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IRIS2 Software System - Overview

Contents

Revisions:

28-Nov-2000: First Version.
31-May 2001 Update User Interface section
09-Jul-2001 Add File section
23-Jul-2002 Update for final system

1 Introduction

This document provides an overview of the IRIS2 Software System. It is intended to provide information which may be useful to support staff at the telescope, astronomers supporting the instrument, or anyone else who would like to know more about how the system works.

It is not intended to be a user's guide for observers, though the information here may be of interest to advanced users.

2 Running the System

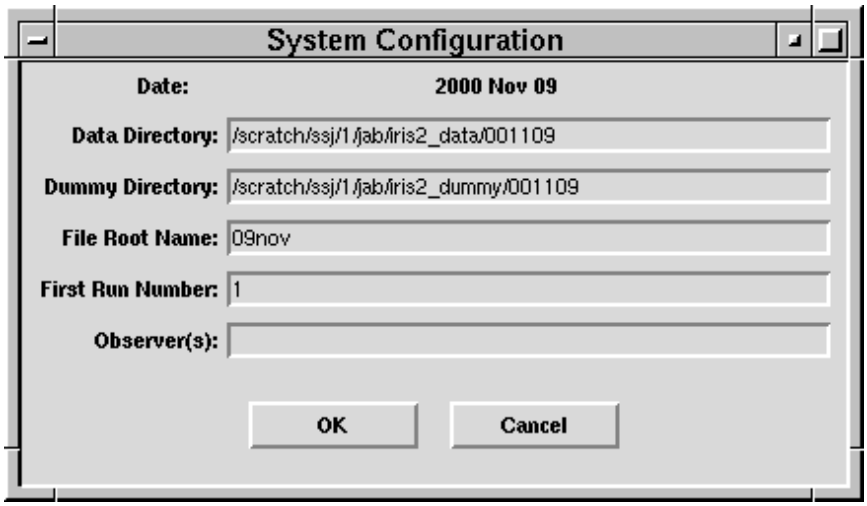
2.1 Starting up the Observing System

The telescope PTCS system should already be running (it runs on machine aatssz), and the IRIS2 and CCD Controller VME machines need to be ready – reset them if necessary.

The steps are as then as follows:

1. Log into the IRIS2 solaris machine (aatvme10) as **aatobs**
2. Type the command **dits_netstart**
3. Type the command **iris2**

This command starts the system loader task which is responsible for loading the rest of the system. As each task loads you will see its name change from red to green on the user interface. When loading is complete all the names should be green, the windows for the IRIS2 User Interface and the Real Time display should have appeared and the configuration dialog should appear.



IRIS2 System Configuration Dialog

This dialog specifies the data directories and other information needed to determine the data file names and the OBSERVER information for the FITS headers. Normally the defaults should give the correct directories for the current date and only the Observer(s) field needs to be filled in.

Once this is complete the System Loader window can be iconized. It is not needed during normal observing. The only time it will be needed again is to reset, reconfigure or exit from the system.

2.2 Reconfiguring

Once started the IRIS2 software system can continue running for many days and shouldn't need to be restarted unless something goes wrong. However, at the start of each observing night it is necessary to reconfigure in order to set the correct data directories and observer information for the current night.

To do this bring up the System Loader window (if it has been iconized) and select **Reconfigure** from the **Commands** menu. This will bring up the system configuration dialog as shown above. The directory fields should be set automatically based on the current UT date. Normally only the Observer(s) field needs to be entered.

2.3 If Something Goes Wrong

2.3.1 Resetting

In most cases the reset command should recover from software problems. To do a reset bring up the System Loader window and select **Reset** from the **Commands** menu.

During a reset each task in turn is checked. If a task has crashed or shut down it is reloaded. Otherwise it gets sent a reset command. The overall effect should be to return the system to its state just after startup. The System Configuration dialog comes up just as during a normal startup of the system.

2.3.2 Full Restart

If reset fails then a full restart can be done as follows.

1. Select **Exit** from the **File** menu of the System Loader. This will shut down the system.
2. On the terminal window type **cleanup**.
3. Then start up the system as normal using the commands **dits_netstart** and **iris2**.

2.3.3 Resetting the VXWorks Systems

The RESET or Full Restart above will recover from problems with the UNIX side of the system. If problems occur in either of the two VxWorks systems, aatvme6 which runs the controller (DCT task) or aatvme7 which controls the dewar mechanisms (SPECTRO task), then these need to be reset before restarting.

The controller system, aatvme6, can be reset by typing the command:

~devccd/newccd/vmeReset

when logged into aatvme10.

The dewar system, aatvme7, is reset by means of its red reset button. It is the second unit from the top in the electronics rack in the Cassegrain cage.

After resettting either or both systems, wait about a minute for the reset to complete. Then do a RESET, or Full Restart of the Unix side of the system as described above.

2.4 Shutting Down the IRIS2 System

Bring up the System Loader window and select **Exit** from the **File** menu. The tasks will then shut down in sequence and a progress dialog will report as they are closed down.

If any problems occur during shutdown (e.g. error messages, or the shutdown fails to close down all the tasks) you should then type **cleanup** to ensure all the tasks are removed.

2.5 Running a Test IRIS2 System

To test the IRIS2 hardware without interfering with observing — for example if another instrument is in use, the instructions are basically the same but we use account **iris2tes** in place of **aatobs**. This will ensure that we don't attempt to communicate with the telescope.

First start up the controller VxWorks system (aaovme5). There are instructions on how to do this next to the aaovme10 console. When it is ready:

1. Log into the IRIS2 Solaris machine (aaovme10) as **iris2tes**
2. Type the command **dits_netstart**
3. Type the command **tel**
4. Wait for the telescope system to start up
5. Type the command **iris2**

The **tel** command brings up a simulation version of the telescope system. This step can be omitted if you don't need to test any of the features which involve telescope communication.

2.6 Running the System in Simulation at the Telescope

To run a simulation version of the software system — that is one that simulates in software the IRIS2 hardware and the CCD controller — use the following steps.

1. Log into the IRIS2 Solaris machine (aatvme10) as **iris2tes**
2. Type the command **dits_netstart**

3. Type the command **tel**
4. Wait for the telescope system to start up
5. Type the command **iris2sim**

The **tel** command brings up a simulation version of the telescope system. This step can be omitted if you don't need to test any of the features which involve telescope communication.

2.7 Running the System in Simulation at Epping

Currently the simulation system at Epping can be run on either **aaovme9** or **aaossj.** The steps are as follows:

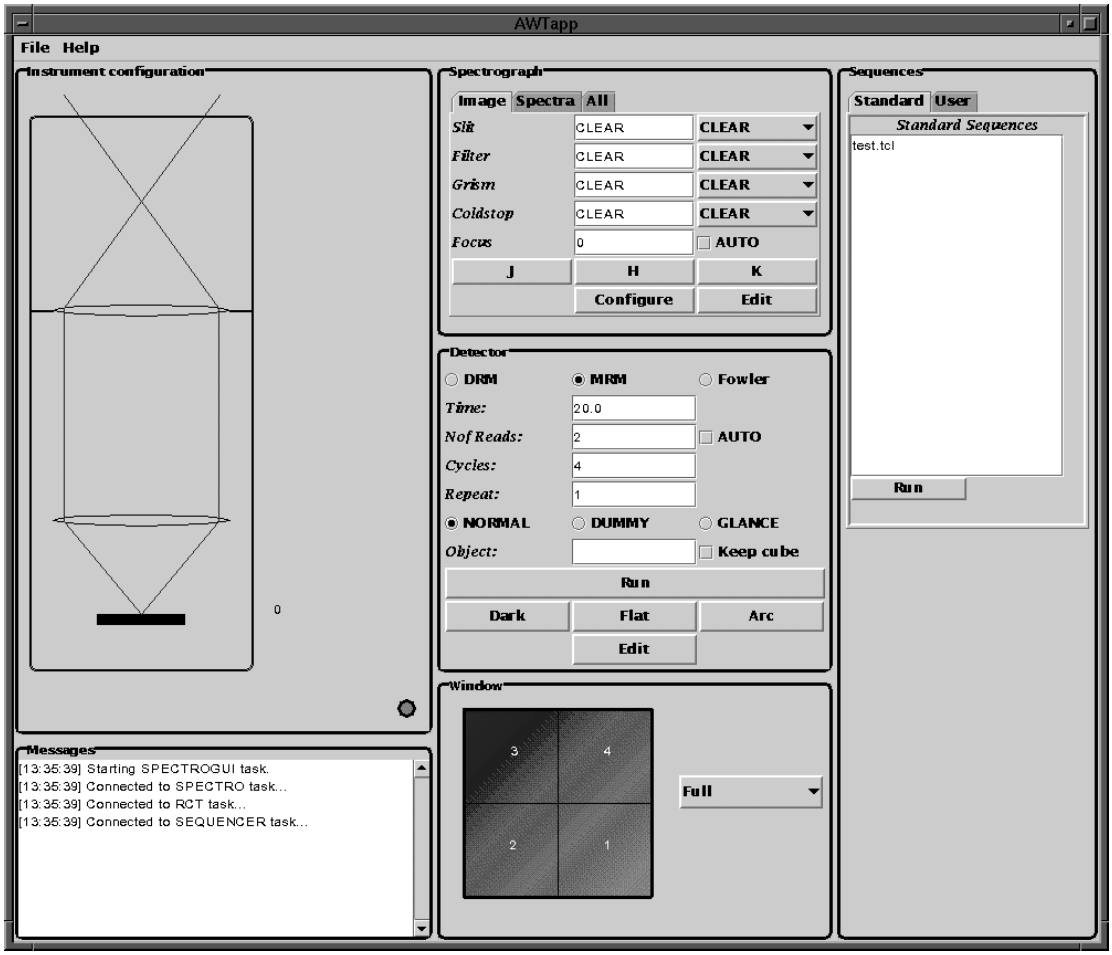
1. Log into the machine as **iris2tes**
2. Type the command **dits_netstart**
3. Type the command **tel**
4. Wait for the telescope system to start up.
5. Type the command **iris2sim**

2.8 Running with just the dewar mechanisms in simulation

It is also possible to run the system with just the dewar mechanisms in simulation, but running the actual detector system. To do this use the command **iris2dsim** instead of **iris2** or **iris2sim.**

3 The User Interface

The figure below shows the user interface as at 31/05/01. Some features still need to be implemented. Its use should be fairly straightforward. The upper center panel controls the IRIS2 dewar configuration. The selected configuration is also shown in the mimic display on the left. The lower center section controls the detector system and is used to specify and start an observation. The right hand panel is used to execute and edit sequences.



4 The Real Time Display

For this purpose we use the ESO real time display software in the form of the SkyCat application.

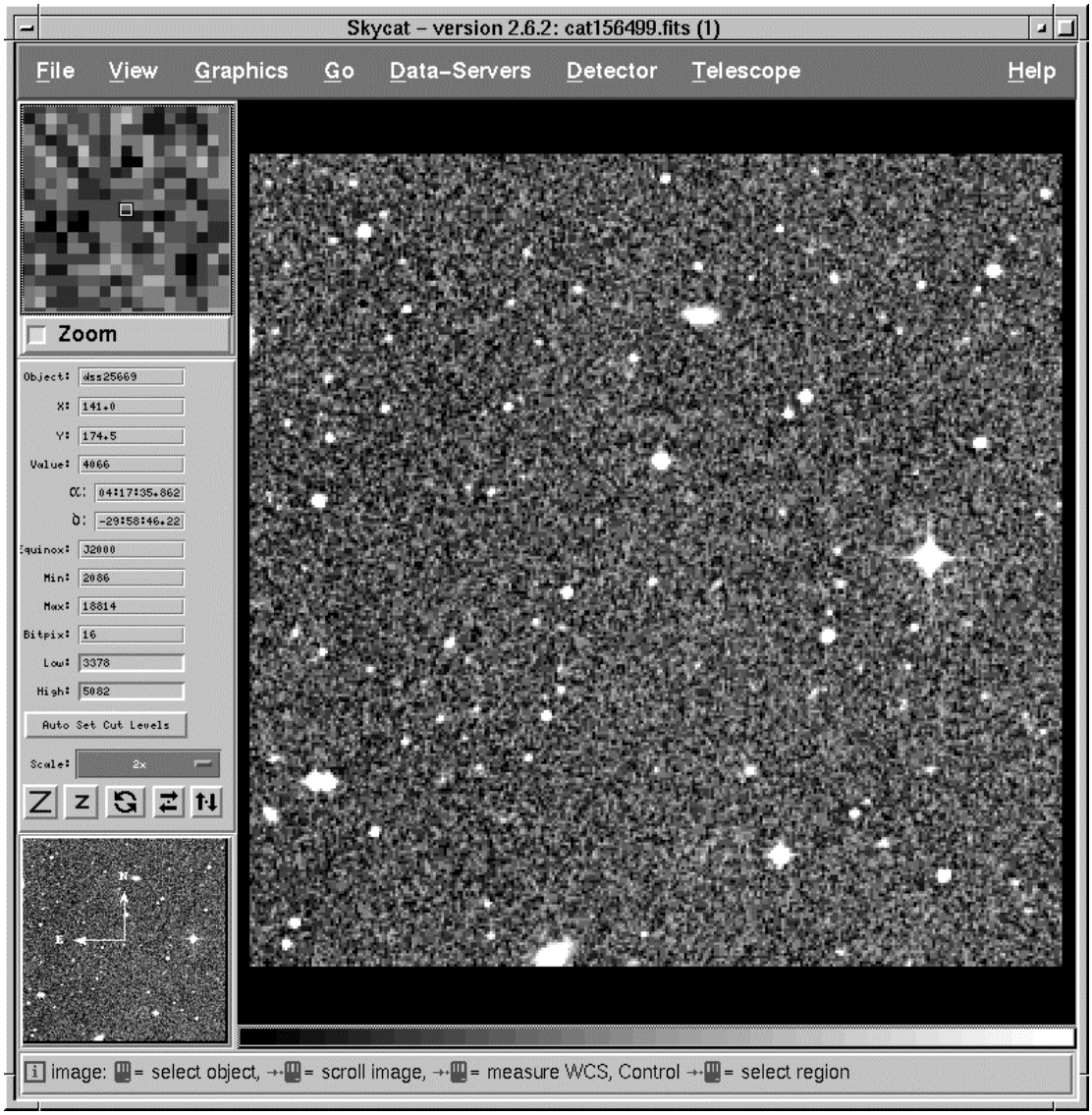
When the IRIS2 software is started the SkyCat application will be started (unless it is already running). The SkyCat version started from the IRIS2 software uses two AAO supplied plug-in components which appear as the **Detector** and **Telescope** menus.

4.1 Displaying Data

The SkyCat application can be used to display data from a number of sources including the following:

1. **The real time data from an observation**. This mode is selected by choosing the IRIS_PROC option in the DETECTOR menu. The data on the screen are updated on the last read of the cycle for double read mode and Fowler read mode, and on every read after the first for multiple read mode. The title bar will display the run number and cycle number. The data displayed are fully processed data including all previous cycles so in the course of an observation the S/N should visibly improve as additional cycles are added in.
2. **Data from a FITS file**. A FITS file can be read in by using the **Open…** option in the **File** menu. In this way data from previous runs in an observing session could be displayed for comparison with the current observation.

3. **Data from the Digital Sky Survey**. To do this use the **Data-Servers** menu and select **Image Servers** and **Digitial Sky at ESO**. This will let you select a position and size for the DSS image to be fetched, with the default being the position of the image currently displayed. Alternatively use **Get DSS Image** from the **Telescope** menu, which will return an image centered on the current telescope position



4.2 Multiple SkyCat Windows

It is possible to have more than one SkyCat window open at the same time. To open a new window choose **New Window** from the **File** menu. Alternatively if you want to open a window on a different display log in to the IRIS2 machine as **aatobs** and type **skycat**. Thus it is possible to have one window displaying processed data, another displaying a data file and a third displaying the DSS image of the field.

Alternatively multiple windows could be used to display additional copies of the observation for the Night Assistant or at other locations.

4.3 Saving Images

Any image displayed on the SkyCat display can be saved as a FITS file by using the **Save As…** option in the **File** menu. This can be useful for temporarily keeping idle or glance data. However, the files will not have the full header information that is recorded with the final IRIS2 data files.

4.4 Subtracting Bias

SkyCat includes a feature which allows a bias image to be subtracted from the image before display. This is accessed through the **Bias Image…** option in the **File** menu. It is possible to specify up to five bias images here which can be selected from as required.

4.5 Other Features

A number of useful features of the application can be accessed from the menus. Some of the more useful features are as follows:

4.5.1 Cut Levels

The **Cut Levels…** item in the **View** menu provides sophisticated control of the low and high scaling levels for the display. It is also possible to enter low and high levels in the panel to the left of the image.

4.5.2 Pick Object

The **Pick Object…** item in the **View** menu allows measurement of the position and size of a star image.

4.5.3 Pixel Table

The Pixel Table… item in the View menu brings up a table of the data values for a grid of pixels, and optionally some statistics on these values.

4.5.4 Graphics

The Graphics menu provides options for drawing graphics and text on top of the image. The graphics will correctly zoom and scroll with the image.

4.6 The Detector Menu

The Detector menu is used to select a data source for the real time display. In the case of the IRIS2 system the options will be IRIS_PROC, for real time data from IRIS observations, or IRIS_IDLE for IRIS idle mode data. The **Disconnect** menu item will stop real time data being displayed.

The SkyCat application may lose its connection with the IRIS2 software if the IRIS2 system was restarted after starting SkyCat. If that happens the **Reset Server Connection** menu item should reestablish the connection.

4.7 The Telescope Interface

The SkyCat application runs with a telescope plugin which allows interaction with the telescope as follows:

4. Shift clicking on the left mouse button will move the telescope to the indicated position on the image. A confirm dialog is put up before the move.
5. Shift clicking on the centre mouse button draws a cursor on the image. Cursors set up in this way can be removed with the **Clear Cursors** menu item.
6. The **Move to Selected Object…** menu item results in a telescope offset to the position of the selected object (objects are selected from catalogues accessed through the **Data-Servers** menu, either by clicking on the object in the catalogue list, or on the display).
7. The **Slew to Selected Object…** performs the same function but uses a slew command rather than an offset.
8. The **Get Telescope Position…** menu item returns the current telescope position in a popup dialog.
9. The **Get DSS Image…** menu item returns a digitial sky survey image centered on the current telescope position.

The SkyCat application may lose its connection with the telescope software if the telescope system was restarted after starting SkyCat. If that happens the **Reset Server Connection** menu item should reestablish the connection.

5 The Sequencer

5.1 Introduction

This section describes the sequencer task for the IRIS2 system. This task is responsible for executing sequences of operations which involve coordinated use of different subsystems, typically the detector, telescope and IRIS2 ‘spectrograph’.

The sequencer is designed to be sufficiently flexible to be used for other instruments based around the new AAO CCD controller.

5.2 Sequences

Sequences are specified in the form of text files. The main action of the sequencer task is the RUN action which executes a specified sequence. Sequences can be selected, edited and executed from the Sequences section of the IRIS2 user interface.

5.2.1 A simple example

Here is an example of a simple sequence file

```
#  Sequence to take two K band imaging runs at two telescope
#  positions

DETECTOR config iris_obs2
IRIS2 config k_imaging

TELESCOPE offset 0 0

DETECTOR run
TELESCOPE offset 0 20
DETECTOR run
TELESCOPE offset 0 0
```

The sequence consists of a series of commands. The first word in the command specifies the subsystem which the command applies to. There are three subsystems in the IRIS2 system.

DETECTOR — Commands involved in taking data from the detector are sent to this subsystem.

IRIS2 — Commands to setup the configuration of the wheels in the IRIS2 dewar are sent to this subsystem.

TELESCOPE — Commands to move the telescope are sent to this subsystem.

The first two commands in the sequence are **config** commands which specify configuration files for the data taking, and for the dewar mechanisms.

You must have a **config** command for the detector before doing any other detector operation. The file specified is an *observation description file* specifying the IRIS 2 data taking mode, exposure time, cycles, window etc. You make one of these files using the **Save As…** button on the Detector section of the user interface.

The **config** command for the dewar is optional, but if used it sets the positions of all the dewar mechanisms. These files can be created using the IRIS2 user interface using the **Save As…** button in the dewar section of the interface. .

The remaining commands specify a series of telescope offsets and data taking runs. A run is taken, the telescope is then offset 20 arc seconds and another run taken. The telescope is then returned to its initial position.

5.2.2 Waiting for events

While the above sequence will work, it won't do so with optimum efficiency. The reason for this is that it will wait for each step in the sequence to complete before starting the next one. In the case of a **run** command, the run does not complete until the data file is written to disk. However, we could actually start offsetting the telescope as soon as the exposure has completed. This can be achieved with the following version.

```
#  Sequence to take two K band imaging runs at two telescope
#  positions - optimized version.

DETECTOR config iris_obs2
IRIS2 config k_imaging

TELESCOPE offset 0 0

DETECTOR run -nowait
DETECTOR wait exposure_end
TELESCOPE offset 0 20
DETECTOR run -nowait
DETECTOR wait exposure_end
TELESCOPE offset 0 0
```

In this example the **–nowait** option is specified on the **run** command which causes this command to start the run and then return immediately. It is followed by a **wait** command which waits for a specific event, in this case **exposure_end**.

This mechanism allows two or more operations to be performed concurrently. For example:

```
IRIS2 filter K -nowait
TELESCOPE offset 10 10 -nowait
IRIS2 wait ready
TELESCOPE wait tracking
```

This will perform the filter movement and telescope offset concurrently and then wait for both operations to complete.

Note (9/07/01) – Using the –nowait option on a DETECTOR run command doesn't seem to work reliably at present.

Note that the default behavior (if **–nowait** is not specified) is always to wait for completion of any operation. This is safe if not necessarily optimum.

5.2.3 Using Tcl

The sequence files used by the sequencer task are actually in the Tcl language and are run by a Tcl interpreter incorporated in the task. Thus any Tcl features can be used within them. Here is an example which uses Tcl procedures and looping constructs.

```
#  Sequence to take two K band imaging runs at two telescope
#  positions and repeat 3 times.

proc nod {n} {

   DETECTOR config iris_obs2
   IRIS2 config k_imaging

   TELESCOPE offset 0 0

   set i 0
   while {$i <= $n} {
```

```
      DETECTOR run -nowait
      DETECTOR wait exposure_end
      TELESCOPE offset 0 20
      DETECTOR run -nowait
      DETECTOR wait exposure_end
      TELESCOPE offset 0 0
      incr i
   }
}

#  Execute the above procedure with n=3

nod 3
```

5.3 Sequence Commands

5.3.1 General Sequencer Commands

Command	Parameter(s)	Purpose
MESSAGE	string	Output a message on the Sequencer dialog
PAUSE	string	Output a message and pause until the user hits the CONTINUE button

5.3.2 DETECTOR Subsystem commands

Command	Parameter(s)	Purpose
config	Name of observation description file	Specify the observation description to be used for subsequent runs. This is the .sds form of the observation description file which can be generated from the text file by the OBSGEN utility.
run	obstype (optional)	Start a run as specified by the current observation configuration. Obstype specifies the type of observation (BIAS, DARK, ARC, FLAT, OBJECT, SKY)
recipe	Name of an ORACDR reduction recipe	Specify a reduction recipe to be used for subsequent runs in the sequence.
startgroup	maxgrp (optional)	Start an ORAC DR reduction group. The optional maxgrp parameter is the maximum number of observations in the group. The group is ended by an endgroup command or another startgroup.
endgroup	—	End a group started with startgroup
fits_real	Keyword, value, comment	Add a real FITS header entry for the next or current run

		next or current run.
fits_integer	Keyword, value, comment	Add an integer FITS header entry for the next or current run.
fits_logical	Keyword, value, comment	Add a logical FITS header entry for the next or current run. (value can be TRUE or FALSE)
fits_string	Keyword, value, comment	Add a character string FITS header entry for the next or current run.
comment	Comment string	Add a FITS comment record for the next or current run.
object	Object name	Specify an object name – used for all subsequent runs until changed.
exposure	Exposure time in seconds	Specify a new exposure time overwriting the value in the observation description.
cycles	Number of cycles	Specify a new number of cycles overwriting the value in the observation description.
reads	Number of reads	Specify a new number of reads overwriting the value in the observation description.
expose	—	For a multiple exposure CCD run, start a new exposure (Not implemented for IRIS2)
readout	—	For a multiple exposure CCD run, start the readout (Not implemented for IRIS2)

5.3.3 DETECTOR Subsystem events

Name	Event
exposure_start	Start of exposure (i.e. opening of the shutter for a CCD, or initial read for IRIS).
exposure_end	End of exposure (i.e. closing of the shutter for a CCD or final read for IRIS).
readout_end	End of readout
run_end	End of run. This means all activity associated with the run has completed, including writing the data file to disk.

5.3.4 TELESCOPE Subsystem commands

Command	Parameter(s)	Purpose
offset	EW and NS offsets (arc seconds)	Offset the telescope by the specified amount. The offsets are relative to a base position, and are in J2000 gnomonic projection.
offset_xy	X and Y offsets (mm)	Offset the telescope by a spcified amount in mm in the focal plane. The XY system is defined so that it is fixed relative to the detector however the instrument is rotated.
axis	Axis name (A, B or REF)	Change the telescope pointing axis.
control	ON or OFF	Turn telescope control on or off. This is needed before using either of the offset commands.

5.3.5 TELESCOPE Subsystem events

Name	Event
tracking	Telescope is tracking (i.e. has completed any movement)

5.3.6 IRIS2 Subsystem commands

Command	Parameter(s)	Purpose
config	Name of IRIS2 configuration file	Configure the IRIS2 mechanisms using a configuration file
slit	Slit position name	Move the IRIS2 slit/aperture wheel to a named position.
filter	Filter position name	Move the IRIS2 filter wheel to a named position.
coldstop	Coldstop position name	Move the IRIS2 coldstop wheel to a named position.
grism	Grism name	Move the IRIS2 grism wheel to a named position.
focus	Focus offset in steps	Move the IRIS2 detector to a new focus offset.

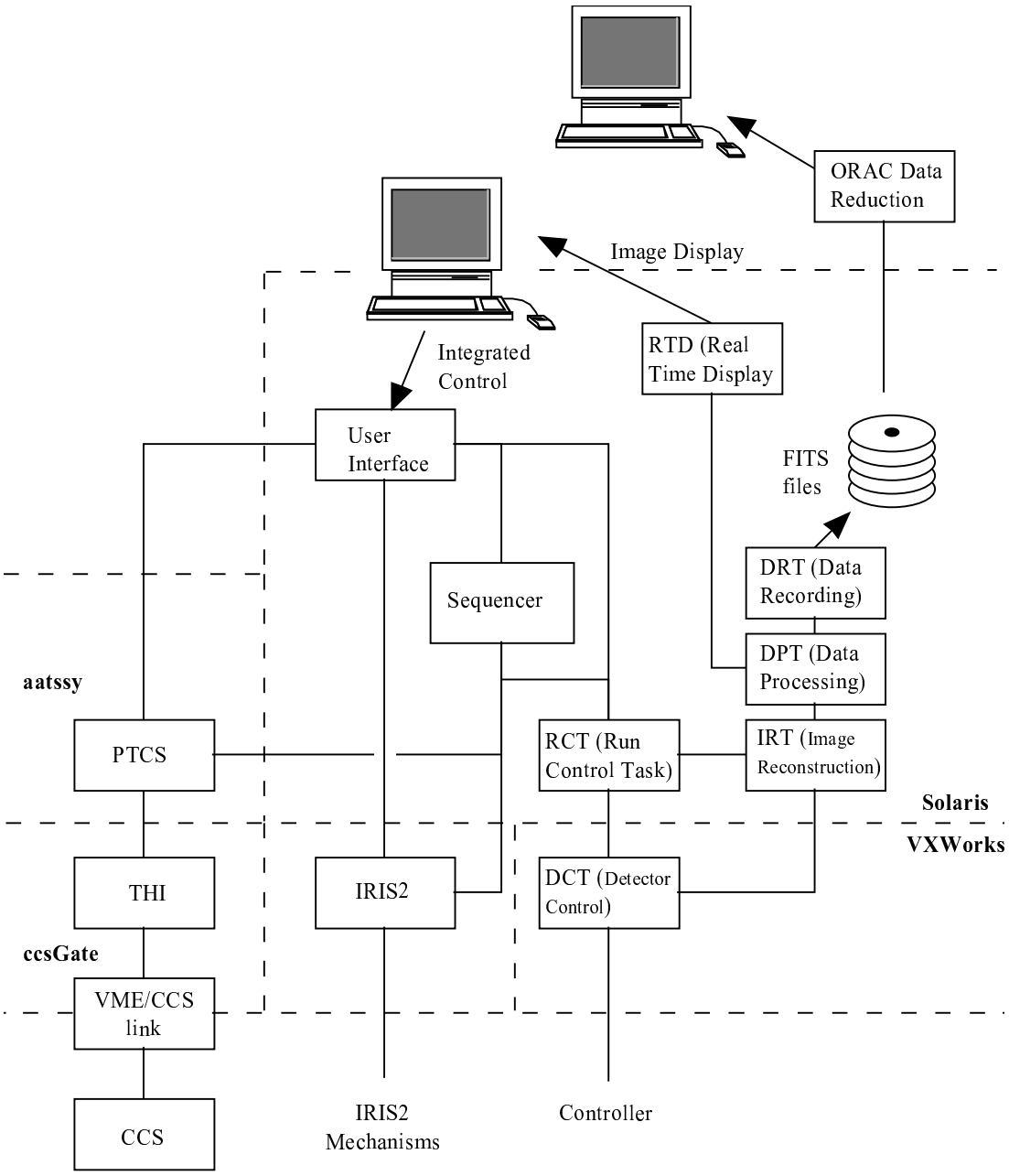
5.3.7 IRIS2 Subsystem events

Name	Event
ready	Instrument is ready (i.e. all mechanisms have completed any requested movements).

6 The Software System

The main tasks involved in the software system are shown in the diagram below. A full list and brief description of each task is given in the next section.

Most of the software runs on a dual processor VME system which contains both a 680x0 processor running VxWorks, and a Sparc processor running Solaris. The DCT task which has the direct connection to the detector runs on the VxWorks processor with the rest of the system running on the Sparc processor. The telescope and IRIS2 systems each have their own VME machine, and the PTCS software runs on aatssy.



IRIS 2 - Software system

7 List of Tasks

This section describes the various tasks involved in the IRIS2 software system.

7.1 Run Control Task (RCT)

The RCT is responsible for the overall control of the sequence of events involved in taking a run. It does this by coordinating the operation of the DCT, IRT, DPROC and DRT tasks. It is also responsible for informing all tasks that provide information for the FITS header of the start and end of an exposure, so that they can forward their header data to the DRT.

7.2 Detector Control Task (DCT)

The DCT is the task which is in direct communication with the CCD controller via the fibre optic link. It is responsible for downloading information and commands to the controller and receives the image data back from the controller. It passes the data on to the IRT.

7.3 Image Reconstruction Task (IRT)

The IRT receives the data from the DCT and has the job of combining the data received from the four quadrants of the detector and reconstructing an image of the correct format for the window being used. It then passes the data on to the data processing task.

7.4 Data Processing Task (DPROC)

The DPROC task performs any data processing required for the observing mode in use. For example subtracting the start and end reads in two read mode, or fitting of a straight line in multiple read mode as well as combining the cycles. The processed data is passed to the real time display task for display, and to the data recording task for final recording.

7.5 Data Recording Task (DRT)

The DRT receives the final data from DPROC and is responsible for writing the data files. It also has to collect from all relevant tasks the information needed to construct the FITS headers for the file.

7.6 Display Server Task (DSERV)

The DSERV task provides an interface between the real time display (SkyCat) task and the data processing task. It maintains a list of named image sources which the display can be connected to by selection from its **Detector** menu.

7.7 PTCS SkyCat Interface (PTCS_SKYCAT)

This task provides an interface between the real time display (SkyCat) task and the telescope control system. It supports the functions in the **Telescope** menu of the display task.

7.8 Portable Telescope Control System (PTCS)

The Portable Telescope Control System (PTCS) provides the interface to the telescope control computer, and enables the IRIS2 system to request information it needs for the FITS headers as well as send commands to offset, beamswitch etc.

Initially we are using an interim system in which a modified PTCS task interfaces with the existing Interdata telescope control computer. At some time in the future we will probably move to a system in which the telescope is directly controlled by the PTCS

(this is planned as part of the Observatory Infrastructure project). Since the interface will be unchanged this should have minimal impact on the IRIS2 system.

7.9 Real Time Display (SkyCat)

This task provides a real time display of data from the detector (replacing the XMEM display in the old AAO system). It has not been written at AAO. Instead we are using the real time display RTD system developed by ESO. The RTD has an extensible structure and has been built in to a number of applications. The one we are using is the SkyCat application which adds some catalogue access capabilities to the basic RTD. We also use two plug-ins of our own to enable the RTD to interface to our detector and telescope systems. These show up as additional **Detector** and **Telescope** menus on the application.

7.10 Sequencer Task (SEQUENCER)

The SEQUENCER task performs coordinated high level control of the entire IRIS2 system. It can control observational sequences which includes commands executed by the RCT, the PTCS and Spectrograph tasks. Sequences are programmed in the form of text files.

7.11 IRIS2 Spectrograph Task (SPECTRO)

This task performs direct control of the mechanisms in the IRIS2 dewar. There are four wheels plus the detector focus mechansism.

7.12 IRIS2 User Interface (SPECTROGUI)

This task provides the overall graphical user interface for the instrument.

7.13 System Loader Task

This task is responsible for loading all the other tasks in the system (except for the PTCS task which is expected to be already running). It also sends appropriate initialization and configuration commands to each task and can be used to reset the system.

8 Files used by the IRIS2 system

This section lists configuration files used in the IRIS 2 system which might occasionally need changing in the course of maintaining the system.

8.1 setup.csh

This cshell script sets up environment variables and aliases needed by the IRIS2 system. It is run on login to one of the IRIS2 accounts.

Location of file used by system: SETUP_DIR

Source location: /instsoft/iris2/setup

8.2 iris2.cfg and related files

There is one of these files for each command used to start the system (iris2, iris2sim etc.). These are configuration files used by the System Loader Task to know how to load the system. The file contains information on the node names on which various tasks run, and the IP number of the Solaris machine, whether tasks like the DCT and SPECTRO are simulating, and the root directories for data, log files etc.

Location of file used by system: SETUP_DIR

Source Location: /instsoft/iris2/setup

8.3 iris2startup.csh and related files

There is one of these files for each command used to start the system (iris2, iris2sim etc.). These are the cshell scripts which are executed by the commands.

Location of file used by system: SETUP_DIR

Source Location: /instsoft/iris2/setup

8.4 Wheel definition files

There is one of these files for each of the wheels in the IRIS2 dewar (FILTER.cfg, GRISM.cfg, SLIT.cfg, COLDSTOP.cfg). They are text files describing the contents of the wheels. The files are used by the SPECTRO task, and also by the User Interface (to construct the menus of wheel positions).

Location of file used by system: SPECTRO_DIR

Source Location: /instsoft/iris2/spectro

8.5 default.job

This file is read by the DCT on startup or reset. It lists files to be downloaded to the controller (see Controller Files below).

Location of file used by system: DCT_DIR

Source location: /instsoft/iris2/dct_tests

8.6 DCT_Configurations

This file is a text file used by the DCT which specifies the modes and speeds supported by the Controller. It may refer to other files (such as .spd files) which are either in the same directory (if a file name alone is specified) or in the /devccd directories.

Location of file used by system: DCT_DIR

Source location: /instsoft/iris2/dct_tests

8.7 Controller Files

There are a large number of files providing information to be downloaded to the controller, such as waveforms, parameters etc. The detailed description of these falls outside the scope of this document (they are maintained by the electronics group). The files are found in a directory which appears to the VxWorks system as /devccd. It can also be accessed as ~devccd/newccd on aaossk or as /home/aaossk/devccd/newccd on aaoprog.