than ten scientific CCD cameras for instruments working at optical wavelengths. After a brief introduction to the VLT Control System, the VLT CCD Detectors Control Software is presented.

1. Introduction

The VLT Control System is a distributed system consisting of a set of UNIX Workstations, dedicated to high level operations, such as coordination of sub-system activities and interface to the users, and VME-based Local Control Units (LCU), dedicated to the control of sub-systems hardware. The operating system used on the LCUs is VxWorks. All computing units—Workstations and LCUs—are connected through LANs.

The CCD Software Package (Longinotti et al. 1995) is built on top of the VLT common software, which is a layer of services (drivers, libraries, utilities) used by all VLT applications (Raffi 1995). It has been designed as one package to control all CCD cameras, both scientific (SCCD) and technical (TCCD). In this way, costs for software maintenance are reduced and the interface to applications is standardized, in that instrumentation and telescope software interface to all cameras in one and the same way (§4). It became available as part of the VLT Software in October 1995, and four releases have been issued since then. It is currently used at the ESO New Technology Telescope for auto-guiding (two TCCDs), image analysis for active optics (two TCCDs), image quality assessment (two TCCDs), the EMMI instrument (two SCCDs and one TCCD for slit viewing), and the SUSI instrument (one SCCD). It is also used by the VLT FORS instrument (one SCCD), and in ESO labs for SCCD and TCCD new chip and camera tests and verification.

2. System Architecture

In addition to the two standard platforms (Workstation and LCU) described above, a third—called Array Control Electronics (ACE), and based on a transputer network and DSP—is used to control the CCD camera head.

The software running on each platform has the following characteristics:

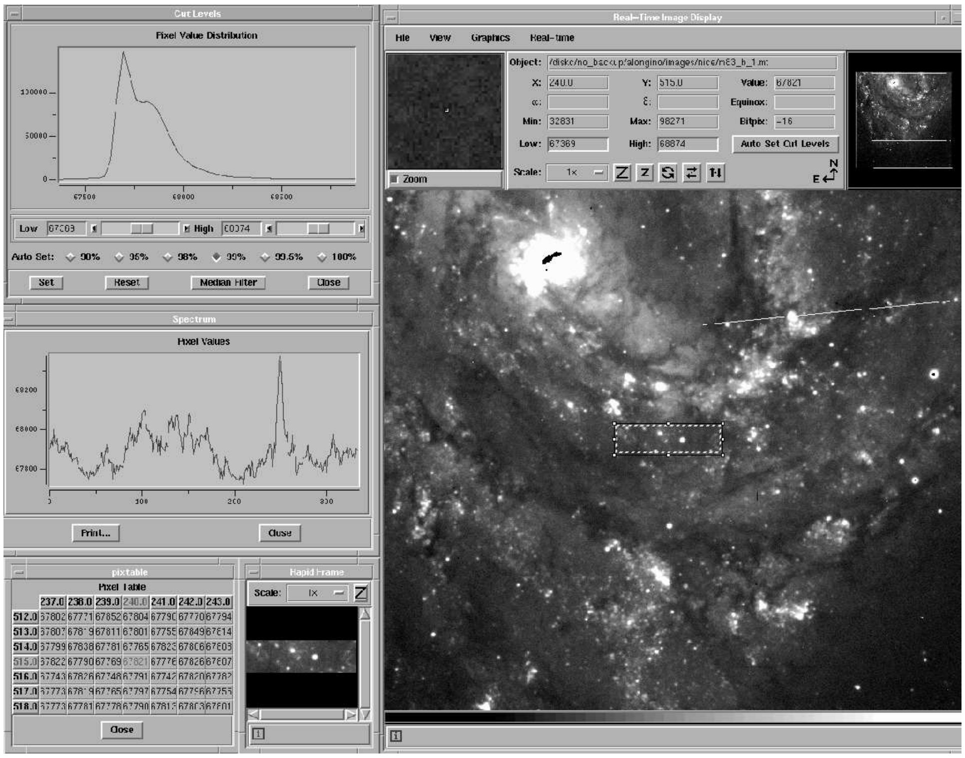

Figure 1. VLT CCD and Real-Time Display.

- **Workstation**. It includes programmatic and interactive user interface.

  The language used is C, with Tcl/Tk used for GUIs.

- **LCU**. The core of the camera system control runs here. Performance is optimized in that operations such as read-out from ACE and image transfer to the Workstation, are performed in parallel whenever possible. Image data are temporarily saved in the LCU memory (e.g., for image re-transmission in case of a network failure).

  The language used is C.

- **ACE**. The transputer and DSP based embedded software runs here. It provides the direct interface to the camera electronics.

  The languages used are Occam (transputers) and C (DSP).

3. Functionality

Compared to the previous generation of ESO CCD systems, in addition to the standard functionality (different readout modes and speeds provided, binning, windowing, execution and control of an exposure, possibly repeated n times, storage of data in FITS files, telemetry, and temperature control), it implements:

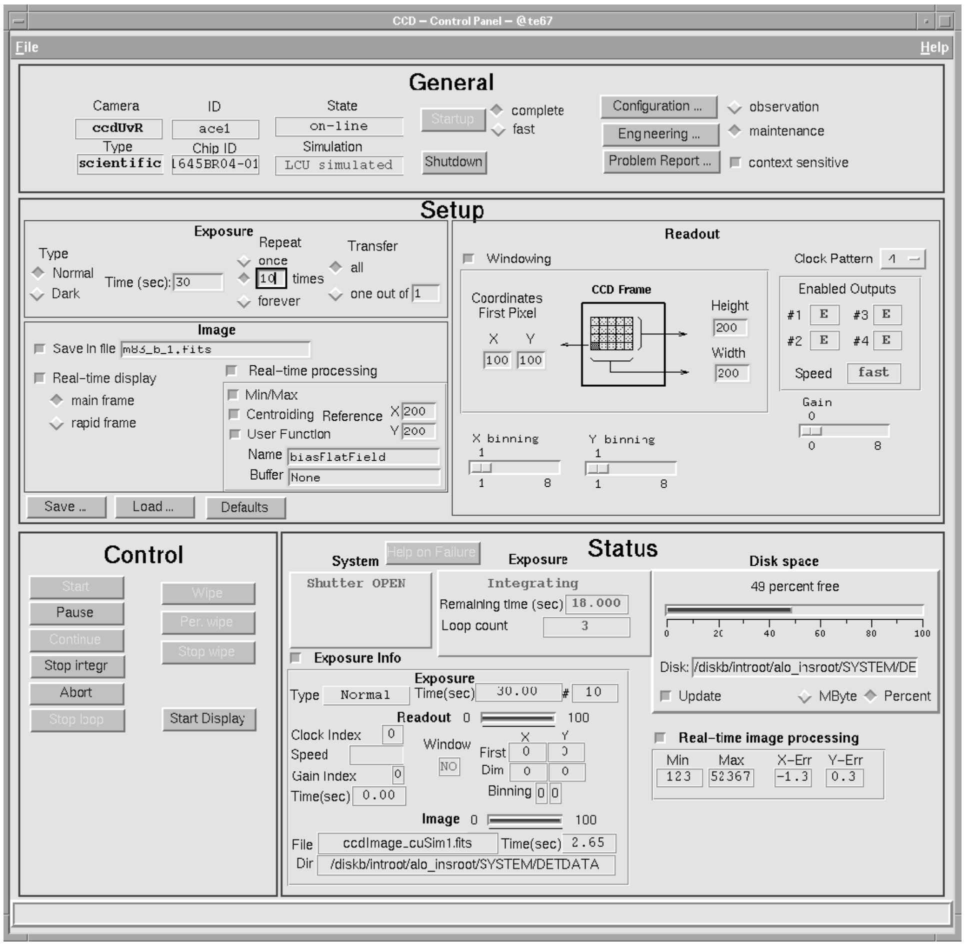

Figure 2. VLT CCD stand-alone control panel.

- **Real-time image processing** on LCU for TCCDs (image quality improvement, centroiding calculation, hook for user function implementing special algorithms).
- **Gain setting** as part of the user setup.
- **Parallel readout from up to four outputs**. The physical image is reconstructed within the LCU.
- **Display of images** while they are being read-out, on any X-11 terminal through the **VLT Real-Time Display** facility (see Figure 1).
- A **Graphical User Interface** (GUI), to control and monitor the status of a CCD camera as a simple stand-alone instrument—extremely useful for laboratory and field testing (see Figure 2 and §5).
- Support for **special control hardware** on LCU, such as the high precision shutter for the FORS instrument.

- Support for **new generation controllers**. About 80% of the LCU software is independent from the particular controller connected to the LCU VME crate, and can therefore be re-used with other controllers.

4. Interface to External Software Packages

The interface to external software is well defined and consists of standard components within the VLT software:

- **Command/Replies**, based on the VLT Message System.
- **Setup files**, containing exposure setup definitions.
- **FITS files**, containing the images produced as the result of exposures.

5. Usage as Stand-alone Instrument

The CCD Software is able to work as a simple stand-alone instrument through a control panel, built using the **VLT panel editor**, which is based on Tcl/Tk (see Figure 2). Among others, it allows the following actions:

- Define a single exposure setup and save it in a setup file, or retrieve already defined setup files.
- Define a sequence of exposures (e.g., for standard calibration operations).
- Start exposures, monitor their status, and possibly stop, pause, or abort them.
- Display images with the VLT Real-time Image Display.
- Interface to VLT data flow.

Acknowledgments. I would like to thank here the people who contributed to the development of the VLT CCD software, in particular, C. Cumani and P. Duhoux.

For more information or questions, please contact A. Longinotti (e-mail to alongino@eso.org).

Information can also be retrieved through anonymous ftp.[1]

References

Raffi, G. 1995, The Messenger, 81 , 5

Herlin, T., Brighton, A., & Biereichel, P. 1995, The Messenger, 81, 6

Longinotti, A., Cumani C., & Duhoux, P. 1995, The Messenger, 82, 7

[1] ftp://te1.hq.eso.org/vlt/pub/doc, files ccd*