Contents

Getting Things Running

1.1 Hardware Setup.............................................................................................................1
1.2 Starting the HRC Software..........................................................................................1
1.3 Stopping the HRC Software.......................................................................................1

GUI Reference

2.1 MAIN > Comm-Links Status Indicator.......................................................................4
2.2 MAIN > Miscellaneous indicators.............................................................................4
2.3 MAIN > Exposure Progress Indicators.......................................................................4
2.4 MAIN > Filter Wheel Indicators and Controls...............................................................4
2.5 MAIN > TCS Parameters............................................................................................5
2.6 MAIN > Image file parameters...................................................................................5
2.7 MAIN > Exposure Parameters Pane...........................................................................5
2.7.1 Detector Setup Window..........................................................................................6

Common Operations

3.1 Taking a Single Exposure.............................................................................................8
3.2 Taking a Kinetic Series.................................................................................................8
3.3 The MOVIE mode........................................................................................................9
3.4 Changing The Detector Readout Parameters.............................................................10

Configuration Files

4.1 Configuration Files.....................................................................................................11
4.1.1 ENV_Default.cfg...................................................................................................11
4.1.2 ENVSLCN_Default.cfg..........................................................................................11
4.1.3 Filters_Default.cfg...............................................................................................12
4.1.4 HRCAPP_Default.cfg...........................................................................................12
4.1.5 INSDEVICE_Default.cfg.....................................................................................13
4.1.6 lucaDefault.cfg....................................................................................................13
4.1.7 PIPS_Default.cfg..................................................................................................14
4.2 Header Templates......................................................................................................14
Trouble-Shooting

5.1 The ENV_MAIN Monitor.................................................................15
5.2 The PAN indicator Is In Red after Startup/Initialization..............................15
5.3 The Initialization times out and the Filters show “no response”..........................15
5.4 The GUI indicators Went Bananas!..........................................................15

Real Time Display

Glossary
Chapter 1: Getting Things Running

This user manual is intended to describe the use of the High Resolution Camera Software (HRCSOFT) from a user's point of view. It is not a programming manual. For implementations details please read the HRCSOFT Programmer Manual.

1.1 Hardware Setup

Before firing up the HRCSOFT, and with the HRC computer turned ON, some hardware has to be powered up:

Power up the Luca Camera. The host computer should be turned ON at this time!

Make sure the filter wheel is powered up and that the RS-232 cable is plugged in.

**IMPORTANT:** The host computer should be turned ON when powering up the Luca CCD. This assures correct detection of the USB device by the host computer.

1.2 Starting the HRC Software

You can launch the HRCSOFT program from your favorite terminal. Open a shell window and invoke the HRCSOFT program with the following command:

```
% cd /home/ao/HRCsoft/bin
% ./start_hrc
```

The splash screen pops up, and stay on top until the Andor acquisition system is initialized (Luca Camera API). After a few seconds (~10 sec) the main GUI window appears. The application is now running and ready to receive commands. Look for the connections in the upper part of the GUI for possible problems. Red color means error.

**IMPORTANT:** Some time the GUI takes some time to open the TCP socket connection to the IC Device. Be patient and wait.

If everything went fine then the PAN and ICS icons will be in orange color meaning they are in OFFLINE state. Press the INIT button to bring the system to operational ready state.

After pressing the INIT button the PAN and ICS icons flash to yellow color signaling ACTIVE state while initializing. Wait for them finish. Now the system is ready to take exposures.

1.3 Stopping the HRC Software.

To stop the HRC software press first the OFFLINE button to bring the system into OFFLINE state.
Chapter 1: Getting Things Running

Then press the SHUTDOWN button to actually quit the application program.
Chapter 2: GUI Reference

When the application starts the user is presented with a single window containing the most relevant system status variables (). If the boot process ended with no failures then the application is ready to receive commands.

**Figure 1**: Main GUI. The most relevant indicators and controls are displayed.

**INIT**. Use this button to initialize the instrument subsystems. During this process the camera cooler will be turned ON, the default parameters of the detector will be loaded, and the filter wheel will be initialized.

**OFFLINE**. Use this button to off-line the instrument subsystems. During this process the camera cooler will be turned OFF, and the last exposure parameters will be saved to the HRCAPP_Default.cfg configuration file (see section TBD).

**SHUTDOWN**. Use this button to exit the program. The button is enabled only after the program is in the off-line state.
Chapter 2: GUI Reference

2.1 MAIN > Comm-Links Status Indicator

The comm-link indicator uses a color code to represent the status of the subsystems involved in the HRCSOFTWARE operation: PAN, ICS, DHS, TCS and OPEx\(^1\). The code is Red = Problems, White = No Connection, Green = Idle, Yellow = Active, and Orange = Offline.

2.2 MAIN > Miscellaneous indicators

- **PAN State**: Camera controller logic device state. The state can be one of IDLE, OFFLINE, ERROR, or ACTIVE.
- **ICS State**: Instrument control logic device state. The state can be one of IDLE, OFFLINE, ERROR, or ACTIVE.
- **CCD Temperature**: CCD temperature in C degrees.
- **Last Error**: Information box showing the last fault registered by the system. Warning and the result of certain operations are also shown here.

2.3 MAIN > Exposure Progress Indicators

While taking an exposure, the progress indicator give feedback on the current state of the operation.

- **# Exp Done**: This bar presents the number of images acquired during the present sequence. The user can request multiple exposures in the # Exp control.
- **Exposure Time**: Shows the elapsed time during the current exposure. Useful during kinematic series of exposures.
- **Readout & Write**: The percent of advance in reading images to memory and writing them to disk.
- **Disk Space Used**: The amount of space left in the volume to which the selected Path belongs to. Gets updated after every exposure.

2.4 MAIN > Filter Wheel Indicators and Controls

To the right of the main window are the filter wheel indicators and controls.

- **Filter Position**: A number from 1 to 10 indicating the current physical wheel position. When moving this indicator shows the word MOVING.
- **Filter**: A user defined label corresponding to each filter position is shown here. See section TBD to learn how to edit the associated configuration file. When moving this indicator shows the word MOVING.

\(^1\) The OPEx reference is here only for completeness. Its implementation is completely beyond the scope of the HRCSOFTWARE.
Moving LED. This indicator is lite when the filter wheel is moving.

Filter Target. Use this combo box to select a filter position. The list presented in the combo box is matches the user defined labels described in section TBD.

Move Filter. Press this button to move the filter wheel to the selected target position.

2.5 MAIN > TCS Parameters

RA. Right Ascention

Dec. Declination

Rotator. Rotator mechanical angle.

UT. Universal time.

Airmass.

Rotator PA. Rotator position angle.

Focus.

ADC. TBD

2.6 MAIN > Image file parameters

Path. Directory path in which the images will be stored.

Basename. Root name for the exposure. File name will be form by appending the sequence number to this base name.

SeqNum. Sequence number. A positive integer that will be appended to the base name to form the actual image file name.

Last Filename. Name of the last image file written to disk.

2.7 MAIN > Exposure Parameters Pane

To the bottom of the main window is the exposure parameters pane. The user will most often interact with these set of controls.

Current Config. This label presents the current detector configuration file loaded as defined in the HRCAPP_Default configuration file (see section TBD).

Detector Setup. Press this button to open the detector setup window. See section TBD for more details.
Chapter 2: GUI Reference

2.7.1 Detector Setup Window

Use this window to configure the detector readout parameters: EMCCD gain, binning factors, and

Figure 2: Detector setup window. Predefined detector configurations are available from a configuration file.

Title. User defined title. Associated to the TITLE keyword in the FITS file.
Object. Object name. Associated to the OBJECT keyword in the produced FITS file.
Comments. User defined comments. Associated to keyword COMMENT in the produced FITS file.

# Exp. Number of exposures to take. Each exposure will be saved to its own FITS file.
ExpTime. Exposure time in seconds. The minimum value accepted by the controller is 0.00001 second.

Mode. Acquisition mode: Single Scan or Kinetics mode. Under kinetic mode a sequence of exposures is taken by the camera at a predefined cycle time, and stored as a FITS data cube in disk.

Cycle Time. Time between start of exposures under kinetic mode. The input box is enabled when the kinetic acquisition mode is selected.
Number. Number of exposures to take under kinetic mode. The input box is enabled when the kinetic acquisition mode is selected.

ABORT. Use this button to abort the current acquisition.
STOP. Use this button to stop the current acquisition. This command will wait for the current exposure to finish and then will stop any further activities.
GO. Start and exposure sequence. When the GO button is pressed the exposure parameters are passed to the controller and then the acquisition starts.
regions of interest. When the window is opened the current parameters are shown. Enter the new parameters and the press the *Apply* button to actually set the new values. Use the *Defaults* button to restore all the parameters to their default value. When ready close the window by pressing the *Close* button.
Chapter 3: Common Operations

3.1 Taking a Single Exposure

Follow the steps below to take a single exposure.

1. Check that the status icons at the top of the main window GUI are all green. That indicates that the program is in the IDLE state and ready to receive commands.

2. Select the type of exposure you want to take using the radio buttons in the exposure controls pane (Figure TBD)

![Figure 3: Use the radio buttons to select the type of exposure. Controls will be enabled/disabled depending on the selected mode.](image)

3. Select the **Single Scan** option from the **Acquisition Mode** combo box.

4. Optionally enter a title, comments, and object name. These fields will be added as keywords to the produced FITS file.

5. Optionally select from the Filter combo box the filter to use during the exposure.

6. Press GO. The status icons go from green to yellow (ACTIVE state) and back to green to indicate that the frame has been taken. If the real-time display is running (see chapter TBD) the frame will be displayed.

3.2 Taking a Kinetic Series

1. Check that the status icons at the top of the main window GUI are all green. That indicates that the program is in the IDLE state and ready to receive commands.

2. Select the **OBJECT** type of exposure \(^2\) using the radio buttons in the exposure controls pane

\(^2\) It is possible to select though the Kinetic mode under all modes but Movie.
3. Select **Kinetics** option from the *Acquisition Mode* combo box.

4. Enter the Kinetic cycle time and the number of kinetic frames to take in the *Cycle Time* and *Number* input boxes.

5. Optionally enter a title, comments, and object name. These fields will be added as keywords to the produced FITS file.

6. Optionally select from the Filter combo box the filter to use during the exposure.

7. Press GO. The status icons go from green to yellow (ACTIVE state) and back to green to indicate that the series has ended. If the real-time display is running the data cube will be displayed. This might take a while depending on the number and size of the frames in the data cube.

### 3.3 The MOVIE mode

The movie mode might come handy when acquiring a star and then focusing. The HRCSOFT can be used together with the HRC real-time display to take multiple exposure in the so-called MOVIE type of exposure. In this mode the HRC software grabs a frame every one second and alternates while saving to disk between two files called movie1.fits and movie2.fits. If the real-time display is running and monitoring the output directory, then a continuous refresh will be observed. Follow the steps below to start and stop the MOVIE mode.

1. Check that the status icons at the top of the main window GUI are all green. That indicates that the program is in the IDLE state and ready to receive commands.

2. Select the **MOVIE** type of exposure using the radio buttons in the exposure controls pane.

3. Select the exposure time.
Chapter 3: Common Operations

4. Press GO to start acquiring images.

5. Press STOP to stop acquiring images. Wait for the status indicator to go green (IDLE state) before attempting further operations, otherwise your commands will be rejected.

3.4 Changing The Detector Readout Parameters

1. Open the Detector Setup window (section TBD)

2. Enter in the input boxes the desired values.

3. Optionally select predefined configurations using the buttons or the combo box to the right of the GUI window. This configuration are stored in the PIPS_Default.cfg configuration file (see section TBD).

4. Press the Apply button to set the new parameters. In case of error it is always possible to go back to the default parameters by pressing the Defaults button.

5. Use the Close button or the ESC key to quit the GUI window.
Chapter 4: Configuration Files

Configuration files provide a mean to set multiple system parameters to some predefined value. Some of the parameters can be changed by the user during run-time, others will remain fixed and can only be changed by editing the files and restarting the software application. A detailed description of the configuration files and their parameters follows.

4.1 Configuration Files

Most configuration files follow a common format. Files are divided in multiple sections, each one beginning with a keyword enclosed in square brackets. Each section lists a parameter name followed by an equal sign and its value. A semicolon marks the beginning of a short parameter description.

```
[Section Keyword]
Parameter = Value ; this is the parameter description
```

The name and path of these files is fixed and can not be modified since they are hard coded in the software. Some of these files have keywords to point to other configuration files which can have user defined names.

All configuration files are expected to live in the directory `/home/ao/HRCSoft/config`.

4.1.1 ENV_Default.cfg

Two versions of this file exist. One for the program daemon and the other for the program GUI. One lives under directory HRCAPP and the other one under directory HRCGUI. This file defines the behavior of the ENV_MAIN module, the SML task spawner and monitor.

```
[ENVIRONMENT]
MainVisible= ; make the module visible or not

[DEVICES]
<YOUR DEVICE NAME>=<ITS PATH> ; List of logic devices to spawn
.

[SERVERS]
<MY SERVER NAME>="" ; List of SCLN servers to spawn

[TRANSLATIONS] ; Logic device proxys
<DEVICE A>=<DEVICE B> TX <DEVICE A>
```

4.1.2 ENV_SCLN_Default.cfg

The SML user the SOAR communication library (SCLN) when communication happens over the net.
Chapter 4: Configuration Files

The SCLN is an implementation of a network communication layer that suits the interoperability requirements of the SOAR telescope environment.

Two versions of this file exist. One for the program daemon and the other for the program GUI. One lives under directory HRCAPP and the other one under directory HRCGUI. Each section in the configuration file defines a client-server pair with the corresponding listening port.

```
[CommLib]
Version= ; Version for which this configuration is usable

[MY DEVICE]
IP_Server= ; IP address of the server
IP_Client= ; IP address of the client
IP_Port= ; Remote port number
```

For more information on the SCLN and its protocol read the document “SOAR Communication Library New” available at the SAM web site archive.

### 4.1.3 Filters_Default.cfg

The configuration file is FILTER_Default.cfg. It has multiple sections to support more than one filter wheel, in tandem configuration. The main section is SETUP_FILTER_. Here all the combinations are described in the form of filter combos. The remaining sections are specific to each wheel. When moving filters by name, it is the combo name the one used.

```
[SETUP_FILTER_W1_]
SETUP_FILTER_W1_SIZE=10
SETUP_FILTER_W1_P1_NAME=OPEN
SETUP_FILTER_W1_P1_FOCOFF=0.000000
.
.
[SETUP_FILTER_]
SETUP_FILTER_SIZE=10
SETUP_FILTER_F1_NAME=OPEN1
SETUP_FILTER_F1_POSW1=1
SETUP_FILTER_F1_POSW2=1
SETUP_FILTER_F1_FOCOFF=0.000000
SETUP_FILTER_F1_COMBO=OPEN+OPEN
SETUP_FILTER_F1_COLOR=16777215
.
.
```

### 4.1.4 HRCAPP_Default.cfg

Use this configuration file to keep the default values for the HRC software daemon.

```
[SETUP_EXPPARMS_]
```
Chapter 4: Configuration Files

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>REPEATS</td>
<td>Number of exposures in a sequence</td>
<td></td>
</tr>
<tr>
<td>TIME</td>
<td>Exposure time</td>
<td></td>
</tr>
<tr>
<td>ACQMODE</td>
<td>Scan mode, 4 = kinetics mode</td>
<td>1</td>
</tr>
<tr>
<td>KINETICS</td>
<td>Number of frames in a kinetics series</td>
<td></td>
</tr>
<tr>
<td>KINETICSCYCLE</td>
<td>Time between start of exposure in kinetic series</td>
<td></td>
</tr>
<tr>
<td>SEQNUM</td>
<td>Sequence number to build file name</td>
<td></td>
</tr>
<tr>
<td>PATHBASE</td>
<td>Default directory path to store images</td>
<td></td>
</tr>
<tr>
<td>TITLE</td>
<td>Default title</td>
<td></td>
</tr>
<tr>
<td>COMMENT</td>
<td>Default comments</td>
<td></td>
</tr>
<tr>
<td>OBSERVER</td>
<td>Default observer</td>
<td></td>
</tr>
<tr>
<td>CONFIGNORMAL</td>
<td>Default detector configuration</td>
<td></td>
</tr>
</tbody>
</table>

The [SETUP_DHS_] section stores a lookup table between FITS keywords and database topics. Keyword values are stored in the database under topics. To program uses <TOPIC> and <KEYWORD> to build the database variable and obtain the keyword value.

4.1.5 INSDEVICE_Default.cfg

This is the configuration file for the filter wheel. Right now has a single key that identifies the serial port to which the filter wheel is connected.

```
[GENERAL]
COM=2
```

4.1.6 lucaDefault.cfg

This is the default camera controller configuration. Although this configuration file has been named lucaDefault.cfg here, its name can be anything. The keyword CONFIGNORMAL in HRCAPP_Default.cfg points the right name.

```
[GENERAL]
TEMPERATURE=-20 ; temperature set-point in C degrees
DETSIZEX=658 ; detector size in x
DETSIZEY=496 ; detector size in y

[ARRAY_VOLTAGES]
EMGAIN=0 ; EMCCD gain [0-255]

[READOUTPARAMS]
READMODE=4 ; read mode, 4 = image
ACQMODE=1 ; acquisition mode, 1=single, 3=kinetics
```

Chapter 4: Configuration Files

EXPOSURETIME=0.10; exposure time in seconds
IMAGE="1 1 1 658 1 496"; binning and region of interest
KINETICS=1; number of kinetic frames
KINETICSCYCLE=0.2; time between kinetics frames
ACCUMULATIONS=1; number of frames to accumulate
ACCUMULATIONSCYCLE=0.2; time between accumulations
TRIGGERMODE=0; 0=software

4.1.7 PIPS_Default.cfg

This is the configuration file for the Detector Setup Plugin. Each section correspond to a detector setup that defines the ROI and the EMCCD gain to use. When the window is open the section contents are loaded. The first three sections of the file are assigned to the three quick setup buttons available and the boolean text for each button is updated to show the section name it corresponds to.

All sections including the ones assigned to the quick setup buttons are listed in the setup combo box. The configuration file sections include five keywords

[Section Name]
GAIN= ; EMCCD gain to use
HCENTER= ; ROI center in x
VCENTER= ; ROI center in y
HSIDE= ; ROI side in x
VSIDE= ; ROI side in y

4.2 Header Templates

The header template is used by the program to generate FITS file headers. Each line of the line correspond to a keyword. If the word database is included then the value to fill in is extracted from the program database. Otherwise the value in the template file is used. A brief example follows

FILENAME='database' /Original host filename
TITLE = 'database' /Observation title
OBJECT = 'database' /Observation object
OBSTYPE = 'database' /Observation type

Each keyword in the example above will get its value from the program database.
Chapter 5: Trouble-Shooting

5.1 The ENV_MAIN Monitor

The HRC software has been written using SML (SOAR message library). SML applications use the ENV_MAIN module to spawn an monitor the activity of the software modules that built an SML application. If ENV_MAIN module is visible or not depends on the configuration file ENV_Default.cfg.

The HRC software has the ENV_MAIN module visible for trouble-shooting purposes. The module usually lives minimized in the task bar, and the user can open it at any time to check in detail the status of the logic devices. By using the SHOW buttons array the user can choose to open a device, check status, etc.

5.2 The PAN indicator Is In Red after Startup/Initialization

Check that the camera power is on, then that the USB cable is plugged in. Always turn the PC on first and only when the booting has finished turn the camera on. Use the ENV_MAIN module and look for the PAN_DEVICE for further information.

5.3 The Initialization times out and the Filters show “no response”

Check that the filter wheel is powered on and that the serial cable is connected to the right port (see section TBD for details on the configuration file). Use the ENV_MAIN module and look for the INSDEVICE for further information.

5.4 The GUI indicators Went Bananas!

Restart the application. This symptom might indicate an out of sync problem between logic devices in their message queues. It is known that Labview runs its networking implementation in the user interface thread. Things like blocking the execution of the thread (intense use of user interface resources) can cause a drop in communications, and this in turn can cause races conditions that right now the message library can neither prevent nor detect. A future implementation of SML might deal with this problem.
Chapter 6: Real Time Display

An application was written specially to suit the need of real time display capabilities when using the High-resolution camera. The HRCRTD software is a stand alone piece of software that continuously monitor the selected directory for new images and display them using ds9 as its display server.

When a new FITS file is written to the specified directory, the HRCRTD program waits until the file is closed before asking ds9 to display it. The communication between the HRCRTD program and ds9 is done using the XPA utilities. Ds9 and the XPA utilities plus documentation are available at http://heasarc.gsfc.nasa.gov/docs/software/software_stories/ds9/.

Figure 5: The HRCam real time display continuously monitors a directory for new images and display them using ds9.
Chapter 7: Glossary

DHE
Detector head electronics

ICDevice
Stands for Instrument Control Device. Is one of the logic devices that built the HRCAPP daemon.

ICS
Instrument Control System

PAN
Pixel Acquisition Node. Logix unit representing the DHE plus interfaces.