CONFIGURATION AND DATABASE FOR THE CONTROL SYSTEM OF THE VISIR INSTRUMENT

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Abstract

A French-Dutch consortium of institutes led by CEA/Saclay is designing and building VISIR [1] (VLT Imager and Spectrometer for the mid-InfraRed), a cryogenic multimode instrument for ground-based astronomy at wavelengths of 10 and 20 µm. It will be mounted in 2002 at the focus of the third 8-meter telescope of the ESO VLT observatory in Chile.

In order to control the different parts of the instrument, to interface the telescope and to perform observations, a suitable control system is being developed. It must adhere to common solutions, which are used for all the VLT instruments. The VLT software [2] makes extensive use of configuration files, parameter files and data dictionaries to configure the instrument database, to perform observation and to store astronomical data.

The overall layout of the control system will be described, the use of the VLT software will be discussed and a particular emphasis will be put on the benefit of the extensive use of a well-defined and structured environment for configuration and data representation.

1 INTRODUCTION

VISIR is an imaging and spectrometric instrument at the focus of one of the telescopes of the VLT built by ESO on Mt Paranal in Chile. VISIR will collect infrared radiation essentially produced by dust in various environments, such as circumstellar disks, a domain seldom studied so far. These disks can harbor newly formed planets. Another aspect covered by VISIR is the phenomena related to stars formation. VISIR is composed of an imager and a spectrometer operating in the thermal infrared. Photons are detected by a photo-conducting array of 256x256 pixels cooled down at cryogenic temperatures. Wavelength selection is performed with filters. For the spectrometer part of the instrument, dispersion is achieved with a grating. One key element in the VISIR design is an innovative type of cryomechanism, which is able to actuate optical devices with a very high accuracy and positioning repeatability. The instrument will be installed in 2002. Fig. 1 shows the outer part of the cryostat, its diameter is 1.20m and the total weight of the instrument will be 1000 kg.

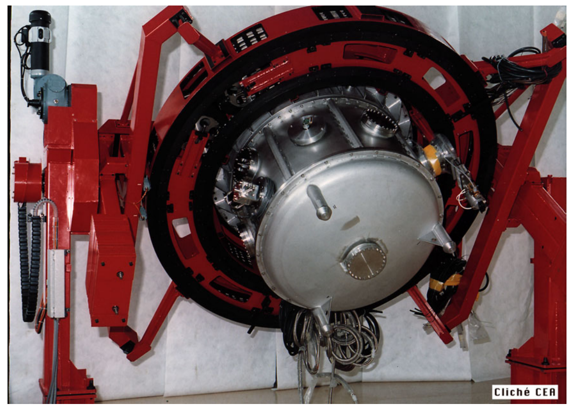

Fig. 1 VISIR mounted on the integration support

For the control of the instruments, ESO provides a complete precisely defined solution to all institutes and sub-contractors responsible of the development of an instrument. This approach is completely justified: the VLT observatory will consist of 12 instruments for the 4 telescopes plus 3 others for the VLT interferometer program. All these instruments come from various European laboratories and will be managed locally in Chile by a limited number of ESO people. Then, it is mandatory for the local team to deal with hardware and software standard solutions for day-to-day operation, maintenance and possible repairs.

The different hardware elements to build a control system for an instrument are the following:

- A HP workstation running UNIX (WS).
- A VME crate with a 68K or a Power PC CPU running vxWorks (LCU).
- An Ethernet network linking the workstation and the LCU.
- A set of 5 VME modules to achieve motor controls, analog IOs, binary IOs, timing synchronization and serial interfaces to other devices.
- A set of specialized modules to perform detector read-outs.

Software is also completely defined; the VLT Common Software consists of layers of software in the

UNIX and in the vxWorks environments. On the UNIX side, this software is based on RTAP provided by HP. This package consists mainly of a database system and an interprocess communication layer. A compatible database and communication protocol was developed by ESO in the vxWorks environment.

The infrastructure to perform the control and acquisition of VISIR consists of one WS, two LCUs and a front-end acquisition system. The first VME is used to interface the imager and the star simulator (an assembly of devices to simulate stars with standard sources). The second one is used to interface the spectrometer. These two LCUs with the associated electronics will be mounted on each side of the cryostat. Two non-standard VME modules are used for the specific needs of the gratings control: a 16 bit DAC module and a 16 bit LVDT readout module.

2 DATABASE

2.1 Overview

The VLT common Software relies on a real-time database distributed on the WS and the LCUs. This database system supports an object-oriented organization: the points are the true objects describing the system and, in general, are instances of classes. The database includes also some other object-oriented concepts like class inheritance and overloading. The points contain a list of attributes, which contain the data.

Each database used in the control system (one for each LCU and one for the WS), is defined by ASCII files: different files are used to define the classes and the point instances. These files look like C++ include files and a special tool is used to generate loadable modules from them. Unfortunately no tool is provided to build easily a database. Furthermore, the process of generating a database is slow: it takes 1 minute for 50 points on a rather powerful workstation (HP 9000/785 with 1GB RAM). So another policy was adopted to easily generate the big complex motor databases.

2.2 Structure and configuration of the motor database

Each instrument contains several motors of various types: VISIR has 13 stepper motors with limit and reference switches. They are used to rotate filter wheels, to introduce diaphragms or lenses, to move tables, etc. The software handling of these motors is quite sophisticated: the database definition of one motor is based on a generic class. This class has more than 100 different attributes of various types and lengths. To handle efficiently all these parameters, a dedicated ensemble of panels is used to initialize the motor configuration. When the LCU is booted, a skeleton database instantiating a motor of the proper type is loaded. Then, the configuration previously defined by the panels is loaded. It is an elegant way to hide the complexity of the motor database and to save time in avoiding rebuilding again and again the database on the WS.

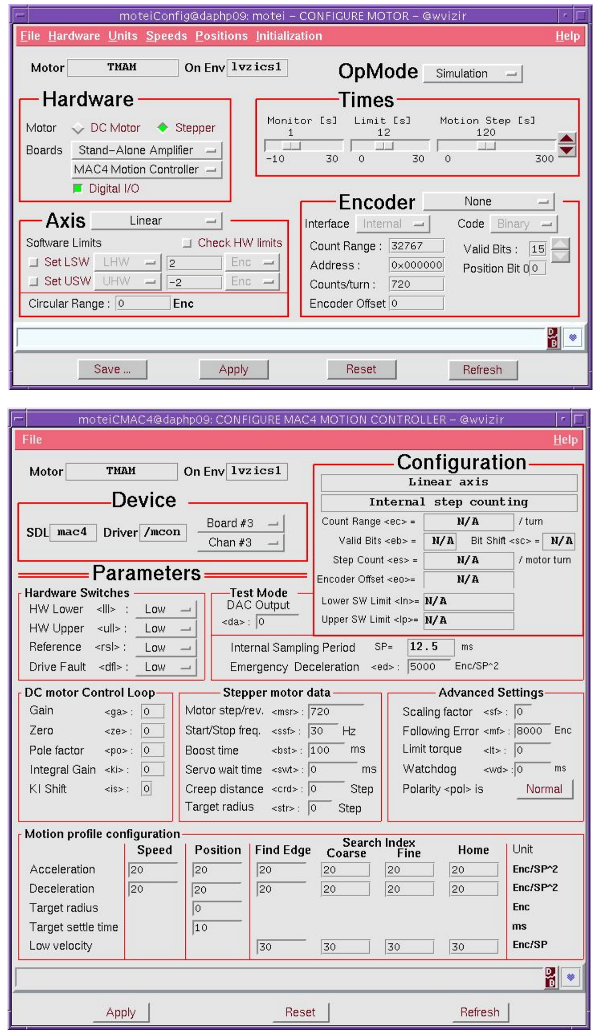

Fig. 2 Panels for motor configuration

3 DATA FLOW SYSTEM

3.1 Overview

In such a facility operated with a reduced team and hosting foreign scientists, well defined and coherent parameters and data specifications are fundamental. To achieve this goal, a complete data flow system starting from the observation preparation and ending in the astronomical data and log files are provided by ESO. Practically, data dictionaries are used in order to define all parameters used in a given context, e.g.. to control the instrument or to interface the telescope or to perform an acquisition.

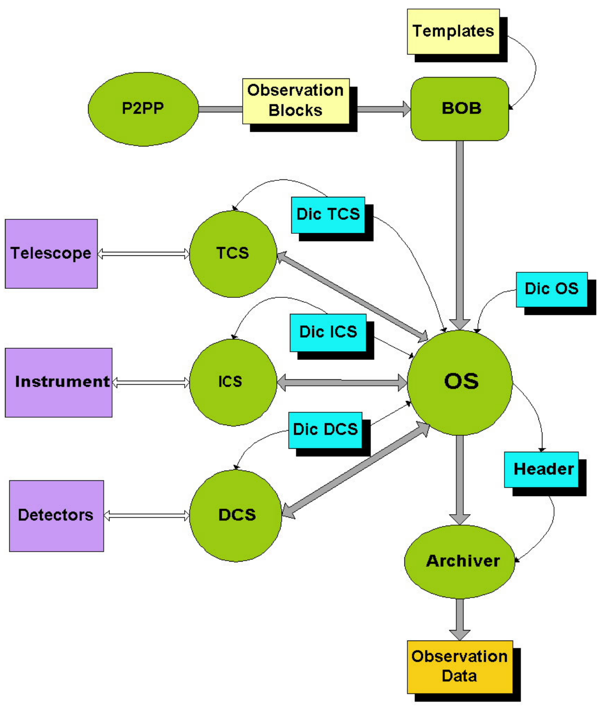

Fig.3 Software Architecture

The main software building blocks are shown on Fig. 3. The Observing Software (OS) is the central part of the system. It receives commands from the Sequencer (BOB). These commands are grouped together in so-called observation blocks (OBs) prepared by astronomers with a dedicated tool (P2PP). OS coordinates the exposure in sending commands to the telescope via TCS, to the instrument via ICS and to the detector via DCS. Finally, OS receives astronomical data from DCS and is responsible for archiving these data. For each subsystem a dictionary must be supplied. The dictionaries contain all the keywords, their context, their format, their description etc…which will be used throughout the system. All instruments of the VLT share the telescope dictionary, the detector dictionary and a large part of the instrument dictionary. Finally, the astronomical data are archived with a set of keywords associated with their values in order to identify the data. Then, all operational steps (setting the telescope and the instrument, performing the acquisition, storing the data) are based on these dictionaries giving a great coherence to all the different control and acquisition systems of the VLT. Fig. 4 shows the generic OS software interface, which controls the subsystems and handles exposures. This generic interface will be later enhanced for the specific VISIR needs.

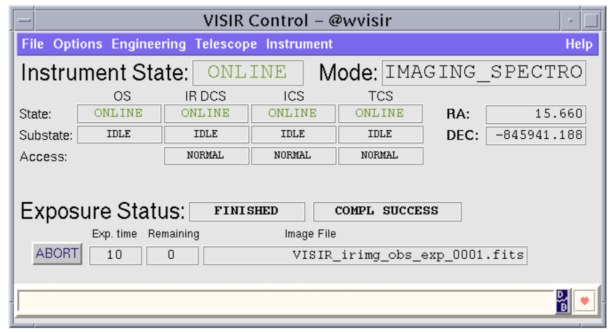

Fig. 4 Generic OS user interface

4 SUMMARY

The VISIR control software is being done with the hardware and software framework provided by ESO for the whole VLT. To overcome the complexity of the database, especially for the mechanisms, tools are provided for dynamic configuration. Dictionaries are used for instrument configuration, for telescope and detector settings and for identification of data. This policy gives a good coherency to all instruments and telescope control systems and eases preparation and performance of observations.

REFERENCES

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[2] G. Raffi - Control Software for the ESO VLT - Proc. of ICALEPCS’91, KEK, Tsukuba, pp. 202-207.