

# **Instrument Control Software User's Manual**

---

## **SOAR Adaptive Module (SAM)**

**Revision 3.7.0, November 2013**

## Change Record

<i>Version</i>	<i>Date</i>	<i>Description</i>	<i>Owner Name</i>
3.5.1	July 22, 2013	Fix LASER Tab documentation	R.Cantarutti
3.6.0	September 11, 2013	Add SLCH Interlock Override control indicator	R.Cantarutti
3.7.0	November 28, 2013	Reorder/update sections 2.4 to 2.14. Update sections 2.15.2, 2.18, 2.10 and 4.1.1	R.Cantarutti

# Table of Contents

## Chapter: 1 Getting Things Running.....1

1.1 Starting the Instrument Control Software.....	1
1.2 Stopping the Instrument Control Software.....	1
1.3 Environment Variable ICSOFT_HOME.....	1
1.4 Command Line Options.....	1

## Chapter: 2 GUI Reference.....3

2.1 MAIN > Menu Bar.....	3
2.1.1 MAIN > Menu Bar > AO-Loop Menu.....	3
2.1.2 MAIN > Menu Bar > TT-Loop Menu.....	4
2.1.3 MAIN > Menu Bar > WFS Menu.....	4
2.2 MAIN > General Status Pane.....	4
2.2.1 MAIN > General Status > Comm-Links.....	4
2.2.2 MAIN > General Status > Last Error Message Box.....	4
2.3 MAIN > General Control Pane.....	5
2.4 MAIN > Control Loops.....	5
2.5 MAIN > Selector Mirror Pane.....	5
2.6 MAIN > Loop Control Buttons.....	5
2.7 MAIN > Events & Commands Box.....	6
2.8 MAIN > Guide Probes Status Parameters Pane.....	6
2.9 MAIN > WFS Status Pane.....	7
2.10 MAIN> SOAR M3 Pane.....	8
2.11 MAIN> LLT M3 Pane.....	8
2.12 MAIN > Loop Parameters Pane.....	8
2.13 MAIN > SLCH Parameters.....	8
2.14 MAIN > TCS Parameters.....	9
2.15 MAIN > Operation Tab.....	9
2.15.1 Scripts Controls.....	10
2.15.2 Graphic View.....	10
2.16 MAIN>Catalogs Tab (DEPRECATED!).....	11
2.17 MAIN>Guide Probes Tab.....	12
2.18 MAIN> WFS / TURSIM Tab.....	14
2.19 MAIN > LLT / LASER Tab.....	16
2.20 MAIN> ADC / TCS.....	18
2.21 MAIN > Telemetry Tab.....	19
2.22 MAIN>Maintenance.....	19
2.22.1 MAIN > Maintenance > [RTC   AOM   LM   TCS] Manager.....	19
2.22.2 MAIN > Maintenance > Sync [RTC   AOM].....	20

## Chapter: 3 Common Operations.....21

3.1 Centering a Guide Probe.....	21
----------------------------------	----

3.2 Parking a Guide Probe.....	21
3.3 Guide Probe APD Activation.....	21
3.4 Guide Probe APD Bias Calibration.....	21
3.5 Using TURSIM.....	21
3.6 Adjusting TURSIM light source.....	22
3.7 Flattening the DM.....	22
3.8 Flattening the DM taking rotation into account.....	22
3.9 Recording a new Flatten DM file.....	22
3.10 Resetting the WFS.....	22
3.11 Tracking with the ADC.....	23
3.12 Selecting the output port.....	23
3.13 Selecting a Guider Star From a User Defined Catalog.....	23
3.14 Selecting a Guide Star From the Yale Bright Star Catalog.....	23
3.15 Selecting a Guide Star Interactively Using GMAP.....	24
3.15.1 NGS Mode.....	24
3.15.2 LGS Mode.....	24

## **Chapter: 4 Configuration Files and Macros.....27**

4.1 Configuration Files.....	27
4.1.1 icsoft.ini.....	28
4.1.2 soar_comms.ini.....	29
4.1.3 viserver.ini.....	29
4.1.4 telemetry.ini.....	29
4.1.5 instruments.ini.....	30
4.1.6 lltfoc.ini.....	30
4.1.7 rgatedelay.ini.....	30
4.1.8 wfsfoc.ini.....	31
4.1.9 Dmflat_rot1.txt.....	31
4.1.10 faults.ini.....	31
4.2 Macros.....	32
4.3 Scripts.....	32
4.3.1 Coded Names.....	32
4.3.2 Instrument Initialization Scripts.....	32
4.3.3 User defined scripts.....	32
4.4 Catalog Files.....	32
4.4.1 User Guide Star Files.....	32
4.4.2 stacklist.dat.....	33

## **Chapter: 5 Log Files.....35**

5.1 Type Alarm Events.....	35
----------------------------	----

## **Chapter: 6 Acquisition Camera Software.....37**

6.1 User Interface.....	37
6.1.1 Main GUI.....	37
6.1.2 Image Display.....	37

6.1.2.1 Cross-Hair.....	37
6.1.2.2 Pop-Up Menu.....	37
6.2 Configuration File.....	37

**Chapter: 7 Troubleshooting.....39**

7.1 Can't Find Guide Stars.....	39
7.1.1 NGS Mode.....	39
7.2 Tweaking Quad-Sensor Offsets.....	39

**Chapter: 8 Glossary.....40**

# Chapter: 1 Getting Things Running

This user manual is intended to describe the use of the SAM Instrument Control Software(ICSOFT) from a user's point of view. It is not a programming manual. For implementation details please read the IC Software Programmer Manual (ICSPM).

## 1.1 Starting the Instrument Control Software

- a) Turn on the instrument control computer and wait for the system to boot.
- b) Log on as user **ao**
- c) Open a shell window and invoke the instrument control application with the following command:

```
% cd /home/ao/ICsoft/Bin
% labview ICsoft.vi -- <options>
```

- d) Optionally you can press the button labeled ICSOFT in the task bar.

## 1.2 Stopping the Instrument Control Software

To stop the ICSOFT application click the *EXIT* button. A dialog box will prompt for confirmation. Select *YES*.

## 1.3 Environment Variable ICSOFT\_HOME

The location of the ICSOFT is defined by an environment variable included in the `.cshrc` file. Right now this variable is pointed to the `/home/ao/ICsoft` directory. To check its value type at the command prompt of your favorite terminal the following command

```
% setenv ICSOFT_HOME /home/ao/ICsoft
```

## 1.4 Command Line Options

The ICSOFT accepts a few command line options to customize its behavior. Valid options are listed below

- aom The ICSOFT starts with the AOM manager disabled.
- lm The ICSOFT starts with the LM manager disabled.
- rtc The ICSOFT starts with the RTC manager disabled.
- tcs The ICSOFT starts with the TCS manager disabled.

For example to start the ICSOFT with all outgoing connections turned off you would type

```
% ./samics ---aom -lm -rtc -tcs
```

## Chapter: 2 GUI Reference

When the application starts the user is presented with a single window containing the most relevant system status variables (Figure 1). If the boot process ended with no failures then the operational state is signaled and the application is ready to receive commands.

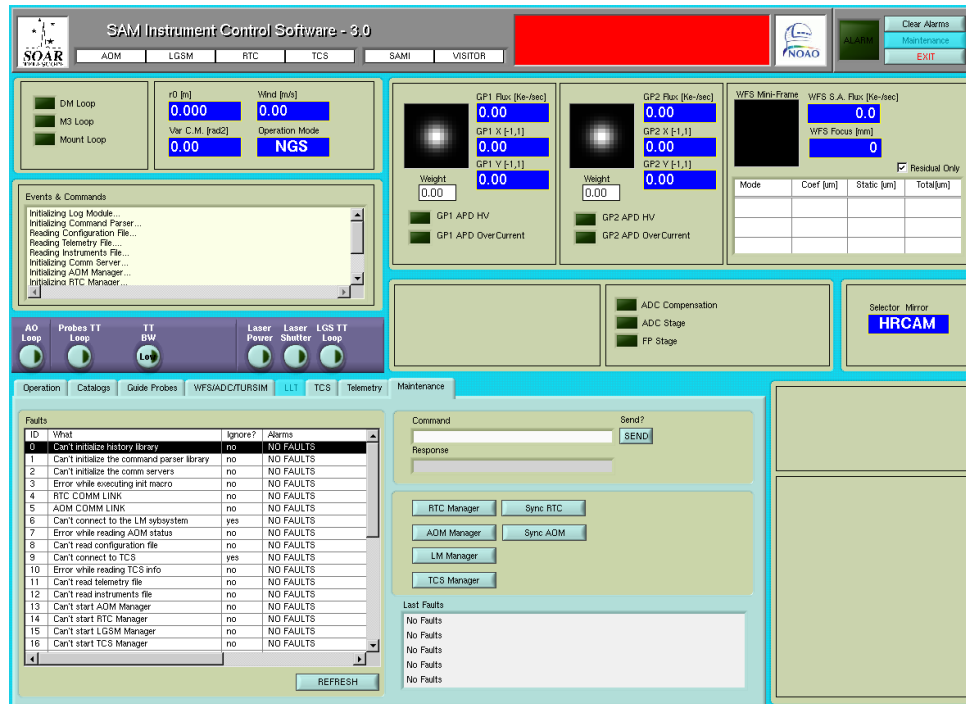


Figure 1: Main GUI. The most relevant status variables are displayed. The actual user interface may look a bit different.

### 2.1 MAIN > Menu Bar

At the very top of the main window is the menu bar. It includes several menu options and most of them just open a Labview remote panel to the desired graphic interface running in a different processor. For details on the actual remote panel functionality please refer to the corresponding subsystem user manual. For example, to get information on the RTC Loop GUI, see the RTSOFT user manual.

#### 2.1.1 MAIN > Menu Bar > AO-Loop Menu.

**Show AO Loop GUI.** Opens a Labview remote panel to the RTC Loop GUI window.

**Reconstructor Error.** Opens a Labview remote panel presenting the RTC Reconstructor Error Analysis window.

**Show DM GUI.** Opens a Labview remote panel presenting the RTC DM GUI window.

**AO Loop Data Recorder.** Opens a Labview remote panel presenting the RTC AO Loop Data

Recorder GUI window.

### 2.1.2 MAIN > Menu Bar > TT-Loop Menu

**Show TT Loop GUI.** Opens a Labview remote panel presenting the RTC TT GUI window.

**TT Probes Flux.** Opens a Labview remote panel presenting the RTC TT flux charts window.

**Statistics.** Opens a Labview remote panel presenting the RTC probes error signal GUI window.

**TT Loop Data Recorder.** Opens a Labview remote panel presenting the RTC TT loop data recorder GUI window.

### 2.1.3 MAIN > Menu Bar > WFS Menu

**Show WFS GUI.** Opens a Labview remote panel presenting the RTC WFS GUI window.

**Show WFS Display.** Opens a Labview remote panel presenting the RTC WFS Display window.

**Slopes Statistics.** Opens a Labview remote panel presenting the RTC Slopes Statistics GUI window.

**Subapertures Flux and FWHM.** Opens a Labview remote panel presenting the RTC Subapertures Flux and FWHM GUI window.

**Histogram.** Opens a Labview remote panel presenting the RTC Frame Histogram GUI window.

**Bias Calibration.** Opens a Labview remote panel presenting the RTC Bias Calibration Tool window.

**Static Aberrations.** Opens a Labview remote panel presenting the RTC Static Aberrations Tool window.

## 2.2 MAIN > General Status Pane

### 2.2.1 MAIN > General Status > Comm-Links

The comm-link indicators uses a color code to represent the status of the connection: RED = Problems, WHITE = No Conn, GREEN = OK.

**Clients Indicator.** Indicates the status of the connections to remote systems: AOM, LGSM, RTC, and TCS.

**Servers Indicator.** Indicates the status of incoming connections to the ICS: SAMI and VISITOR.

### 2.2.2 MAIN > General Status > Last Error Message Box

The box displays the last warning or error message produced by the system. When no warnings or errors are present the box is solid green. When a warning message is produced the box goes yellow. Finally when an error messages is produced the box goes red.



The box stays red and displaying the error messages even if the fault condition is fixed. To refresh the box contents and color press the *Clear Alarms* button (see section 2.3 below). To gather more information based on the current condition of this box the user should always look at the instrument diagram in the *Operation Tab* (see section 2.15.2 below) and at the faults table in the *Maintenance Tab* (see section 2.21 below).

## 2.3 MAIN > General Control Pane

**Clear Alarms Button.** Clears the alarm signal. Note that if an error condition is still present in the system, the alarm condition will be signaled again.

**Maintenance Button.** Currently DISABLED.

**EXIT Button.** Prompts the user to terminate the application.

## 2.4 MAIN > Control Loop Status Pane

**SOAR M3 Loop LED Indicator.** Indicates the M3 control loop status: open or closed. This indicator goes ON when the guider probes tip tilt loop is closed. When a fault the word ERR! is set.

**SOAR Mount Loop LED Indicator.** Indicates the Mount control loop status: open or closed. This indicator goes ON when the SOAR mount loop is closed. When a fault the word ERR! is set.

**LLT M3 Loop LED Indicator.** Indicates the Laser Launch Telescope (LLT) M3 control loop status: open or closed. This indicator goes ON when the LLT M3 loop is closed. When a fault the word ERR! is set.

**DM Loop LED Indicator.** Indicates the AO control loop status: open or closed. This indicator goes ON when the AO loop is closed. When a fault the word ERR! is set.

**Running Script LED Indicator.** It turns ON to indicate that a LUA script is being executed.

## 2.5 MAIN > Selector Mirror Pane

**Selector Mirror String Indicator.** Shows the currently selected instrument: SAMI or VI. The selected instrument defines the output selector mirror position. When the output selector mechanism is active the indicator blinks. When a fault condition has been detected the indicator background color turns red and the word ERR! appears.

## 2.6 MAIN > Control Loop Buttons Pane

**SOAR M3 Loop Button Control.** [Open | Close] the SOAR M3 mirror control loop. Telescope, TT, Laser and AO parameters get automatically recorded into the log file.

**SOAR Mount Loop Button Control.** [Open | Close] the SOAR mount control loop. Telescope, TT, Laser and AO parameters get automatically recorded into the log file.

**Guide Stars Button Control.** Use this button to select and show the Guide Probes Tab.

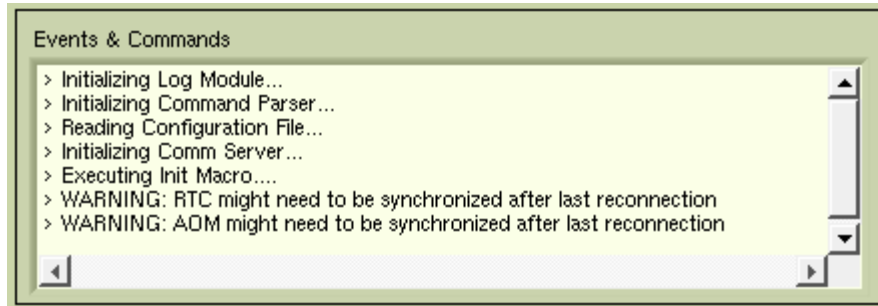


Figure 2: Scripts can redirect their output to this box by using the LOG command.

**LLT M3 Loop Button Control.** [Open | Close] the LLT M3 mirror control loop. Telescope, TT, Laser and AO parameters get automatically recorded into the log file.

**AO Loop Button Control.** [Open | Close] the AO control loop. Telescope, TT, Laser and AO parameters get automatically recorded into the log file.

**Laser Button Control.** Use this button to select and show the LLT/Laser Tab.

**OPEN ALL LOOPS Button Control.** Use this button to execute the associated *OpenAllLoops.lua* LUA script. The script will typically contain commands to open all the control loops.

## 2.7 MAIN > Events & Commands Box

This box serves as an information window to display commands executed in the system, the result of certain operations, events recorded by the ICS, etc. Scripts also can direct their output to this box by using the LOG command (see section ).

## 2.8 MAIN > Guide Probes Status Pane

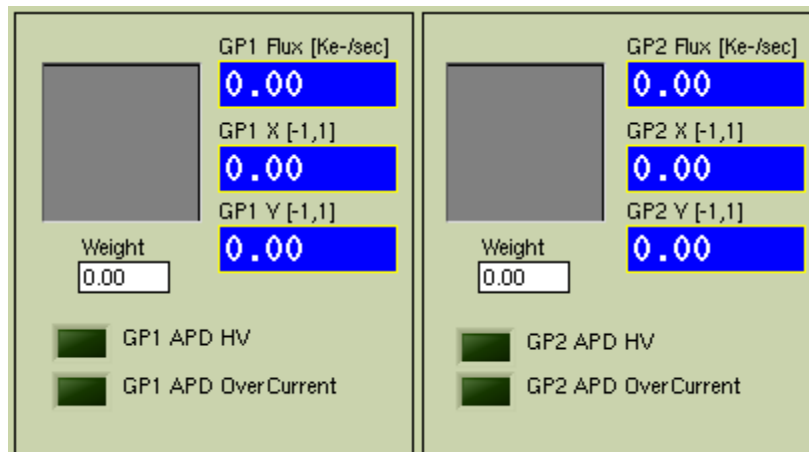


Figure 3: During normal operation the Over Current LED has to be off. To clear an over current condition use the Reset control in the Guide Probes Tab.

**[GP1 | GP2] Flux [K-e/sec].** Shows the average total flux received by guide probe [1 | 2] in [K-

e/ sec]

**[GP1 | GP2] X / Y.** Centroid error in X and Y

**[GP1 | GP2] HV LED Indicator.** Shows if the high voltage is being applied to the APDs. When a fault condition has been detected the word ERR! is set.

**[GP1 | GP2] Over Current LED Indicator.** Shows is the over current protection has been activated. During normal operation this LED has to be off. To clear an over current condition use the *Reset* control in the *Guide Probes Tab* (see section 2.16 below). When a fault condition has been detected the word ERR! is set.

**Lock [GP1 | GP2] Button Control.** Use this button to lock the guide star on the probe. When locked, the tilt error signal coming from the probe will be used for compensating the tilt.

## 2.9 MAIN > WFS Status Pane

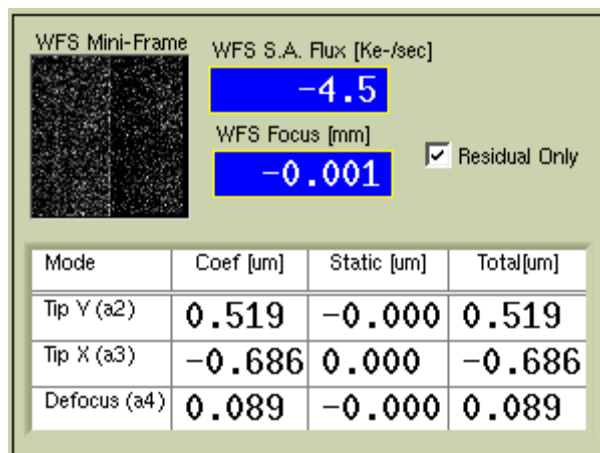


Figure 4: Uncheck the Residual Only check box to show the total aberrations for each mode (residual + DM).

**LGS Boolean Indicator.** The indicator will show a picture of the artificial guide star whenever the Lase diodes are on and the two shutters are opened. Nothing is shown otherwise.

**WFS Spots Display.** Picture indicator presenting a preview of the current WFS display, updated every second.

**WFS Flux [Ke-/sec] Indicator.** Presents the average flux per sub-aperture in the WFS.

**WFS Focus [mm] String Indicator.** Shows the current WFS focus position in [mm]. When the mechanism is moving it blinks. When the mechanism has been disabled the indicator turns grey. When a fault had been detected the background color turns to red and the word ERR! is set.

**Residual Only Check Box.** Uncheck this box to show the total aberrations (residuals + DM)

**Zernike Coefficients Table.** Modal estimation of the first three Zernike Modes (tilt in x and y plus defocus)

## 2.10 MAIN> SOAR M3 Pane

**SOAR M3 EL Slide Indicator.** Presents the elevation of the SOAR M3 mirror in units of arc seconds. In close loop, the pointer will typically sit around zero.

**SOAR M3 AZ Slide Indicator.** Presents the azimuth of the SOAR M3 mirror in units of arc seconds. In close loop, the pointer will typically sit around zero.

## 2.11 MAIN> LLT M3 Pane

**LLT M3 EL Slide Indicator.** Presents the elevation of the LLT M3 mirror in units of arc seconds. In close loop, the pointer will typically sit around zero.

**LLT M3 AZ Slide Indicator.** Presents the azimuth of the LLT M3 mirror in units of arc seconds. In close loop, the pointer will typically sit around zero.

## 2.12 MAIN > AO Loop Parameters Pane

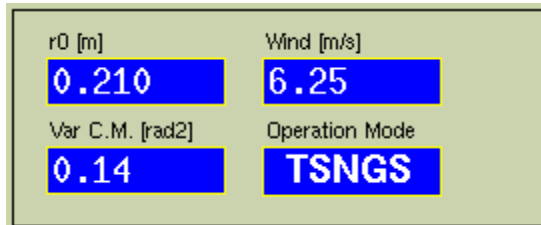


Figure 5: The RTSOFT produce estimates once every few seconds for r0, wind speed and the variance of the corrected modes.

**r0 [m] Indicator.** Seeing estimate produced by the RTSOFT once every few seconds.

**Wind [m/s] Indicator.** Wind speed estimate produced by the RTSOFT once every few seconds.

**VAR C.M.[rad2] Indicator.** Variance of the corrected modes in rad2 produced by the RTSOFT once every few seconds..

**Operation Mode.** Indicates what operation mode is active: TSNGS, NGS, TSLGS or LGS.

## 2.13 MAIN > SLCH Parameters Pane

**SLCH State Indicator.** String indicating the current state of the SLCH interlock.

**Time [s] Indicator.** Remaining time before the SCLH software forbids the LASER from operate.

**SLCH Override LED Indicator.** Shows the current state of the SLCH interlock override (OVERRIDE=green & blinking or ENGAGE=solid black). When a fault the word ERR! is set.

## 2.14 MAIN > TCS Parameters Pane

**MOUNT RA Indicator.** String indicating the current mount RA coordinate in units of hours.

**MOUNT DEC Indicator.** String indicating the current mount Dec coordinate in units of degrees.

**MOUNT HA Indicator.** String indicating the current mount HA coordinate in units of hours.

**LST Indicator.** String indicating the local sidereal time in units of hours.

**MOUNT EL Indicator.** String indicating the current mount elevation in units of degrees.

**MOUNT AZ Indicator.** String indicating the current mount azimuth in units of degrees.

**Rotator Angle Indicator.** String indicating the current rotator mechanical angle in units of degrees.

**SAM PA Indicator.** String indicating the current SAM position angle in units of degrees.

**SOAR M3 Position Indicator.** String indicating the current SOAR M3 turret position

**UT Indicator.** String indicating the current universal time in units of hours.

**F.OFFSET [X | Y] Indicators.** String indicating the current field offset as reported back by GMAP after an FO operation.

## 2.15 MAIN > Operation Tab

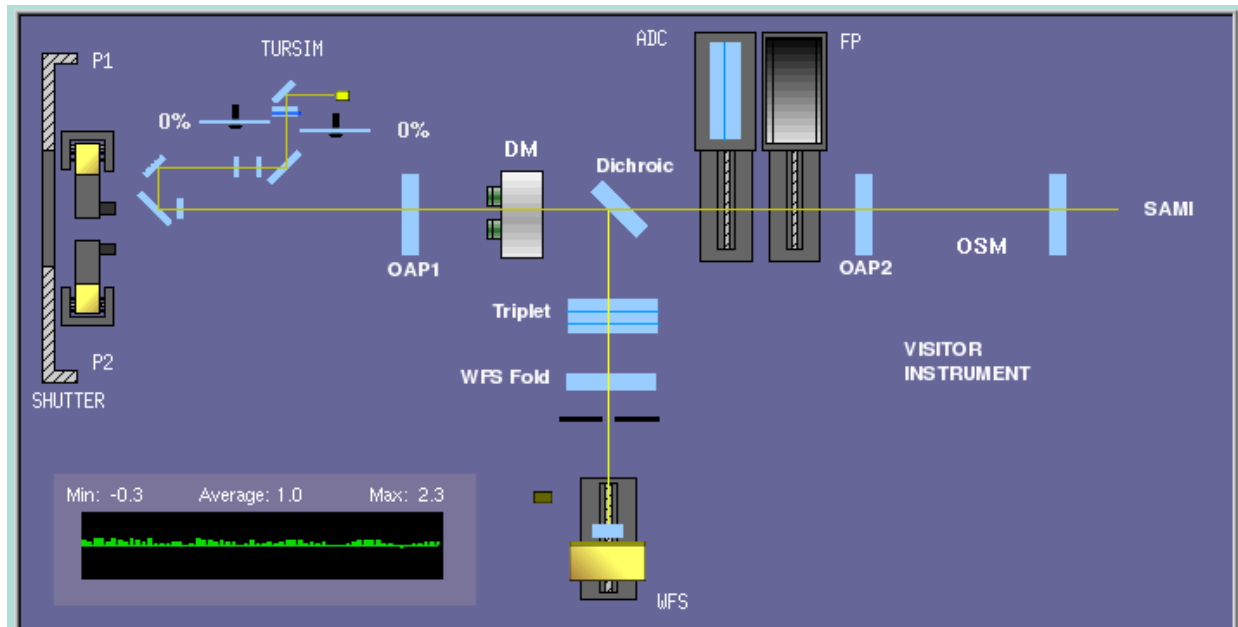


Figure 6: Clicking on a device picture (Guide Probes, DM, TURSIM, ADC, FP, WFS, Shutter and OSM) brings up a pop-up menu with available actions.

**Operation Mode Selector Box.** Selects the operation mode: NGS, TSNGS, LGS or TSLGS, by running the associated configuration script: *NGS.lua*, *TSNGS.lua*, *LGS.lua* and *TSLGS.lua*

**Set Operation Mode Button Control.** Use this button to execute the script associated to the selected operation mode.

**Instrument Selector Box.** Selects between dedicated science CCD and visitor instrument. The box lists the instruments defined in the *instrument.ini* file (see section 4.1.5 below). When an instrument is selected the script associated to that instrument in the configuration file is used to set the SAM module.

**Set Instrument Button Control.** Use this button to execute the script associated to the selected instrument.

**LGS Configuration Combo Box.** Use this drop down menu to select between three available configurations: 7[Km], 10[Km] and 13[Km]. Each selection will run associated Lua script *LGS7KM.lua*, *LGS10KM.lua* and *LGS13KM.lua*. Look for the scripts in the *ICsoft/scripts* directory.

**Set Distance Button Control.** Use this button to execute the script associated to the LGS configuration selected using the *LGS Distance* combo box.

### 2.15.1 Scripts Controls

The ICISOFT includes a LUA scripting engine. When a script is executed the output is presented at the *Events & Commands* Box.

**Scripts.** Use this control to select a script from the scripts directory.

**RUN.** Execute the selected macro.

**STOP.** Abort the current macro execution.

**Pause.** Allows to pause and resume the execution of a macro.

### 2.15.2 Graphic View

The user is presented with a graphic view showing the current instrument setup, including light path, light sources and element positions. The display area of the picture control is context sensitive so when the mouse pointer is placed over a certain device the correspondent label and information pane are lighted.

Clicking on a device picture (Guide Probes, DM, TURSIM, ADC, FP, WFS, Shutter and OSM) brings up a pop-up menu with available actions. When a device is not initialized or faulted its device label blinks indicating its current state. The WFS label for example, blinks to indicate that a mechanism (focus, reference beam arm/stage, f/10 adjustment) is ACTIVE. When a fault condition has been detected in at least one of the mechanisms, besides blinking the label background color turns solid red and the label text changes to ERR!

#### DM MENU

ROTFLAT – Flattens the DM based on a previously saved list of voltages including a correction factor based on the current rotator angle.

ZERODM – Set all DM voltages to zero.

SAVE AS FLATTEN - Save the currently applied DM voltages to disk as the new set of voltages to flatten the DM.

**WFS MENU**

Reset (re-start WFS readout)

Calibrate Bias – Obtain an averaged bias to be used when doing bias subtraction.

Calibrate References – Reset all references to current average spot x-y position.

WFS Reference Arm

WFS Reference Light

**GP MENU**

Center Probe

Park Probe

Dimmer

Reset APD

**ES MENU**

ESOPEN

ESCLOSE

SLEEP

WAKE

**TURSIM MENU**

TURSIM IN

TURSIM OUT

Phase Screen 1

Phase Screen 2

Dimmer

**ADC MENU**

ADCIN

ADCOUT

AUTO SET

**FP MENU**

In

Out

**USER MENU**

RECORD  
 DONE TARGET  
 SpotOffset  
 NoOffset  
 SLEEP  
 WAKE

## 2.16 MAIN>Guide Probes Tab

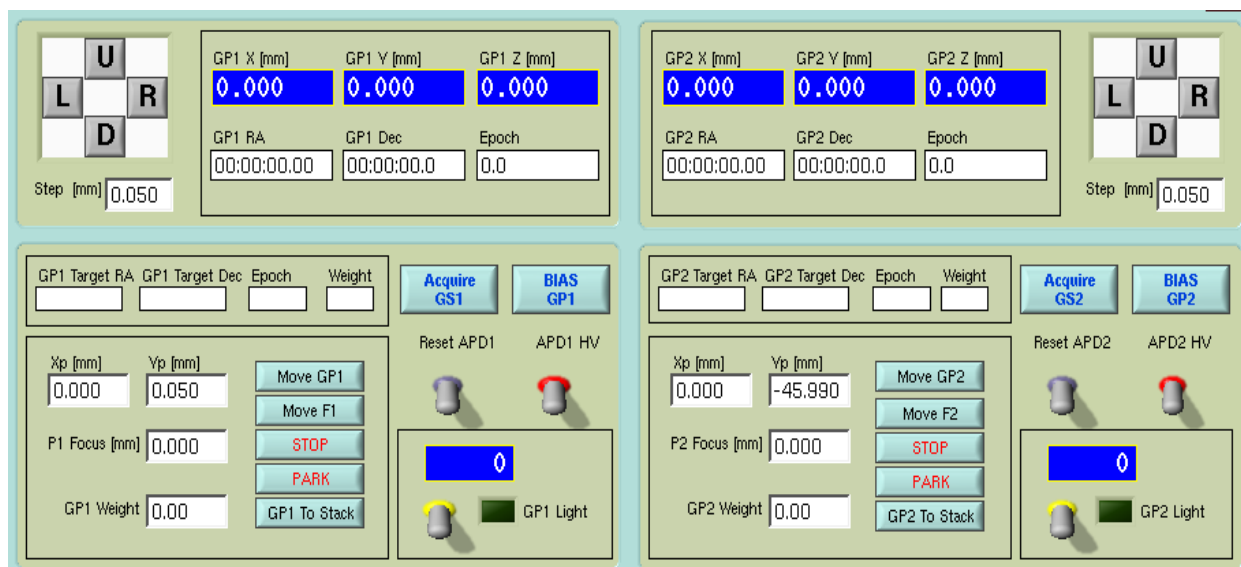


Figure 7: Turn the APD high voltage ON and the reset the over current condition to start using the guide probes. Actual pane may differ a bit.

**[GP1 | GP2] X [mm].** Shows the current X coordinate of guide probe [1 | 2] stage in [mm]. Blinks when moving. Solid red when fault. Grayed when disabled.

**[GP1 | GP2] Y [mm].** Shows the current Y coordinate of guide probe [1 | 2] stage in [mm]. Blinks when moving. Solid red when fault. Grayed when disabled.

**[GP1 | GP2] Z [mm].** Shows the current focus position for guide probe [1 | 2] in [mm]. Blinks when moving. Solid red when fault. Grayed when disabled.

**[GP1 | GP2] RA.** Shows the current RA coordinate of guide probe [1 | 2].

**[GP1 | GP2] Dec.** Shows the current Dec coordinate of guide probe [1 | 2].

**[GP1 | GP2] Epoch.** Shows the epoch of the current RA/Dec coordinates of guide probe [1 | 2].

**[L | R | U | D] Offset Buttons.** Offset the guide probe position by a user defined step size. The step size is defined by the value *Step Selector* control (small, medium, large).



**Step Selector.** Use this control to set the size of the step when doing and offset with the *LRUD Offset* buttons. The three step sizes are predefined in the *icsoft.ini* file by the SLOW, MEDIUM, and FAST keywords.

**Link Selector.** Use this control to select a single guide probe or link their actions. The position of this selector affects the actions of offsetting the guide probes, resetting the APDs, toggling the APDs high voltage, and calibrating the APD bias levels.

**GMAP CATALOGS Button.** Use this button to open the GMAP catalog interface.

**APD HV.** Use this switch to turn ON and OFF the high voltage to the APDs. When turned ON the over current protection will be activated regardless of a real over current condition. Use the *Reset APD* control to clear that condition.

**Reset APD Control.** Use this button to clear the over current state condition. On success the APD over current indicator should be turned off (see section 2.8 above).

**TAKE BIAS Button.** Use this button to estimate the bias for the guide probe APDs. The bias calibration is then subtracted before doing centroid calculations.

**[GP1 | GP2] Target RA.** Presents the RA coordinate of the guide star candidate to be acquired with guide probe.

**[GP1 | GP2] Target Dec.** Presents the Dec coordinate of the guide star candidate to be acquired with probe.

**[GP1 | GP2] Epoch.** Presents the epoch of the RA/Dec coordinates of the guide star candidate to be acquired with the guide probe.

**[GP1 | GP2] Weight.** Set the relative weight assigned to the guide probe. This weight defines the relative contribution of the probe to the total tilt error.

**Acquire [GS1 | GS2] Button.** Use this button to move the guide probe stages to the position indicated in the *Target* indicators.

**Move [GP1 | GP2] Buttons.** Commands the [P1 | P2] stage to move to the X,Y user defined positions.

**Move [F1 | F2] Button.** Commands the [P1 | P2] focus control to move to the user defined focus position.

**STOP Button.** Command the stages to stop.

**PARK Button.** Command the stages to move to the park position by executing the *GP<N>-park.lua* script.

**[GP1| GP2] To Stack Buttons.** Move the current *[GP1 | GP2] RA/Dec/Epoch* coordinates to the stack. Use this button to grab the current probe coordinates and save them for later use.

**[GP1 | GP2] Light Indicator.** Show the current [0-100] dimmer setting. When a fault condition

has been found the background is solid red and the word ERR! is set.

**[GP1 | GP2] Light Control.** Use this control to turn the guider probe reference light [ON | OFF] . The intensity of the light can be adjusted from the guide probe pop-up menu in the picture diagram in the *Operation Tab* (see section 2.15.2 above).

**[GP1 | GP2] Light LED Indicator.** The indicator reports the light is ON or OFF. When a fault condition has been found the word ERR! is set.

## 2.17 MAIN> WFS / TURSIM Tab

**WFS Frame Time [ms] Numeric Indicator.** Shows the time between frames in the WFS. If a WFS fault is detected in the RTC the indicator background turns solid red.

**WFS Dimmer String Indicator.** Reports the current WFS reference light intensity from [1-100]. Note that this is NO indicator of the reference light being ON or OFF. When a fault it turns red and the word ERR! is set. When the dimmer has been disabled the indicator turns gray.

**WFS Ref. Beam String Indicator.** Show the current position of the reference beam arm/stage (IN or OUT). When the mechanism is ACTIVE or IN the indicator blinks to warn the user about a status not useful for normal operation. When a fault condition in the mechanism has been detected the indicator background turns solid red. When the mechanism has been disabled the indicator turns gray.

**WFS F/10 [mm] String Indicator.** Show the current position of the WFS f/10 adjustment mechanism. When the mechanism is ACTIVE the indicator blinks. When a fault condition in the mechanism has been detected the indicator background turns solid red. When the mechanism has been disabled the indicator turns gray.

**Bias Subtraction LED Indicator.** Indicates wether WFS bias subtraction is enabled or disabled. When a fault the word ERR! is set.

**Bgnd Subtraction LED Indicator.** Indicates wether WFS background subtraction is enabled or disabled. When a fault the word ERR! is set.

**WFS Focus [mm] Numeric Control.** Use this control to change the WFS focus.

**WFS Focus Move Button.** Press this button to actually move the WFS focus stage to the value entered in the WFS Focus [mm] numeric control.

**LGS Distance [Km] String Indicator.** Shows the range gate setting for the artificial star distance. This is effectively the delay between the LASER pulse and the moment in which the Pockels Cell is open. . If a fault is found the indicator turns red and the word ERR! is set.

**Gate [Km] String Indicator.** Shows the range gate setting for the gate width. This is effectively the time the Pockels Cell stays open. If a fault is found the indicator turns red and the word ERR! is set.

**RGate Sync Mode String Indicator.** Shows the current synchronization mode for the Pockels

Cell (LASER or AUTO). The indicator blinks if LASER is not selected to warn the user about a status not useful for normal operation. If a fault is found the indicator turns red and the word ERR! is set.

**Pockels Cell Set-Point [KV] String Indicator.** Show the output high voltage setting for the Pockels cell driver. When a fault condition has been detected the indicator background turns solid red and the word ERR! is set. If the Pockels cell high voltage is off the indicator blinks to warn the user about a status not useful for normal operation.

**Pockels Cell High Voltage LED Indicator.** Lit when the Pockels Cell high voltage is ON. When the high voltage is off the LED blinks to warn the user of state non useful for normal operation. When a fault has been detected the word ERR! is set.

**Range Gate Armed LED Indicator.** Lit when the range gate has been armed. When not armed the LED blinks to warn the user of a state not useful for normal operation. When a fault has been detected the word ERR! is set.

**LGS Distance [Km] Numeric Control.** Use this control to enter at what distance is the LLT focused.

**LGS Gate [Km] Numeric Control.** Use this control to enter the size of the gate around the LGS Distance value. For example, a distance of 7[Km] and a size of 0.3[Km] will open a gate between the 6.85[Km] and 7.15[Km].

**Set Range Gate Button Control.** Press this button to configure the Range Gate using the LGS Distance and LGS Gate values. Read the programmer manual for details on how the Range Gate parameters are obtained. The control stays disabled while the Range Gate is armed.

**Pockels Cell High Voltage Button Control.** Use this control to turn the Pockel Cell high voltage [ON | OFF] .

**Range Gate Button Control.** Use this control to ARM / DISARM the range gate synchronization.

**RGate Sync Mode Slide Switch.** Use this control to select between the two synchronization modes available: LASER and AUTO. When LASER is selected the WFS shutter actuates after a fix delay in synchronism with the LASER output trigger. When AUTO is selected the WFS shutter control signal auto-regenerates at a fix rate.

**Acquisition Camera LED Indicator.** Lit when the WFS acquisition camera is turned ON. When ON the indicator blinks to warn the user about a thermal source inside the SAM main module. When a fault the word ERR! is set.

**Acquisition Camera Button.** Use this button to open the Acquisition Camera Viewer program.

**Acquisition Camera Power Toggle Control.** Use this switch to turn the camera ON | OFF.

**TURSIM Dimmer String Indicator.** Reports the current TURSIM light source intensity from

[1-100]. Note that this is NO indicator of the light source being ON or OFF. When a fault the indicator background turns red and the word ERR! is set. When the dimmer is disabled the indicators turns gray.

**[L | R | U | D] Offset Buttons.** Offset the guide probe position by a user defined step size. The step size is defined by the value *Step* control.

## 2.18 MAIN > LLT / LASER Tab

**M1 X [mm].** Shows the current X coordinate of LLT M1 in [mm].

**M1 Y [mm].** Shows the current Y coordinate of LLT M1 in [mm].

**[L | R | U | D] Offset Buttons.** Offset the LLT M1 position by a user defined step size. The step size is defined by the value in the *Step* control.

**Step [mm].** Use this control to set the size of the step when doing and offset with the *LRUD* offset buttons. The three step sizes are predefined in the *icsoft.ini* file by the M1SLOW, M1MEDIUM, and M1FAST keywords.

**M2 Focus [mm] Numeric and Slide Indicator.** Shows the current focus position for M2 in [mm].

**M2 Focus [mm] Numeric Control.** User defined focus position for M2 in [mm].

**Move M2 Button.** Commands the M2 focus control to move to the user defined focus position.

**LLT Power LED Indicator.** Show the current state of the LLT power. When ON the indicator is solid green. When OFF indicator blinks to warn the user about a status non useful for normal operation. When a fault condition had been detected, the indicator turns solid red.

**ON Button.** Turns the LLT power ON.

**OFF Button.** Turns the LLT power OFF.

**LLT Shutter String Indicator.** Show the current state of the environmental cover of the LLT. When OPEN the indicator is solid blue. When CLOSED or MOVING the indicator blinks to warn the user about a status non useful for normal operation. When a fault condition had been detected, the indicator turns solid red.

**OPEN Shutter Button.** Commands the environmental cover to move to the OPEN position.

**CLOSE Shutter Button.** Commands the environmental cover to move to the CLOSE position.

**Acquisition Mirror String Indicator.** Show the current state of the acquisition mirror. When OUT the indicator is solid blue. When IN or MOVING the indicator blinks to warn the user about a status non useful for normal operation. When a fault condition had been detected, the

indicator turns solid red.

**IN Button.** Commands the acquisition mirror to move to the IN position.

**OUT Button.** Commands the acquisition mirror to move to the OUT position.

**PHM1-[X1 | Y1 | X2 | Y2].** Shows the Laser flux over the LLT M1 mirror. The photo-diodes are evenly spaced in the border of the mirror.

**PHM2.** Shows the Laser flux in over the LLT M2 mirror.

**Diode State String Indicator.** Shows the current state of the LASER diode (ON, OFF, STANDBY). When ON the indicator is solid blue. When in OFF or STANDBY state, the indicator blinks to warn the user about a status non useful for normal operation. When a fault condition had been detected, the indicator turns solid red.

**Selector State String Indicator.** Shows the current state of the LASER selector mechanism (IN or OUT). When OUT the indicator is solid blue. When IN or moving the indicator blinks to warn the user about a status non useful for normal operation. When a fault condition had been detected, the indicator turns solid red. If the mechanism has been disabled the indicator turns gray.

**Power [WATT] Numerical Indicator.** Total output power. When a fault condition has been detected, the indicator turns solid red.

**Chiller Temperature [C] Numerical Indicator.** The chiller working temperature. When a fault condition has been detected, the indicator turns solid red.

**Box Temperature [C] Numerical Indicator.** The temperature inside the LASER box. When the temperature is out of its normal range of operation ( $25[C] \pm 10\%$ ) the indicator turns red.

**LASER Shutter LED Indicator.** The indicator is solid green when the shutter is OPEN. Otherwise it blinks to warn the user about a status non useful for normal operation. When a fault the word ERR! is set.

**LASER Safety Shutter LED Indicator.** The indicator is solid green when the shutter is OPEN. Otherwise it blinks to warn the user about a status non useful for normal operation. When a fault the word ERR! is set.

**Box Heater LED Indicator.** The indicator is solid green when the heater is ON. Otherwise it blinks to warn the user about a status non useful for normal operation. When a fault the word ERR! is set.

**LASER 220[V] LED Indicator.** The indicator is solid green when power is on. Otherwise it blinks to warn the user about a status non useful for normal operation. When a fault the word ERR! is set.

**Interlock LED Indicator.** The indicator is solid red when the interlock is engaged and it blinks to warn the user about a status non useful for normal operation. When a fault the word ERR! is

set.

**LASER Shutters Control.** Open/Close the LASER shutter by running the *LaserShutterClose.lua* and *LaserShutterOpen.lua* scripts.

**LASER Diode Control.** ON/OFF LASER diode.

**LASER 220[V] Control.** ON/OFF LASER power.

**SLCH Interlock Control.** Override/Engage the SLCH Interlock in the SLGSOFT (SDN-8401). Override will last no longer than as specified in the SLCHWINDOW keyword in the *icsoft.ini* file. A progress bar will be visible next to the push buttons indicating the time left before the override window is over.

## 2.19 MAIN> ADC / TCS

**Inner Indicator [deg].** The current inner element absolute position in [deg].

**Outer Indicator [deg].** The current outer element absolute position in [deg].

**ADC Compensation Control.** Use this switch to turn the ADC compensation [ON | OFF]

**Inner [deg] Numeric Control.** Use this box to enter a target position angle in [deg] for the inner element.

**Outer [deg] Numeric Control.** Use this box to enter a target position angle in [deg] for the outer element.

**SET Inner & Outer Button.** This button commands the ADC inner and outer elements to the target positions in the *Inner* and *Outer* input boxes.

**STOP Button.** Stop the ADC motion in both the inner and outer elements.

**ADC Mode Radio Button.** Use this radio button control to select if the inner and outer element positions will be calculated using the zenith distance and rotator angle as informed by the TCS or user defined values.

**ZD [deg] Box.** User defined Zenith distance in [deg]. To be used when Manual Mode has been selected.

**Rotation [deg].** User defined rotator angle in [deg]. To be used when Manual Mode has been selected.

**SET ADC Button.** Use this button to command the inner and outer elements of the ADC to move to the position that will compensate for the given Zenith distance and rotation. Depending on the mode selected [AUTO | MANUAL] the Zenith distance and rotation will be obtained from the TCS or from user defined values.

**Offset Pad.** Use this pad to run the dither scripts: *NorthOffset.lua*, *SouthOffset.lua*, *WestOffset.lua* and *EastOffset.lua*.

**Offset Numeric Control.** Use this control to set the dither value. Useful to pass the value to the dither scripts: *NorthOffset.lua*, *SouthOffset.lua*, *WestOffset.lua* and *EastOffset.lua*.

**Dither Pad.** Use this pad to run the dither scripts: *UpDither.lua*, *DownDither.lua*, *LeftDither.lua* and *RightDither.lua*.

**Dither Numeric Control.** Use this control to set the dither value. Useful to pass the value to the dither scripts: *UpDither.lua*, *DownDither.lua*, *LeftDither.lua* and *RightDither.lua*.

**Focus Offset Button.** Use this button to run the *FocusOffset.lua* script

**Focus Offset Numeric Control.** Use this control to set the amount of offset to apply. Useful to pass the value to the *FocusOffset.lua* script.

## 2.20 MAIN > Telemetry Tab

**Telemetry Table.** The telemetry table presents a snapshot of the telemetry test-points available. By double-clicking on each line, the Telemetry Chart will start plotting the selected testpoint. See the *telemetry.ini* file description in section Error: Reference source not found Error: Reference source not found for details on the test-points format.

**Telemetry Chart.** This chart get updated with data coming from the currently selected test-point in the telemetry table. When a test-point is selected the chart is first initialized with the historical data available in the log file. From then on the chart is updated with the new values.

**Sample Length Control.** Indicates how many points should be read from the log file before starting to update the *Telemetry Chart*.

## 2.21 MAIN>Maintenance

**Faults Table.** This sheet presents the list of known faults as defined in the *faults.ini* file. The column labeled Alarms shows the date and hour at which an alarm event was caught. Use the Refresh button to update the sheet entries.

**Refresh Button.** Use this button to refresh the *Faults Table* entries.

**Last Faults.** Last five warnings and errors encountered by the application.

**Command Box.** Input box to enter string commands. For a complete list of the available string commands read the ICISOFT Programmer Manual.

**Send.** Write the command entered in the Command input box to a software/hardware module.

**Response.** Reply to the last command sent to a software/hardware module.

### 2.21.1 MAIN > Maintenance > [RTC | AOM | LM | TCS] Manager

**Connected LED.** Indicates that the manager is connected.

**CLOSE.** Use this button to close the manager window.

**Name.** This is the name of the server as declared in the *soar\_comms.ini* file.

**Address.** This is the IP address of the server as declared in the *soar\_comms.ini* file Port. This the port in which the server listen to incoming connections as defined in the *soar\_comms.ini* file.

**Fetch Status?** Turn this switch ON to enable the continuous poll for status updates to the server.

**Update?** Turn this switch ON to see the messages interchanged between the manager and the server.

**CLEAR.** Press this button to clear the contents of the messages list.

**Messages.** When the *Update?* Option has been selected, this list box presents the messages exchanged between the manager and the remote server.

### 2.21.2 MAIN > Maintenance > Sync [RTC | AOM]

By pressing this buttons the ICSOFT synchronize the remote application to the current local parameters.

#### RTC

1. The operation mode is set to the ICSOFT operation mode: TSNGS, NGS, LGS or TSLGS.
2. The Range Gate Delay is set using the LASER altitude set in the ICSOFT. The Delay is calculated using the coefficients in the *rgatedelay.ini* file (see section 4.1.7)

#### AOM

1. The attached instrument setup script is executed (see section 4.1.5)
2. The WFS focus is adjusted depending on the current operation mode using the values in the *wfsfoc.ini* file (see section 4.1.8). Note that this override focus adjustments done by the instrument script.
3. The TURSIM injection arm is moved IN or OUT depending on the current operation mode.



## Chapter: 3 Common Operations

### 3.1 Centering a Guide Probe

1. Select the *Operation Tab* from the main GUI window.
2. Right click over the Guide Probe picture. The Guide Probe pop-up menu is displayed.
3. Select *Center Probe* from the menu.

### 3.2 Parking a Guide Probe

1. Select the *Operation Tab* from the main GUI window.
2. Right click over the Guide Probe picture. The Guide Probe pop-up menu is displayed.
3. Select *Park Probe* from the menu.

### 3.3 Guide Probe APD Activation

1. Select the *Guide Probes Tab* from the main GUI window.
2. Select the guide probe to operate (guide probe 1, 2 or both) with *Link Selector* control.
3. Toggle the *APD HV* control. See the *APD HV* and *APD Overcurrent* indicators go on.
4. Reset the protection with the *Reset APD* control. See the *APD Overcurrent* indicator go off.

### 3.4 Guide Probe APD Bias Calibration

1. Select the *Guide Probes Tab* from the main GUI window.
2. Select the guide probe to operate (guide probe 1, 2 or both) with *Link Selector* control.
3. Press the *BIAS* button to start a calibration sequence. See the *RTC* indicator go TBD.

### 3.5 Using TURSIM

1. Select the *Operation Tab* from the main GUI window.
2. Right click over the TURSIM picture. The TURSIM pop-up menu is displayed.
3. Select *Injection Arm > In* from the menu. Wait for the injection arm picture to appear in the diagram.
4. Right click over the TURSIM picture.
5. Select *Dimmer > On*. Wait for the light indicator to go yellow.
6. Right click over the TURSIM picture.
7. Select *Dimmer > Intensity > value*.

8. Right click over the TURSIM picture.
9. Select *Phase Screen [1|2] > In*. Wait for the phase screen icon to move in.
10. Right click over the TURSIM picture.
11. Select *Phase Screen > Speed > velocity*. Wait for the velocity indicator to reach the desired value.

### 3.6 Adjusting TURSIM light source

1. Select the *WFS/ADC/TURSIM Tab* from the main GUI window.
2. Use the *[L|R|U|D] Offset Buttons* (section Error: Reference source not found) to move the light source while looking at the tilt residual (section 2.9).
3. Repeat until the tilt error is typically in the range [-0.1, 0.1]

### 3.7 Flattening the DM

1. Select the *Operation Tab* from the main GUI window.
2. Right click over the DM picture. The DM pop-up menu is displayed.
3. Select *STATIC FLAT* from the menu.

### 3.8 Flattening the DM taking rotation into account

1. Select the *Operation Tab* from the main GUI window.
2. Right click over the DM picture. The DM pop-up menu is displayed.
3. Select *ROTFLAT* from the menu.

### 3.9 Recording a new Flatten DM file

1. Close and open the loop on a suitable source. TURSIM will do.
2. Select the *Operation Tab* from the main GUI window.
3. Right click over the DM picture. The DM pop-up menu is displayed.
4. Select *SAVE AS FLATTEN*.

### 3.10 Resetting the WFS

1. Select the *Operation Tab* from the main GUI window.
2. Right click over the WFS picture. The WFS pop-up menu is displayed.
3. Select *Reset WFS* from the menu.

### 3.11 Tracking with the ADC

1. Select the *Operation Tab* from the main GUI window.
2. Right click over the ADC picture. The ADC pop-up menu is displayed.
3. Select *In* from the menu. Wait for the ADC icon to move in. The ADC state LED indicator flashes indicating the motion is active.
4. Select the *WFS/ADC/TURSIM Tab* from the main GUI window.
5. Switch ON the *ADC Compensation?* Control.

### 3.12 Selecting the output port

1. Select the *Operation Tab* from the main GUI window.
2. Click on the *Instrument* selector box and select the instrument attached to the desired port.
3. Wait for the associated script to finish. The currently selected port is indicated by the *Selector Mirror* indicator.

### 3.13 Selecting a Guider Star From a User Defined Catalog

1. Enter the name of the user catalog in the catalog input box, or use the browse button to select the file.
2. Press the Load Catalog button to load the contents of the file into the guide stars table.
3. Click on the table line corresponding to the guide star candidate.
4. Press the Check [P1 | P2] button to make sure the coordinates of the guide star candidate are within range of the current guide field. If the coordinates are not within range an information message is showed at the Events & Commands list box.
5. Press Set [P1 | P2] to set the selected guide star coordinates as the target coordinates for the next guide star acquisition. The coordinates are copied to the target [P1 | P2] indicators.

### 3.14 Selecting a Guide Star From the Yale Bright Star Catalog

The Yale Bright Star Catalog is available to peek a list of close by guide star candidates.

1. Select the radio button labeled “Yale Bright Star Catalog”
2. Select the source of the reference coordinates. Select “Telescope Coordinates” to use the current RA/Dec coordinates of the telescope as informed by the TCS. Select “User Coordinates” to manually enter the coordinates in the selected system (RA/Dec, Az/EI, HA/Dec).
3. Press the “Closest Bright Stars” buttons. The guide stars table gets updated with a list of near by stars.
4. Click on the table line corresponding to the guide star candidate.
5. Press the Check [P1 | P2] button to make sure the coordinates of the guide star candidate are

within range of the current guide field. If the coordinates are not within range an information message is showed at the Events & Commands list box.

6. Press Set [P1 | P2] to set the selected guide star coordinates as the target coordinates for the next guide star acquisition. The coordinates are copied to the target [P1 | P2] indicators.

### 3.15 Selecting a Guide Star Interactively Using GMAP

Guide star candidates can be interactively selected using the GMAP sky map. For details read the GMAP User Manual.

#### 3.15.1 NGS Mode

1. Point the telescope to the science field and put the natural guide star on the WFS. Use the WFS acquisition camera to aid in that task.
2. If not already running GS3, this is a good time to launch the GS3 program either manually or from the ICSOFT (*Catalogs Tab*).
3. Select the *Skymap* menu option from the *File* menu in the main GUI window. The skymap windows shows up.
4. Press the *Tel button* in the sky-map window to grab the field coordinates. The window contents get updated.
5. Press the *PA button* in the sky-map window to update the position angle. The window contents get updated again.
6. Assuming that the natural guide star is now on the sky-map, right click on the star and press the *FC button* to grab the offset between the mount and the center of the SAM field. The offsets are sent automatically to the ICSOFT.
7. Press the *Tel button* in the sky-map window to refresh the screen and reflect the new field center offsets.
8. Left click on a star inside the patrol field to select a guide star. A white circle around the star signals that the star has been selected.
9. Press [*P1|P2*] *button* to send the coordinates of the selected star to the ICSOFT. The guide star candidate coordinates are loaded into the target indicators in the *Guide Probes Tab* of the ICSOFT main GUI window.

#### 3.15.2 LGS Mode

1. Point the telescope to the science field and take a picture with SAMI.
2. “mscdisplay” the image. It is important to have the whole picture coordinates right. You can check that by simply moving the cursor around and watch for the coordinates not resetting to zero when changing detector.
3. Put the active focus on the SAMI GUI and press F3 to activate the interactive selection cursor.

4. Select a star by putting the cursor on top of a star and pressing “C”. The offset between the SAM field center and the star is sent to the ICSOFT.
5. If not already running GS3, this is a good time to launch the GS3 program either manually or from the ICSOFT (*Catalogs Tab*).
6. Select the *Skymap* menu option from the *File* menu in the main GUI window. The sky-map windows shows up.
7. Press the *Tel* button in the sky-map window to grab the field coordinates. The window contents get updated.
8. Press the *PA* button in the sky-map window to update the position angle. The window contents get updated again.
9. Right click on the same star you just click on SAMI display and then press the *FO* button. This will calculate the offset between the center of the field and mount coordinates taking into account the offset reported by SAMI to the ICSOFT. The offset is sent automatically to the ICSOFT.
10. Press the *Tel* button in the sky-map window to refresh the screen and reflect the new field center offsets.
11. Left click on a star inside the patrol field to select a guide star. A white circle around the star signals that the star has been selected.
12. Press *[P1|P2]* button to send the coordinates of the selected star to the ICSOFT. The guide star candidate coordinates are loaded into the target indicators in the *Guide Probes Tab* of the ICSOFT main GUI window.

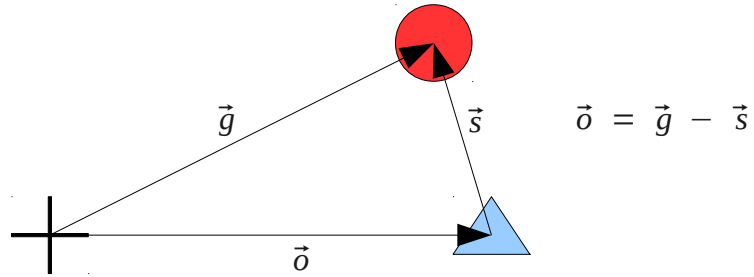


Figure 8: The cross mark the telescope coordinates in the sky-map. The circle is the selected star. The triangle is the field center.

### 3.16 Adjusting the time to automatically open the AO and LLT loops

Edit the `icsoft.ini` file and change the value for keyword `SLCHAUTOOPEN` to control the time before the LCH closure to automatically open the AO and LLT loops.

## Chapter: 4 Configuration Files and Macros

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 ICSOFT application. A detailed description of the configuration files, macros, and their parameters follows.

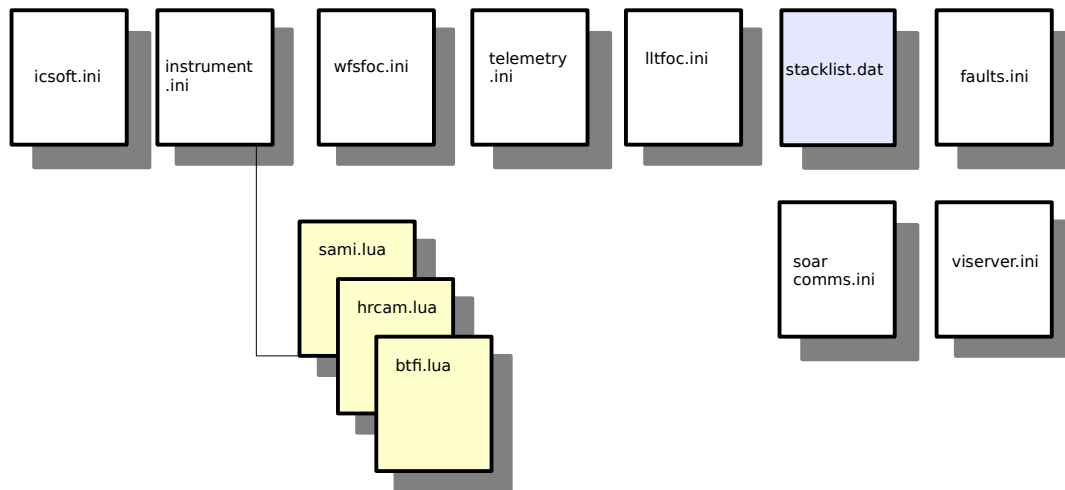


Figure 9: Configurationfiles and script dependencies

### 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
```

Other files are ordinary text files containing a list of space separated fields. Table 1 lists the core set of configuration files. The name and relative path of these files is fixed and can not be modified since they are hard coded in the ICSOFT. 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/ICsoft/config*.

Table 1: Parameter files and their description.

<i>File Name</i>	<i>Description</i>
icsoft.ini	ICSOFT parameters
soar_comms.ini	SOAR communication library parameters
faults.ini	Faults definitions
instruments.ini	List of instruments and their location
lltfoc.ini	Polynomial coefficients relating focus to LGS distance.

<i>File Name</i>	<i>Description</i>
rgatedelay.ini	Polynomial coefficients relating range gate delay to LGS distance.
telemetry.ini	Multiple sections describing test-point
viserver.ini	Labview remote panel definitions
wfsfoc.ini	Polynomial coefficients relating WFS focus and LGS distance.

#### 4.1.1 icsoft.ini

The file has only one section: General. The user can hand edit this file to modify parameters values. The following is an example of how this file looks like. Some of the parameters values will be replaced when the application program exists.

```
[GENERAL]
FLENGTH=65666           ; Telescope focal Length in [mm]
INSTRUMENT=VISITOR     ; Current instrument label
MODE=LGS               ; Current operation mode [TSNGS,NGS,TSLGS,LGS]
LGSDISTANCE=11.0      ; Current LGS distance in [Km]
P1XUP=0                ; P1 stage right limit in [mm]
P1XDOWN=-50           ; P1 stage left limit in [mm]
P1YUP=50              ; P1 stage up limit in [mm]
P1YDOWN=-50          ; P1 stage down limit in [mm]
P2XUP=50              ; P2 stage right limit in [mm]
P2XDOWN=0            ; P2 stage left limit in [mm]
P2YUP=50              ; P2 stage up limit in [mm]
P2YDOWN=-50          ; P2 stage down limit in [mm]
SLOW=0.20             ; Short step size in [mm]
MEDIUM=0.30          ; Medium step size in [mm]
FAST=10.00            ; Large step size in [mm]
LLTFLENGTH=1000      ; Laser Telescope focal length in [mm]
OBSLATITUDE=-30.238   ; Observatory Latitude in [deg]
OBSLONGITUDE=-70.734 ; Observatory Longitude in [deg]
OPOFFSETX=0.0         ; Guide probes offset due to optics in x [mm]
OPOFFSETY=0.0         ; Guide probes offset due to optics in y [mm]
GPOFFSETX=0.0         ; Offset between mount and field-center in x [mm]
GPOFFSETY=0.0         ; Offset between mount and field-center in y [mm]
GP1APDX=0.55         ; Offset between encoder and quad sensor in x [mm]
GP1APDY=0.10         ; Offset between encoder and quad sensor in y [mm]
GP2APDX=0.80         ; Offset between encoder and quad sensor in x [mm]
GP2APDY=0.30         ; Offset between encoder and quad sensor in y [mm]
SAMIFCX=1946          ; Field center location in SAMI in x [pixels]
SAMIFCY=2077.6        ; Field center location in SAMI in y [pixels]
SAMIROT=0             ; SAMI rotation
SAMISCALE=0.0453825   ; SAMI scale in [arcsec/pixel]
SLCHWINDOW=3600       ; SLCH override time window in units of [seconds]
SLCHRESET=1           ; Cadence for watchdog reset in SLGSOFT in [seconds]
SLCHSHUTLIM=5         ; Above this number the dome is considered open
SLCHAUTOOPEN=3        ; Time before LCH closure to automatically open loops
```



### 4.1.2 soar\_comms.ini

The ICSOFT communication infrastructure is built upon the SOAR communication library (SCLN). The SCLN is an implementation of a network communication layer that suites the interoperability requirements of the SOAR telescope environment. Each section in the configuration file for this software module defines a client-server pair with the corresponding listening port.

```
[CommLib]
Version=                ;Version for which this configuration is usable
[RTC]
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 viserver.ini

The ICSOFT uses Labview remote panels to display some interfaces and charts. The remote panel technology allows to open a GUI located in another computer as it has been opened locally. The *viserver.ini* file includes multiple sections with information regarding the name and location of the remote GUI. The ICSOFT invokes the remote panel using the section labels in this file.

```
[NAME]                  ; unique label identifying the remote panel.
VINAME=                 ; name of the remote VI of the GUI
ADDRESS=                ; remote machine IP address
PORT=                  ; remote machine listening port
```

### 4.1.4 telemetry.ini

The ICSOFT use the *telemetry.ini* file to format the telemetry test-points and figure out the sampling period for logging telemetry data. The file includes multiple sections, each one corresponding to a different test-point. The ICSOFT hard wires the ID to the test-point to link it to a section.

```
[TESPOINT NUMBER]     ; unique number for this section
ID=                    ; unique number used as the test-point ID
Label=                 ; string test-point name
Units=                 ; test-point measurement units
Help=                  ; brief test-point description
Stime=                 ; sampling time in [seconds]
Min=                   ; minimum legal value for the test-point
Max=                   ; maximum legal value for the test-point
```

The ICSOFT will save every *Stime* seconds the test-point value to the ICSOFT log file. The *Label* and *Units* keyword will be used to format the telemetry table and charts (see section 2.20 above).

### 4.1.5 instruments.ini

The *instrument.ini* file is used to populate the *Instrument* Selector Box Control (see section 2.15 above). It include multiple sections, one for each instrument defining a label and a configuration macro.

Right now the configuration macro selects the right FOLD2 mirror position for the instrument.

```
[INTRUMENT NUMBER]      ; unique number for this section
ID=                      ; unique number uses as the instrument ID
Name=                    ; text string with the instrument name
Macro=                   ; instrument macro to configure SAM
```

For example, to add SAMI to the instrument.ini file edit the file defining an ID, then Name="SAMI" as the name, and finally Macro=*sami.mc* as the initialization macro.

#### 4.1.6 lltfoc.ini

This is TBD but after conversations with RT he most probably will gave me a polynomial fit to the function relating LGS distance in [Km] to LLT focus position in [mm]. The lltfoc.ini file includes a single section with the coefficients of a 9th order polynomial. To use a lower order just set the upper order coefficients to zero.

```
[GENERAL]
a0=2.0
a1=2.0
a2=0.0
a3=0.0
a4=0.0
a5=0.0
a6=0.0
a7=0.0
a8=0.0
a9=0.0
```

#### 4.1.7 rgatedelay.ini

This is TBD but probably a polynomial fit will be used to relate the LGS distance in [Km] to the range gate delay in [ns]. The rgatedelay.ini file includes a single section with the coefficients of a 9th order polynomial. To use a lower order just set the upper order coefficients to zero.

```
[GENERAL]
a0=2.0
a1=2.0
a2=0.0
a3=0.0
a4=0.0
a5=0.0
a6=0.0
a7=0.0
a8=0.0
a9=0.0
```

#### 4.1.8 wfsfoc.ini

This is TBD but after conversations with RT he most probably will gave me a polynomial fit to the function relating LGS distance in [Km] to WFS focus position in [mm]. The wfsfoc.ini file includes two sections; the GENERAL section includes the coefficients of a 9th order polynomial for the fit. To use a lower order just set the upper order coefficients to zero.

For example, the section labeled NGS, set the nominal WFS position in [mm] when under NGS and TSNGS operation modes.

```
[GENERAL]
a0=2.0
a1=2.0
a2=0.0
a3=0.0
a4=0.0
a5=0.0
a6=0.0
a7=0.0
a8=0.0
a9=0.0
[NGS]
FOCUS= ; WFS focus under NGS mode in [mm]
```

#### 4.1.9 Dmflat\_rot1.txt

Text file containing the coefficients to adjust the flat DM voltages. The file is 60 lines long and each line correspond to DM actuator *line-number*. Each line in turn contains three coefficient to calculate the actuator voltage as

$$\text{Volate} = P_0 + P_1 \cos(\text{ROT}) + P_2 \sin(\text{ROT}) \quad (1)$$

Where *ROT* is the current Nasmyth rotator angle.

#### 4.1.10 faults.ini

The ICISOFT logging and error handling infrastructure is built upon the *FaultsLib* software module. The configuration file for that module defines error codes and their corresponding error messages.

```
[0]
ID= ;Fault identification number
What= ;The fault label
Help= ;Brief description of the fault
Limit= ;Number of occurrences to raise an alarm
LogAlways= ;TRUE or FALSE.
```

The error code assignment to a certain fault condition is hard coded in the software and the configuration file makes possible to hand edit the error message content. If the `Limit` keyword is set to -1, then fault condition gets ignored. If the `LogAlways` keyword is set to `TRUE`, then the event will be logged independent of if there was an error or not.

## 4.2 Macros

The ICISOFT executes an initialization macro when it first starts. The macro is the AO software initialization macro *initics.mc*. This macro is the last initialization done by the AO software before it enters operational mode. So it is the appropriate place to set parameters or override some default parameter values. Right now the *initics.mc* macro is empty.

## 4.3 Scripts

### 4.3.1 Coded Names

### 4.3.2 Instrument Initialization Scripts

For each instrument to be used with SAM and initialization script is provided. The script name is defined in the *instrument.ini* file and it is executed when an instrument gets selected using the *Instrument Selector Box* (see section 2.15 above). Typically, this script will command the output selector mirror to move to the position that will feed light to the instrument and will adjust the WFS focus position if needed. An example follows depicting SAMI, the dedicated science CCD

```
% cat ICsoft/scripts/sami.lua

sam.command("LOG SAMI setup...")

-- Adjust WFS focus
sam.command("LOG Adjusting WFS focus")
sam.wait_until_end("AOM WFS FOCUS MOVE 80.3",15000)

-- Select SAMI port
sam.command("LOG Moving Output Selector Mirror Out")
sam.wait_until_end("AOM OUTSEL MOVE OUT",15000)

sam.command("LOG SAMI setup done")
```

Other commands can be included here as needed.

### 4.3.3 User defined scripts

User defined scripts should be placed in the *ICsoft/scripts* directory. They will be automatically displayed in the scripts list box in the *Operation Tab* (see section 2.15.1 above).

## Chapter: 5 Log Files

When the ICISOFT first runs, it opens a regular text file to save log messages describing run-time events. Events can be of several types including type alarm, type command, type status, and type simple-event. For details on the implementation of the logging mechanism read the ICSPM.

The events and the conditions in which a log message is generated is hard-coded into the ICISOFT, but certain flexibility exists when it comes to define error messages associated to error codes. A configuration file called *faults.ini* (section 4.1.10 above) exists that serves as a look up table between error codes and error messages. The logging engine, when given an error code, searches the right error message and then produces the corresponding log message.

The actual log file can be found under directory */home/ao/ICsoft/logs* which is typically a link to a user defined directory. Each line in the log file starts with a time-stamp that includes date and time in YYMMDD HH:MM:SS format. Then a label describes what type of event (alarm, status, etc.) the log message refers to. A second label states the name of the “originator”, that is, the piece of software code that produced the event. This second label is most useful for debug purposes. The line ends with the log message describing the event. This last message does not follow a predefined format.

We use the system utility log rotate to manage the ICS log file. The configuration file is in */etc/logrotate.d/icsoft*.

```
% cat /etc/logrotate.d/icsoft
/home/ao/ICsoft/logs/*.log {
    compress
    daily
    rotate 30
}
```

The above keeps the last thirty days logs in compressed format. The `logrotate` utility is executed as a `crontab` job by the `cron` daemon on a daily basis (see */etc/cron.daily/* directory for `logrotate`). We adjusted it to run at midday

```
% cat /etc/crontab
# run parts
01 * * * * root run_parts /etc/cron.hourly
00 12 * * * root run_parts /etc/cron.daily
22 12 * * 0 root run_parts /etc/cron.weekly
42 12 1 * * root run_parts /etc/cron.monthly
```

Note: The whatis database update has to be removed!!

### 5.1 Type Alarm Events

Events of type alarm produced by the ICISOFT can trigger the alarm flag. Each error code defined in the *faults.ini* configuration file has an associated counter that keeps track of consecutive type alarm events. When three alarm messages in a row for a given error code are detected, the global alarm flag is

## Chapter: 5 Log Files

raised. The number of type alarm events in a row is actually configurable in the *faults.ini* configuration file (see section 4.1.10 above).

## Chapter: 6 Acquisition Camera Software

### 6.1 User Interface

#### 6.1.1 Main GUI

#### 6.1.2 Image Display

##### 6.1.2.1 Cross-Hair

A green cross-hair is available for helping defining a reference position (e.g. field stop position in NGS mode and laser guide star in LGS mode).

When the program first starts the last stored position is used to draw the cross-hair. Left clicking in the image display moves the cross-hair to the cursor position. Options for controlling the cross-hair attributes are available via a pop-up menu.

##### 6.1.2.2 Pop-Up Menu

By right-clicking in the image display area a pop-up menu is opened. The available options are described below

**Save to Disk.** Use this option to save a snapshot to disk in FITS file format.

**Force Mono.**

**Scale.**

**Lock Cross-Hair.** When the cross-hair is locked left clicking in the image display does not change its position.

**Show Cross-Hair.** Toggles between showing and hiding the cross-hair.

**Cross-Hair Set.** Record the current cross-hair position. The coordinates get saved to the configuration file *acqcam.ini*.

**Cross-Hair Recall.** Re-position the cross-hair to the last recorded position. The software reads the coordinates stored in the configuration file *acqcam.ini*.

**Zoom Factor [10%-100%].**

### 6.2 Configuration File

A single configuration file *acqcam.ini* is available. The file is in sub-directory *bin-pc/x86/* under directory */home/ao/Prosilica\_GigE\_SDK/*.

```
[CROSS-HAIR]
XPOS=
YPOS=
```

## Chapter: 7 Troubleshooting

### 7.1 Can't Find Guide Stars

#### 7.1.1 NGS Mode

1. Check using the WFS Acquisition Camera that the natural guide star is in the WFS sensor.
2. Check using GMAP that the natural guide star is in the center of the field. If not use the *FC* button to correct the field center offsets. Remember to press *Tel* to refresh the screen.

### 7.2 Tweaking Quad-Sensor Offsets

1. Lock the star using M3 and then manually move the guide probe making M3 follow until you get the natural guide star right in the WFS.
2. Record the guide probe position
3. Now acquire the guide star using the *Acquire GS* button and record the guide probe position.
4. Subtract the recorded values to obtain the amount to add to the current quad-sensor offsets
5. Hand edit the *icsoft.ini* file to enter the new values.
6. Re-start the application to grab the new values.



## Chapter: 8 Glossary

AO	Adaptive Optics.
DM	Deformable Mirror.
DSP	Digital Signal Processing.
DAQ	Data Acquisition.
Effective Compensation	Maximum order compensation for a given reconstructor matrix.
FITS	Flexible Image Transport Format.
FWHM	Full Width at Half Max.
GLC	Ground Layer Compensation
G Matrix	Slopes in x and y are related to aberrations by the gradient matrix G.
G* Matrix	Inverse of the gradient matrix G.
H Matrix	Interaction matrix.
H* Matrix	Reconstructor matrix.
ICSOF	Instrument Control Software. Supervisory control application that handles the business logic of the SAM instrument.
Integrator	Digital controller. Measured residuals are added to the previous signal with some gain.
Interaction Matrix	The relation between the WFS and the DM in an AO system is characterized by the interaction matrix H.
Kolmogorov Law	The Kolmogorov model of the turbulence distortions prescribes the specific form of the phase structure function for the optical wave.
LGS	Laser Guide Star
LLT	Laser Launch Telescope
Modal Coefficients	Zernike mode coefficients
Modal Reconstructor	Error signal delivered by the WFS is converted into modal amplitudes by matrix G*. Amplitudes are weighted and transformed to voltages by

	matrix $P^*$ .
NGS	Natural Guide Star
Noise Propagation	Noise propagation is described by the covariancematrix of Zernike noise coefficients.
Optimal $G^*$ Reconstructor	Optimal modal reconstructor. Takes into account the information on the statistics of the input disturbance contained in the Noll covariance matrix, and correlated centroid noise.
P Matrix	Aberrations are related to DM voltages by the projection matrix P.
$P^*$ Matrix	Inverse of the protection matrix P.
PXI	modular instrumentation standard based on CompactPCI developed by National Instruments with enhancements for instrumentation
Reconstructor Matrix	Inverse of the interaction matrix H.
Regularization Parameter	Setting this parameter $> 0$ helps balancing the noise and input signal in case when the noise is strong. The reconstructor with the right choice of this parameter gives the smallest RMS wavefront error.
RTC	Real Time Computer
RTCORE	Real Time Core
RTSOFT	Real Time Software
RTSPM	Real Time Software Programmer Manual
SAM	SOAR Adaptive Module
Slope	Gradient averaged within the sub-aperture and expressed in units of phase difference between the edges of sub-aperture.
Smith Predictor	Digital controller that counter acts the effect of delay in the loop.
SVD	Singular Value Decomposition
SVD Reconstructor	The interaction matrix is inverted using SVD. Singular values below some threshold are set to zero.
TTP	Tip Tilt Probe
TURSIM	Turbulence Simulator

*Chapter: 8 Glossary*

WFS	Wavefront Sensor
WCoG Method	Weighted Center of Gravity. Improved center of gravity with different weight to each pixel depending on their flux.
Zernike Coefficients	Input disturbance, correction and residuals are represented as coefficients of Zernike modes.