



University of Durham  
Astronomical Instrumentation Group

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## **NAOMI**

**N**asmyth **A**daptive **O**ptics for **M**ulti-purpose **I**nstrumentation

### **The Engineering and Control Program: 'TopGui'** *User Guide*

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## 2 Scope

This document provides a detailed description of the NAOMI Engineering and Control GUI known as *TopGui*. The function of every feature of the GUI is described here. The document is structured in the same way as the GUI. Each ‘page’ has a description, with subsections to describe the function of each feature within that page. Some knowledge of the overall structure of the NAOMI systems is assumed. (Note that controls that are followed by ... will bring up a separate popup window or menu.)

## 3 Overview

*TopGui* is an integrated tool to allow full control of all aspects of the NAOMI adaptive optics (AO) system. It is intended primarily for the use of observatory staff and AO experts. It is used by these staff for the routine setup and operation of NAOMI. An alternative tool, the *NAOMI Observers GUI*, is available for observers to script observations with NAOMI.

### 3.1 The ‘Tools’ Menu: TopGui Pages (In Brief)

At startup, *TopGui* shows the ‘Main’ page. All other pages are accessed via the ‘Tools’ option on the menu bar. These additional pages are shown by expanding the TopGui window to double size. The window can be contracted back to the basic display by choosing the ‘None’ option from the tools menu. A very brief description of each page is given here. The details of every page are contained in section 5 below.

#### 3.1.1 Mirror Control Page

Full manual control is provided of both the segmented mirror and the NAOMI fast steering or tip/tilt mirror.

#### 3.1.2 Diagnostic Page

A large amount of diagnostic data is available on command. This page allows the user to select a diagnostic stream for display. The display is provided in a separate popup window.

#### 3.1.3 Realtime Page

Many of the parameters of the C40 realtime AO system can be set from this page. The AO reconstructor will also eventually be controlled from this page. (Not yet implemented).

#### 3.1.4 C40 Control Page

The state of the all of the C40 processors within the AO system is displayed here. Full control of the two AO control loops is provided.

#### 3.1.5 Wavefront Sensor Display Page

The wavefront sensor (WFS) display is on the main page. This display can be controlled from the WFS display page. Various WFS tools are also provided. Note that direct control of the SDSU WFSs is provided on a separate page.

### 3.1.6 Status Display Page

A colour coded summary of the status of all aspects of the system is provided here.

### 3.1.7 Locks Page

The status of all of the sequencer locks is displayed here. Locks can also be broken from this page.

### 3.1.8 Mechanism Page

All of the NAOMI mechanisms can be manually controlled from this page at the EPICS assembly level.

### 3.1.9 SDSU Control Page

Direct control of the SDSU CCD cameras is provided from this page.

## 3.2 Other Menu Bar Options (In Brief)

### 3.2.1 The 'File' Option

Files that are relevant to any page in *TopGui* can be loaded and saved from here. A button to exit *TopGui* is also provided.

### 3.2.2 The 'Options' Option

These options are provided mainly for problem debugging and program development purposes. They should not normally be changed. (See [The 'Options' Menu](#) below for details).

### 3.2.3 Engineering Gui Option

Some aspects of the control of NAOMI that are NOT integrated into *TopGui* are provided by separate GUI applications launched from here.

### 3.2.4 Help Option

The version of *TopGui* that is running can be identified from here.

## 4 Running TopGui

### 4.1 Command Line Options

To run *TopGui*, type *TopGui &* at the prompt.

*TopGui* is NOT pro-active. It will not alter the state of the system unless asked to do so. It can therefore safely be restarted at any time.

Several command line options are provided. These are present entirely for program development and debugging and should not normally be used. They are described in Table 1 below. (See [The 'Options' Menu](#) below for details).

| TopGui Command Line Option | Effect                             |
|----------------------------|------------------------------------|
| -help                      | Print help on command line options |
| -noepm                     | Start with no status read from EPM |
| -verbose                   | Start with verbose option set      |

Table 1: TopGui Command Line Options

## 4.2 Displays for TopGui

*TopGui* is normally run on the NAOMI visualisation console 'navis'. It can however be run on most SUNs and can be displayed by most X-servers. It should be noted that the WFS display requires an X-server visual that supports 8 bit Pseudo Color.

## 4.3 Resources Required

*TopGui* is a client of various NAOMI servers that must be running for it to operate correctly. These are:

The NAOMI sequencer (known as Sequencer2).

The NAOMI process monitor (known as EPM2).

These two processes normally run on 'navis'.

The C40 communications server (known as C40Comms).

C40Comms runs on the NAOMI imbedded Sparc 'aocontrol1'.

If any of these resources is not running, a system restart must be performed using the *NaomiRestart* command at the command line of 'navis'. This command will restart all NAOMI systems on both 'navis' and 'aocontrol1'.

## 5 Colour Code

A set of colours is used in *TopGui* to represent different status conditions. The colour code is a slightly extended version of the standard colour code in use at the Isaac Newton Group of Telescopes for instrumentation software:

Green: 'Ok', 'Ready for use' or 'Idle'.

Pink: A warning condition.

Red: An error condition. (Or an emergency stop button)

Orange: An 'Unknown' status. (The EPM has no information)

Blue: A 'Busy' condition. (Generally used for mechanisms)

Cyan: Data has been changed and no longer represents the value in the EPM

Cyan: Also used to show selected elements in a mimic

## 6 The Tools Menu: Details of TopGui Pages

At startup, *TopGui* shows only the 'Main' page. All other pages are accessed via the 'Tools' option on the menu bar. These additional pages are shown by expanding the *TopGui* window to double size. The various elements of each page are arranged in 'frames' or outlined regions with central titles. Each element of each frame is described in a subsection. The title of the element is followed by its type in brackets.

### 6.1 The Main Page

The main page provides a very simple top-level set of displays and controls for routine operation of Naomi. This is the only page visible at start-up. Any other page that may be opened from the *Tools* menu is positioned to the right of this page. The layout of the Main Page is shown in Figure 1.

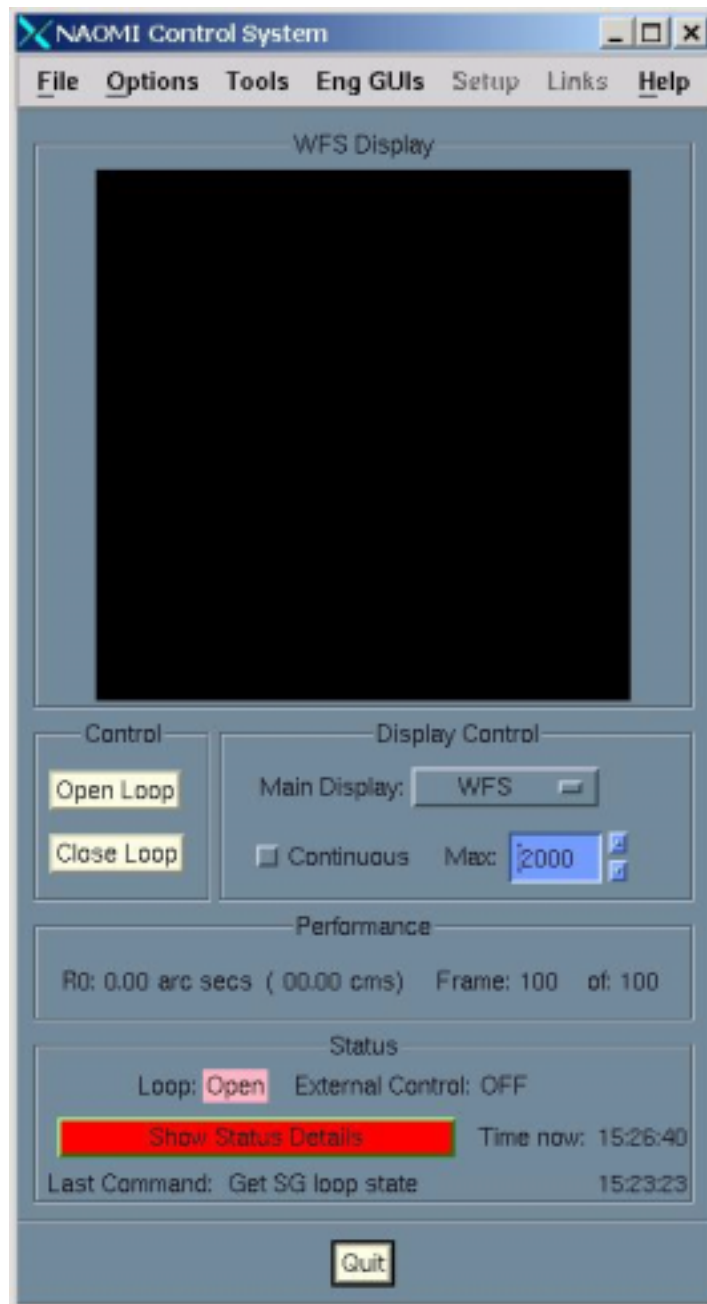


Figure 1: The Layout of the Main Page

### 6.1.1 WFS Display (Frame)

The topmost frame contains the main page display. This is normally used for the WFS display. Other displays may be selected from the 'Main Display' menu in the 'Display Control' frame. However, no other displays are currently implemented.

### 6.1.2 Display Control (Frame)

Some basic controls for the main page display are located here. More detailed control is provided on the 'WFS Control' page.

### **6.1.2.1 Main Display (Menu)**

This menu is used to select what is displayed in the main page display area. Currently, only the WFS display is implemented and this menu option should be left set to WFS.

### **6.1.2.2 Continuous (Toggle)**

If this toggle is set, TopGui will continuously request diagnostics data from the AO system and update the WFS display. If the toggle is not set, no data will be requested and the display will 'freeze'. This control is also available on the *WFS Display Page* (See [Continuous \(Toggle\)](#) below).

### **6.1.2.3 Max (Spinbox)**

The maximum display level for all pixels in the WFS display is displayed here and can be changed. The level will not be used until the next set of data for display arrives. Thus, if 'continuous' is not set, the display will not change when 'max' is changed.

## **6.1.3 Control (Frame)**

The AO control loop (WFS loop) can be controlled from here. More detailed status and control of the C40 based AO control system is provided on the 'C40 Control' page.

### **6.1.3.1 Open Loop (Button)**

This button opens the AO (WFS) control loop. All AO correction will cease.

### **6.1.3.2 Close Loop (Button)**

This button closes the AO (WFS) control loop and activates AO correction.

## **6.1.4 Performance (Frame)**

This is a display only area. The current performance of the AO system is summarised. This performance value is based on the centroid data that is a part of the diagnostics data for the WFS display. If centroid data is not currently being requested, the performance data will not be updated. The performance is displayed as a value of the Fried parameter 'R0' in both arc seconds and as a coherence length in cms. The value is integrated over a number of frames (default 100) that can be changed from the WFS display page (See [Seeing Frames \(Spinbox\)](#) below. The current frame number is also displayed.

## **6.1.5 Status (Frame)**

A small amount of status data is displayed here. More detailed status information is available on the 'Status' page. This can be accessed directly by pressing the 'Show status Details' button.

### **6.1.5.1 Loop (Text Display)**

The current state of the AO (WFS) loop is displayed. If the loop is open, it is coloured pink as a warning. It is coloured green when closed.

### **6.1.5.2 External Control (Text Display)**

This feature is not yet in use and should display 'OFF'.

### **6.1.5.3 Show Status Details (Button)**

The colour of this button shows the overall status of the system. It should be green during astronomical observations. Pressing the button displays the full status page. If the status is not green, the lower level element that is causing a non-green status can be traced by colour coding through the full status page.

### **6.1.5.4 Time now (Text Display)**

The current time is displayed. The time is the system time from the machine on which TopGui is running.

### **6.1.5.5 Last Command (Text Display)**

A simple description of the last command sent to the NAOMI sequencer by TopGui is displayed here. If multiple commands were sent, the last of them is displayed. The time at which the command was sent is also displayed. The time is the system time from the machine on which TopGui is running.

## **6.2 Mirror Control**

The mirror control page is displayed by selecting the 'Mirror Control' option from the 'Tools' menu on the main menu bar. This page allows full manual control of both the segmented mirror and the fast tip-tilt mirror. It should NOT be used during routine observing. The layout of the Mirror Control Page is shown in Figure 2.

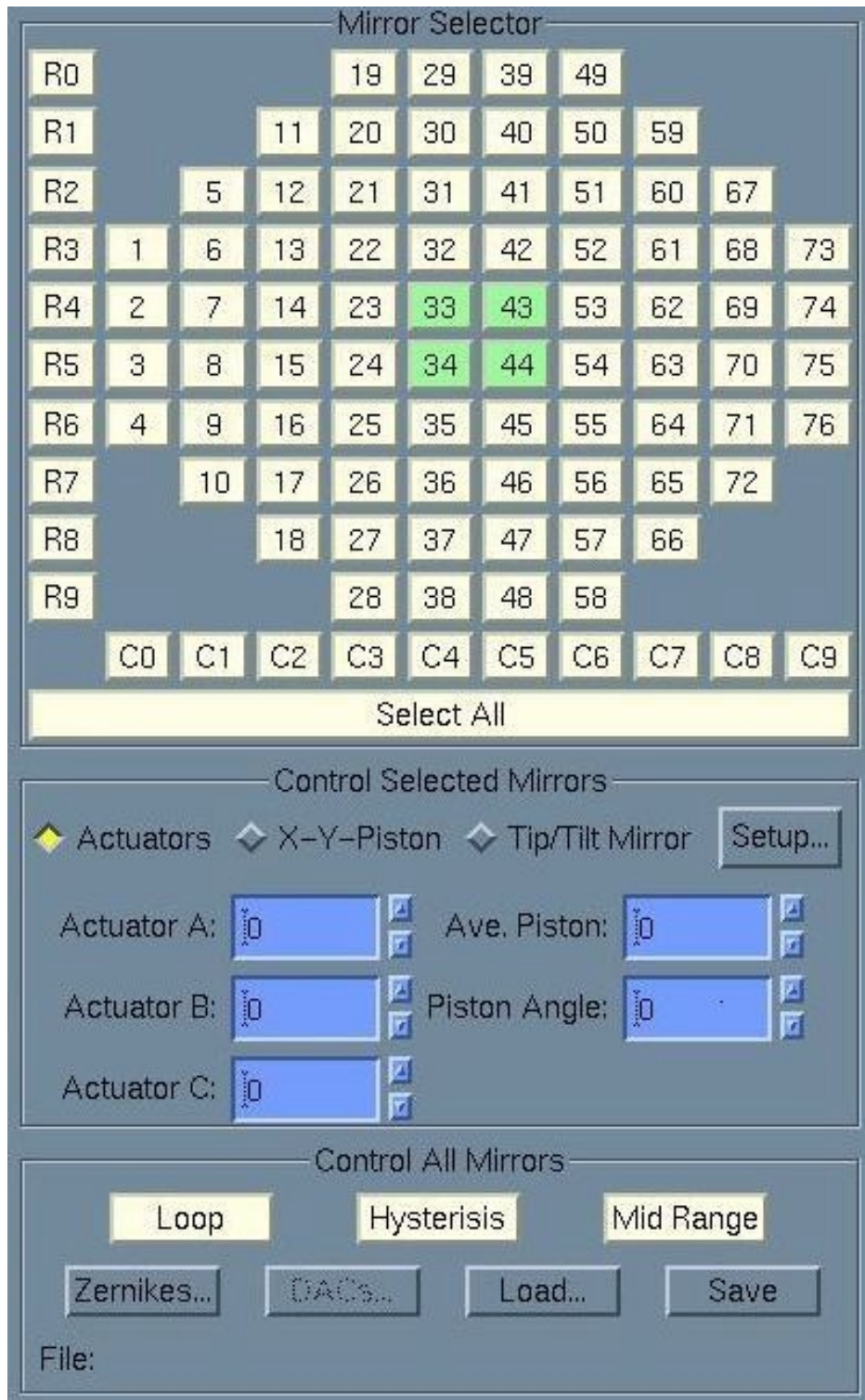


Figure 2: The Layout of the Mirror Control Page

### 6.2.1 Mirror Selector (Frame)

The mirror selector frame contains a mimic of the segmented mirror. Individual segments or rows or columns of the mirror may be controlled. A single element is selected by clicking on that element. A single row is selected by clicking on the row number (eg *R3*) on the left hand side of the mimic. A single column is selected by clicking on the column number (eg *C4*) below the mimic. All segments can be



selected by clicking on the *Select All* button at the bottom of the mimic. The central four obscured segments are marked in green. Information on the current state of the segment(s) selected, is shown in the 'Control Selected Mirrors' frame below.

## 6.2.2 Control Selected Mirrors (Frame)

This frame provides control of selected mirror elements in two different ways, along with control of the fast tip/tilt mirror. If any mirror actuators reach their limits, the relevant segment in the mimic will be coloured pink as a warning. Which type of control is selected is controlled by three exclusive toggles.

### 6.2.2.1 Actuators (Toggle)

When this toggle is set, display and control of the selected mirror segment(s) is provided in the form of individual actuator control. Each mirror segment has 3 actuators called A, B and C. The *Control Selected Mirrors* frame will appear as shown in Figure 3.



Figure 3: Actuator Control of the Deformable Mirror

#### 6.2.2.1.1 Actuator A, Actuator B, Actuator C (Spinboxes)

The average value of the relevant actuator for all of the mirror segments selected is displayed. The values may be changed.

#### 6.2.2.1.2 Ave. Piston (Spinbox)

The average piston value for all three actuators on all the mirror segments selected is displayed. The value may be changed.

#### 6.2.2.1.3 Piston Angle (Spinbox)

If a single column or row of the mirror is selected, the overall piston angle is displayed in this spinbox and may be changed.

### 6.2.2.2 X-Y-Piston (Toggle)

When this toggle is set, display and control of the selected mirror segment(s) is provided in the form of movement in X, Y and piston. It is easier to align a segment in this mode since the direction of movement may be easily predicted. The *Control Selected Mirrors* frame will appear as shown in Figure 4.

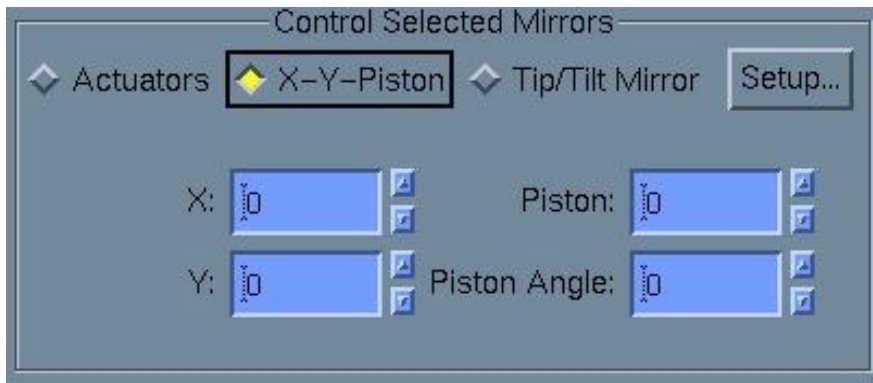


Figure 4: X-Y-Piston Control of the Deformable Mirror

#### 6.2.2.2.1 X (Spinbox)

The position of the selected mirror segment(s) in the X direction is displayed and can be changed.

#### 6.2.2.2.2 Y (Spinbox)

The position of the selected mirror segment(s) in the Y direction is displayed and can be changed.

#### 6.2.2.2.3 Piston (Spinbox)

The average piston value of the selected mirror segment(s) is displayed and can be changed.

#### 6.2.2.2.4 Piston Angle (Spinbox)

If a single column or row of the mirror is selected, the overall piston angle is displayed in this spinbox and may be changed.

#### 6.2.2.3 Tip/Tilt Mirror (Toggle)

When this toggle is set, control of the fast tip/tilt mirror is available. The mirror has 2 actuators known as X and Y. The *Control Selected Mirrors* frame will appear as shown in Figure 5.



Figure 5: Control of the Tip/Tilt Mirror

#### 6.2.2.3.1 TipTilt X (Spinbox)

The tip/tilt mirror position in the X direction is displayed and can be changed. If the actuator reaches its limits, the spinbox background will be coloured pink as a warning.

#### **6.2.2.3.2 TipTilt Y (Spinbox)**

The tip/tilt mirror position in the Y direction is displayed and can be changed. If the actuator reaches its limits, the spinbox background will be coloured pink as a warning.

#### **6.2.2.3.3 Mid Range (Button)**

This button will set both the X and Y actuators of the Tip/Tilt mirror to their mid range (safe) values.

#### **6.2.2.3.4 Zero Values (Button)**

This button will set both the X and Y actuators of the Tip/Tilt mirror to their zero values.

#### **6.2.2.4 Setup... (Button)**

This will bring up the Setup popup window.

#### **6.2.2.4.1 Value Increment (Spinbox)**

The increment achieved in values in spinboxes on the mirror control page by using the up and down arrows can be altered from here.

#### **6.2.2.4.2 Number of bounces. (Spinbox)**

This control should not be used.

### **6.2.3 Control All Mirrors (Frame)**

The controls in this frame affect ALL of the mirror segments in the deformable mirror, regardless of any that may currently be selected.

#### **6.2.3.1 Loop (Button)**

This control should not be used.

#### **6.2.3.2 Hysteresis (Button)**

This button will cause an anti-hysteresis cycle to be executed on all the actuators of the mirror. This will take up to 10 seconds. All of the mirror segments will be moved rapidly many times. This is designed to reduce subsequent hysteresis effects in the piezo-electric actuators. This must NOT be done with the strain-gauge loop closed. An attempt to do so will generate an error message.

#### **6.2.3.3 Mid Range (Button)**

This button will drive all actuators on all mirror sections of the deformable mirror to their mid-range values (Normally 4096). This should be done before the mirror is powered off or on. This represents a 'safe' setting for the mirror. To check if the mirror is at mid-range, click the 'Select All' button under the mirror mimic. The mean actuator values should be 4096.

#### **6.2.3.4 Zernikes... (Button)**

This button will bring up a popup window for adding Zernikes to the deformable mirror shape.

##### **6.2.3.4.1 Mirror Zernike Control (Frame)**

This frame contains 10 spinboxes that allow Zernikes that correspond to Sidel aberrations to be added to the deformable mirror shape. Entering new values will add a unit of the selected Zernike to the current mirror shape.

##### **6.2.3.4.2 Load... (Button)**

The 10 Zernike values may be loaded from file. This button will bring up a file selection popup window. If a file is loaded, the newly loaded Zernike values will be added to the mirror shape. This option is also available from the 'File' menu on the main menu bar. (See [Load Zernikes... \(Menu Option\)](#) below).

##### **6.2.3.4.3 Save as... (Button)**

The 10 Zernike values may be saved to file. This button will bring up a file selection popup window. The name of the file to which to save must be entered. This option is also available from the 'File' menu on the main menu bar. (See [Save Zernikes as... \(Menu Option\)](#) below).

##### **6.2.3.4.4 Ok (Button)**

This button will close the Mirror Zernike Control popup window. The 10 Zernike values will be remembered by TopGui. If TopGui is closed down, they will be lost.

##### **6.2.3.5 Load... (Button)**

This button will bring up a file selection popup window. A previously saved file of the deformable mirror shape may be re-loaded. If a file is loaded, the mirror will be driven to that shape.

This facility is also available from the 'File' menu on the TopGui menu bar. (See [Load DACs... \(Menu Option\)](#) above).

##### **6.2.3.6 Save (Button)**

This button will save the current deformable mirror shape (IE The current DAC values) to file. The file will be given a default name based on the system date/time of the form: *yyyymmdd-hhmm* where *yyyy* is the year, *mm* is the month, *dd* is the day, *hh* is the hour and *mm* is the minute. This facility is also available from the 'File' menu on the TopGui menu bar. (See [Save DACs \(Menu Option\)](#) below).

##### **6.2.3.7 File (Text field)**

The name of the last loaded or saved deformable mirror file is displayed here.

## **6.3 Diag Select Page**

This page of TopGui allows the user to select from the diagnostic data that is available from the C40 AO system. The data requested is actually displayed as a dynamic graphic by a separate application launched from this page. The controls of this popup graphical display application are described in section 5.3.6 below. Any number of these diagnostic windows may be displayed. Most of the data is related directly to one or more of the deformable mirror segments or associated sub-aperture

on the wavefront sensor. A mimic, very similar to that used for manual mirror control, is used to select the segments required. The layout of the Mirror Control Page is shown in Figure 6.

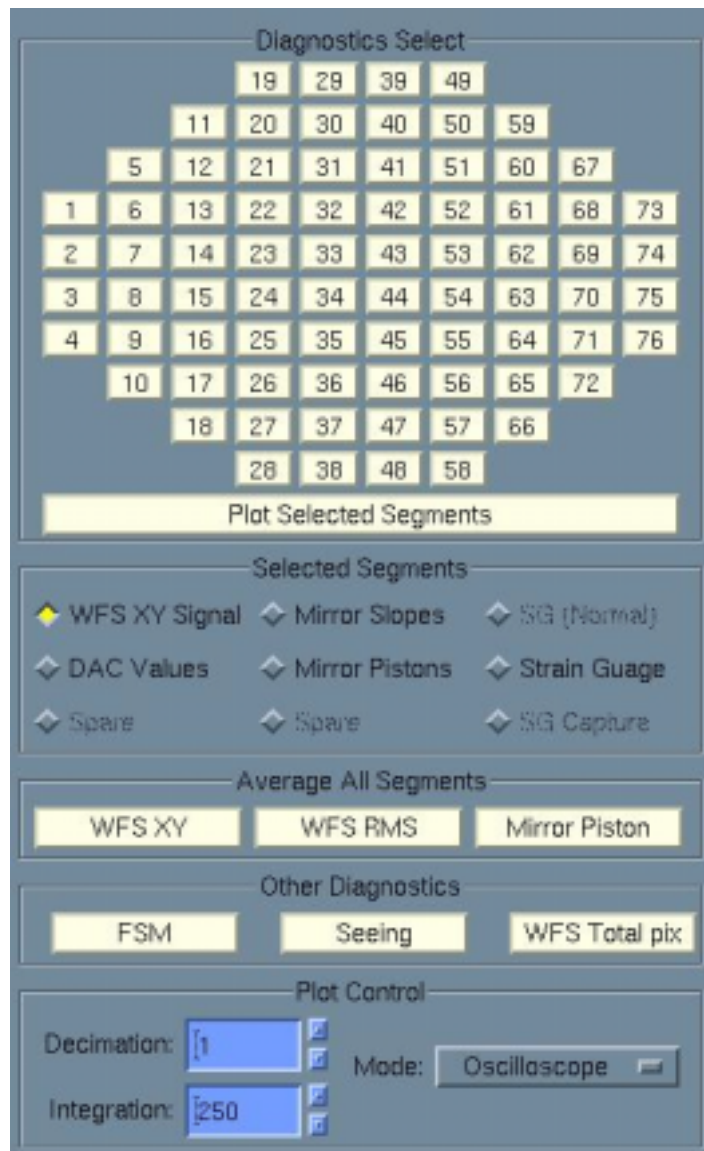


Figure 6: The Layout of the Diagnostics Page

### 6.3.1 Diagnostics Select (Frame)

Data from up to 2 segments can be displayed in any one popup display. Thus 1 or 2 segments should be selected by clicking on those segments. The selected segments will be coloured cyan. To de-select a segment, click on it again. If more than 2 segments are selected, only the first 2 selected will be displayed.

#### 6.3.1.1 Plot Selected Segments (Button)

When the required segment(s) have been selected, and the required data type selected (See [Selected Segments \(Frame\)](#) below), clicking on this button will bring up the popup graphical display.

### **6.3.2 Selected Segments (Frame)**

This frame contains a set of toggles that allow the user to select the type of diagnostic data required for the selected segments. These toggles are mutually exclusive.

#### **6.3.2.1 WFS XY Signal (Toggle)**

If this toggle is selected, data will be requested for the X and Y positions of the centroids of the WFS spots for the selected segments.

#### **6.3.2.2 DAC Values (Toggle)**

If this toggle is selected, data will be requested for the current DAC values of all 3 actuators on each of the selected mirror segments.

#### **6.3.2.3 Mirror Slopes (Toggle)**

If this toggle is selected, data will be requested for the slope value of the requested mirror segments.

#### **6.3.2.4 Mirror Pistons (Toggle)**

If this toggle is selected, data will be requested for the piston values of the requested mirror segments.

#### **6.3.2.5 Strain Gauge (Toggle)**

If this toggle is selected, data will be requested for the current strain gauge values of all 3 actuators on each of the selected mirror segments.

### **6.3.3 Average All Segments (Frame)**

Several diagnostics may be plotted as averages over all of the mirror segments. These buttons will ignore any segment selection.

#### **6.3.3.1 WFS XY (Button)**

This will plot the average values of the X and Y positions of the WFS centroids over all segments.

#### **6.3.3.2 WFS RMS (Button)**

This will plot the RMS spread in the X and Y positions of the WFS centroids over all segments.

#### **6.3.3.3 Mirror Piston (Button)**

This will plot the average piston value of all the mirror segments.

### **6.3.4 Other Diagnostics (Frame)**

#### **6.3.4.1 FSM (Button)**

This will plot the X and Y positions of the Fast Steering Mirror (FSM). (Otherwise known as the Tip/Tilt mirror.)

This is a useful plot during an observation to check that the auto-guiding offload from the Tip/Tilt mirror to the Telescope Control System (TCS) is functioning.

#### **6.3.4.2 Seeing (Button)**

This provides a plot of seeing (as R0 in cms) based on the variance in the centroid positions of a selection of 4 pairs of segments.

#### **6.3.4.3 WFS Total Pix (Button)**

This will plot the total value of all of the light seen in all segments.

### **6.3.5 Plot Control (Frame)**

How the data is required to be plotted should be set here before the plot is requested.

#### **6.3.5.1 Decimation (Spinbox)**

A decimation value may be set here for the diagnostic data stream. The default is for all the data to be sent from the C40 system; a decimation of 1. If this value is increased, only a subset of the data will be sent. E.G. If it is set to 5, only every fifth occurrence of the requested data will be sent.

#### **6.3.5.2 Integration (Spinbox)**

This sets the number of data values that will be displayed in 'Oscilloscope' mode, or the number of values that will be included in each point in 'Power Spectrum' mode. The default is 250.

#### **6.3.5.3 Mode (Menu)**

The data requested can be displayed in 1 of three different forms or modes.

##### **6.3.5.3.1 Oscilloscope Mode (Menu Option)**

In this mode, data will be displayed as an *oscilloscope trace*. However, the data is simply displayed as it arrives, with no attempt made to ensure that the horizontal (time) axis is linear. Once the number of points displayed reaches the integration setting (the display is full), the trace will scroll from right to left so that old data is lost as new data arrives.

##### **6.3.5.3.2 Autocorrelation (Menu Option)**

This mode operates in a similar way to the Power Spectrum mode defined below. The spectrum plotted is an autocorrelation of the data selected.

##### **6.3.5.3.3 Power Spectrum (Menu Option)**

In this mode, data will be collected in the time domain until the number of points reaches the integration that has been set. This may take some time, and no display is seen until the integration is complete. The data is then transformed to the frequency domain and plotted as a power spectrum with a number of points also equal to the integration that has been set. The spectrum will update only when a further number of data points equal to the integration has arrived.

### **6.3.6 Graphical Diagnostics Display (Popup Window)**

All diagnostic data requested is displayed by a separate application in a graphical display window. The controls of this window are defined here.

\*\*\*\* Not done yet!! \*\*\*\*

## 6.4 Realtime Page

This page provides access to the realtime parameters of the AO loop and the reconstructor settings. The layout of the Realtime Page is shown in Figure 7.

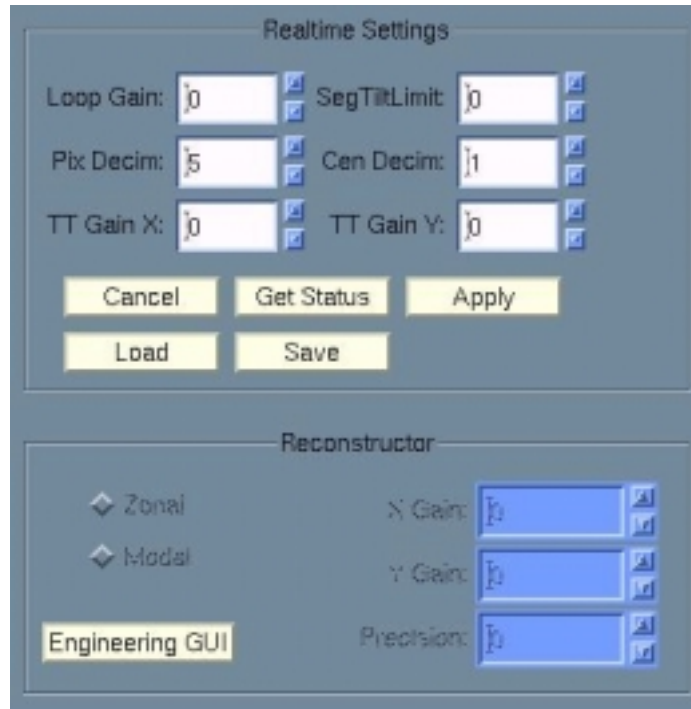


Figure 7: The Layout of the Realtime Page

### 6.4.1 Realtime Settings (Frame)

These controls provides access to the parameters that influence the AO loop itself within the C40 control system. One or more values may be changed at once. The spinboxes show the current values when they have a white background. Values that have been changed locally and not yet sent to the C40s have a cyan background.

#### 6.4.1.1 Loop Gain (Spinbox)

The gain of the AO control loop , as a floating point value, can be varied via this spinbox. The default value at startup is 0.0.

#### 6.4.1.2 SegTiltLimit (Spinbox)

The maximum amount of Tilt on the deformable mirror before it is offloaded to the fast steering Tip/Tilt mirror is set here.

#### 6.4.1.3 Pix Decim (Spinbox)

The rate of CCD pixel data from the C40 AO loop to the C40 diagnostic CPU can be set here. The default value is 50 meaning that one packet in 50 is sent to the diagnostics system. This should not be confused with the diagnostics decimation system (See [Decimation \(Spinbox\)](#) below) that can be used to further limit the rate of data requested for display via the diagnostics page (Section 5.3).

#### 6.4.1.4 Cen Decim (Spinbox)

The rate of WFS centroid data from the C40 AO loop to the C40 diagnostic CPU can be set here (See [Pix Decim \(Spinbox\)](#) above for details). The default value is 50.



#### **6.4.1.5 TT Gain X (Spinbox)**

The gain of the Tip/Tilt fast steering mirror in the X direction can be set here. The default value is 0.0.

#### **6.4.1.6 TT Gain Y (Spinbox)**

The gain of the Tip/Tilt fast steering mirror in the Y direction can be set here. The default value is 0.0.

#### **6.4.1.7 Cancel (Button)**

Any (cyan) values that have been changed but not yet sent can be cancelled by this button. The values will revert to the current (white) values.

#### **6.4.1.8 Get Status (Button)**

The values displayed should always represent the actual values set in the C40 system. If for any reason they do not, this button will cause all of the current values to be read from the C40s and displayed. If the values are already correct, no effect will be seen.

#### **6.4.1.9 Apply (Button)**

When new value(s) have been entered, this button will cause all of the new values to be set in the C40s. If the new values fail to be set, the displays will revert to their previous settings and an error state should be indicated on the main page. If no values have been changed, this button will have no effect.

#### **6.4.1.10 Load (Button)**

All of the realtime settings can be saved to a file for re-loading at a later time. The *Load* button brings up a file dialogue box that displays previously saved files that can be loaded. When a file is loaded, the values contained in it are displayed as new (cyan) values but will only be sent to the C40s if the *Apply* button is pressed. Thus a file can be loaded and the values checked before they are sent or cancelled.

Note that these files are saved at: */software/Electra/save/realtimeControl*. This control is also available from the 'File' menu on the menu bar. (See [Load Settings... \(Menu Option\)](#) below).

#### **6.4.1.11 Save (Button)**

All of the realtime settings can be saved to a file for re-loading at a later time. The file will be automatically named based on the current system time as: *yyyymmdd-hhmm* where *y* is year, *m* is month, *d* is day, *h* is hour and *m* is minute.

Note that these files are saved at: */software/Electra/save/realtimeControl*. This control is also available from the 'File' menu on the menu bar. (See [Save Settings \(Menu Option\)](#) below).

### **6.4.2 Reconstructor (Frame)**

Reconstructor control has not yet been integrated into the *TopGui*. An engineering GUI for reconstructor control can be run from the Engineering GUI button below or from *Eng GUIs -> Reconstructor* from the main menu bar.

### 6.4.2.1 Engineering GUI (Button)

This button will launch the Reconstructor control GUI as a popup. This GUI can also be launched from the Eng GUIs menu on the menu bar. (See [Reconstructor \(Menu Option\)](#) below)

## 6.5 C40 Control Page

This page displays the status of the C40 control system and allows the user to stop or start the C40 rings and open or close the 2 control loops. The layout of the C40 Control Page is shown in Figure 8. Note that the strain gauge (SG) loop being open is considered an error state.



Figure 8: The Layout of the C40 Control Page

### 6.5.1 C40 Status (Frame)

The status of the C40 control system is displayed in this frame in both graphical and text form.

### 6.5.1.1 WFS (Label)

This label identifies the graphic below it as a representation of the WFS C40 ring. The label is coloured to represent the ring status.

### 6.5.1.2 1 to 9 (Buttons)

Each button represents the C40 CPU of the same number in the WFS C40 ring. Each is colour coded to represent the status of that CPU. Pressing any of these will select that CPU to be pinged by the *Ping button* (See [Ping \(Button\)](#) below). CPU 9 at the centre of the ring is the diagnostics CPU.

When the WFS ring is framing (I.E. accepting pixel data from the WFS), the 8 ring CPUs will be joined by lines as shown in figure 9 in which both rings are framing.

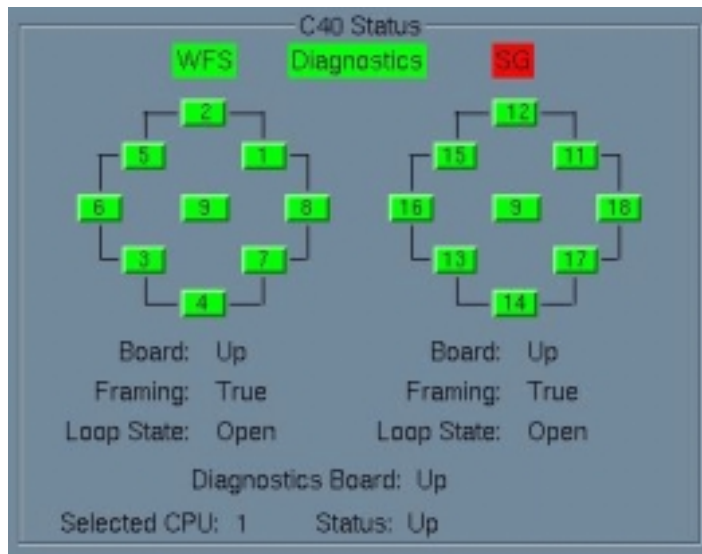


Figure 9: C40 Status with both rings framing

### 6.5.1.3 SG (Label)

This label identifies the graphic below it as a representation of the SG C40 ring. The label is coloured to represent the ring status. Note that this label will show an error state if the SG loop is open.

### 6.5.1.4 11 to 18 and 9 (Buttons)

Each button represents the C40 CPU of the same number in the SG C40 ring. Each is colour coded to represent the status of that CPU. Pressing any of these will select that CPU to be Pinged by the *Ping button* (See [Ping \(Button\)](#) below). CPU 9 at the centre of the ring is the diagnostics CPU.

When the SG ring is framing, the 8 ring CPUs will be joined by lines as shown in figure 8 in which both rings are framing.

### 6.5.1.5 Diagnostics (Label)

This label is colour coded to represent the status of the diagnostic CPU 9.

### 6.5.1.6 Board (Label)

The text string following this label reflects the status of the WFS C40 board (On left) or the SG C40 board (On right).

#### **6.5.1.7 Framing (Label)**

The text string following this label indicates whether the WFS (On left) or SG (On right) C40 ring is framing.

#### **6.5.1.8 Loop State (Label)**

The text string following this label indicates whether the WFS (On left) or SG (On right) C40 control loop is open or closed.

#### **6.5.1.9 Diagnostic Board (Label)**

The text string following this label reflects the status of the Diagnostics C40 board.

#### **6.5.1.10 Selected CPU (Label)**

The number following this label shows which C40 CPU is currently selected. Select a CPU by clicking on the relevant button in the ring graphics. It is this CPU that is pinged by the *Ping* button. (See [Ping \(Button\)](#) below).

#### **6.5.1.11 Status (Label)**

The text following this label reflects the status of the currently selected C40 CPU.

### **6.5.2 C40 Control (Frame)**

#### **6.5.2.1 WFS (Label)**

This label indicates that the 6 buttons below it in this frame control the Wave Front Sensor C40 ring and control loop

#### **6.5.2.2 SG (Label)**

This label indicates that the 4 buttons below it in this frame control the Strain Gauge C40 ring and control loop

#### **6.5.2.3 Open (Button)**

If the WFS (Left) or SG loop (Right) is closed, this button will cause it to open.

#### **6.5.2.4 Close (Button)**

If the WFS (Left) or SG (Right) loop is open, this button will close the relevant loop.

#### **6.5.2.5 Start (Button)**

If the WFS C40 ring is not framing, this button will start it framing. Note that if the SDSU cameras are not framing, there is no pixel data available and the WFS loop will not start.

#### **6.5.2.6 Stop (Button)**

If the WFS C40 ring is framing, this button will stop it framing.

#### **6.5.2.7 Break Trans (Button)**

There is a small window of opportunity for commands to hang up the transaction system between the C40 server on `aocontrol1` and the C40s themselves. If this occurs, all commands to that C40 ring will fail. This condition is cleared by this button for either the WFS or SG ring.

#### **6.5.2.8 GetStatus (Button)**

The values and status displayed on this page should always represent the actual values set in the C40 system. If for any reason they do not, this button will cause all of the current values relating to either the WFS or SG ring to be read from the C40s and displayed. If the values are already correct, no effect will be seen.

#### **6.5.2.9 Ping (Button)**

This button will issue a ping to the Selected CPU (See [1 to 9 \(Buttons\)](#) or [11 to 18 and 9 \(Buttons\)](#) above). The status of that CPU is updated in response to the ping. An error will be generated if the CPU cannot be contacted.

#### **6.5.2.10 GetStatus (Button)**

This button combines the function of the two *GetStatus* buttons described in 5.5.2.8 above. Thus the status of both the SG and WFS rings will be updated at the same time.

#### **6.5.2.11 Emergency Stop (Button)**

This is a panic button. If a situation arises where the equipment might be in danger (eg the deformable mirror ‘thrashing’), this button will open all loops, and stop the C40s running. A full reboot will be required.

### **6.5.3 C40Comms (Frame)**

*C40Comms* is the name of the server running on *aocontrol1* that handles all communications between *TopGui* and the C40 system. This server must be running. The status of the server is shown in this frame.

#### **6.5.3.1 Host (Label)**

The text string following this label identifies the host for the *C40Comms* server. This should always be *aocontrol1*, the embedded Sparc in the C40 VME crate.

#### **6.5.3.2 Running (Label)**

The text string following this label reflects the status of the C40Comms server. This should normally be *Up*. If the status is *Unknown*, the status can be found using the *Ping* button (See [Ping \(Button\)](#) below).

#### **6.5.3.3 Ping (Button)**

This button will *Ping* the *C40Comms* server running on *aocontrol1*, and update its status.

#### **6.5.3.4 C40Comms (Label)**

This label is colour coded to reflect the status of the C40Comms server. It should normally be green.

## **6.6 WFS Display Page**

This page controls the WFS display that appears on the main display page. The layout of the WFS Display Page is shown in Figure 10. A subset of these controls are available on the *Main Display Page*. (See [Display Control \(Frame\)](#) above). Note that this page controls the WFS display. The SDSU wavefront sensor cameras themselves are controlled from the SDSU Control page. (See [SDSU Control Page](#) below).

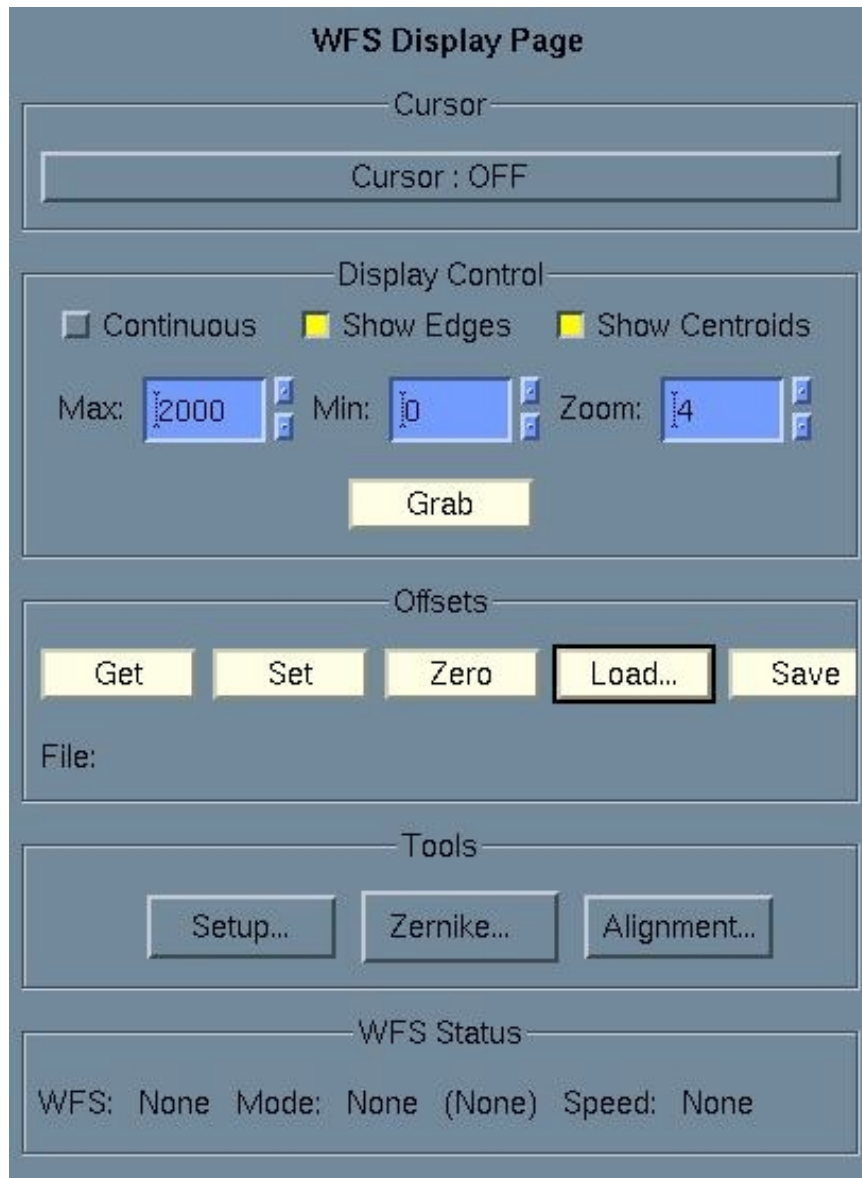


Figure 10: The Layout of the WFS Display Page

### 6.6.1 Cursor (Frame)

A cursor is provided to display the intensity value of any pixel within the WFS display.

#### 6.6.1.1 Cursor (Button)

This button will switch the cursor facility on or off. The normal state is off and the status is displayed on the button. If the cursor is switched on, and the mouse pointer is positioned over the WFS display on the main page, the X and Y position of the selected pixel and its intensity value will be displayed on the cursor button. An X or Y position value of *out* means the mouse is outside the WFS display window. An intensity value of *none* indicates that no intensity data is available. The cursor frame display will then be as shown in Figure 11.

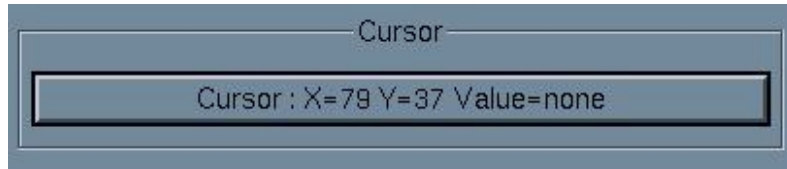


Figure 11: The Cursor Display when Active

## 6.6.2 Display Control (Frame)

The form of the WFS display on the main page can be altered using the controls within this frame.

### 6.6.2.1 Continuous (Toggle)

At startup of *TopGui*, the WFS display will not be updated. If this toggle is set, the display will be updated continuously. The update rate depends on the WFS framing rate and on the pixel decimation rate (See [Pix Decim \(Spinbox\)](#) above). This control is also available on the *Main Display Page* (See [Continuous \(Toggle\)](#) above).

### 6.6.2.2 Show Edges (Toggle)

If this toggle is set, the boxes that represent the 8 by 8 sub-apertures of the WFS will be superimposed on the WFS image in red. (Note that in this version of *TopGui*, if the WFS mode is changed to other than 8 by 8 sub-apertures, the edge display remains as 8 by 8 sub-apertures.)

### 6.6.2.3 Show Centroids (Toggle)

If this toggle is set, the latest centroid positions from the C40s will be superimposed as red crosses in each sub-aperture of the WFS display.

### 6.6.2.4 Max (Spinbox)

This sets the maximum of the dynamic range of the WFS display. The default value is 2000. Any pixel with a value greater than or equal to the maximum will be displayed with the maximum intensity of the display. If the value is changed, it will not take effect until the next update occurs. This control is also available on the *Main Display Page* (See [Max \(Spinbox\)](#) above).

### 6.6.2.5 Min (Spinbox)

This sets the minimum of the dynamic range of the WFS display. The default value is zero. Any pixel with a value less than or equal to the minimum will be displayed with zero intensity. If the value is changed, it will not take effect until the next update occurs.

### 6.6.2.6 Zoom (Spinbox)

The WFS display normally shows the 8 by 8 sub-apertures of the WFS filling the display area (a zoom of 4). This spinbox allows the user to zoom in or out. This can be useful for ease of selection of a particular pixel with the cursor. If the value is changed, it will not take effect until the next update occurs.

### 6.6.2.7 Grab (Button)

If the *Continuous* toggle is not set, this button allows 1 frame of WFS data to be requested. (If *Continuous* is set, *Grab* has no effect).



### 6.6.3 Offsets (Frame)

The WFS offsets are controlled from this frame.

#### 6.6.3.1 Get (Button)

The WFS offsets are saved in the EPM. This button will get the current offsets from the C40s and update the values store in the EPM.

#### 6.6.3.2 Set (Button)

This button will set the WFS offsets from the current centroids. By default, 100 frames of centroid data will be requested from the diagnostics system and used to calculate the offsets. If a different number of centroids are required, this should first be set in the Setup menu (See [Offset Frames \(Spinbox\)](#) below).

#### 6.6.3.3 Zero (Button)

This button will set the WFS offsets in the C40s to zero.

#### 6.6.3.4 Load... (Button)

This will bring up a popup file loading dialogue box. The centroid offsets can be reloaded from a previously saved file (See [Save \(Button\)](#) below). Select an offsets file and click *OK* to load it. The saved offsets will be loaded from file and sent to the C40s. This option is also available from the File menu on the main menu bar. (See [Load Offsets... \(Menu Option\)](#) below).

#### 6.6.3.5 Save (Button)

This will save the current offsets to file. A default filename is supplied of the form: *yyyymmdd-hhmmss.wcnof* where *y* is year, *m* is month, *d* is day, *h* is hour, *m* is minute, and *s* is second. The file will be saved at: */software/Electra/save/WFScentroidOffsets*. This option is also available from the File menu on the menu bar. (See [Save Offsets \(Menu Option\)](#) below).

#### 6.6.3.6 File: (Label)

The text string after this label shows the name of the last saved or loaded offsets file.

### 6.6.4 Tools (Frame)

#### 6.6.4.1 Setup... (Button)

This button will bring up the WFS setup popup window.

##### 6.6.4.1.1 Decimate (Spinbox)

The WFS pixel and centroid data that is displayed is requested from the C40 diagnostics system. The default decimation for this data request is 1. This can be changed here. Thus if a decimation of 5 is set, only every fifth set of pixel and/or centroid data will be requested from the diagnostics system.

##### 6.6.4.1.2 Offset Frames (Spinbox)

When setting the WFS offsets from the current centroids (See [Set \(Button\)](#) above), the centroids will (by default) be averaged over 100 frames of data. This value can be changed here.



#### **6.6.4.1.3 Seeing Frames (Spinbox)**

The seeing display on the *main page* (See [Performance \(Frame\)](#) above) is based (by default) on the variance in 100 frames of centroid data. This number can be changed here. A smaller number will lead to a more frequent update of the seeing estimate but with lower precision.

#### **6.6.4.1.4 Show Pixels (Toggle)**

When this toggle is set (by default) the WFS pixel data is requested and displayed. If it is unset, no pixel data will be displayed. It can be useful to see just the centroid crosses.

#### **6.6.4.2 Zernike... (Button)**

This button yields a drop down menu of 2 Zernike options.

##### **6.6.4.2.1 Deconvolve... (Menu Option)**

This will popup a display of the WFS data de-convolved into the 10 lowest Zernike modes.

##### **6.6.4.2.2 Offsets... (Menu Option)**

This will popup a display of spinboxes that allow any combination of the 10 lowest Zernike modes to be added to the WFS offsets.

*Save as* and *Load* buttons are provided to save and re-load these values to/from file. These options are also available from the File menu on the Menu bar. (See [WFS... \(Menu Option\)](#) below).

#### **6.6.4.3 Alignment... (Button)**

This will popup the WFS alignment tool. This displays the X and Y alignment parameters for every frame of WFS data displayed.

### **6.6.5 WFS Status (Frame)**

The status of the WFS is contained in a header on every packet of WFS pixel data received from the C40s. This data is extracted and displayed in this frame. Note that mode 1 (Full frame mode) does not currently support this feature and the data will be invalid in mode 1).

#### **6.6.5.1 WFS (Label)**

The text string after this label identifies which WFS the data is coming from (Master or Slave).

#### **6.6.5.2 Mode (Label)**

The text string after this label identifies the current mode of the WFS (from 1 to 10) and in brackets the sync state of the WFSs (Synched or un-synched).

#### **6.6.5.3 Speed (Label)**

The text string after this label identifies the current speed setting of the WFS. This can be slow or fast. The default setting is fast. The slow setting provides a slower readout with lower electron noise.

## 6.7 NAOMI Status Page

The status of the various aspects of NAOMI are summarised on this page as a set of labels and buttons colour coded to represent the status of each item. (See [Colour Code](#) above). Clicking on the *Show Status Details* button on the main page (See [Show Status Details \(Button\)](#) above) will also bring up this page. Thus, if an error status is indicated on the main page, this page will identify in red the area in which the error lies and may provide further lower level details by clicking on one of the *Show Details* buttons described below. (The status indicators are hierarchical. Each status indicator will indicate the ‘worst’ level of status of all of the indicators in the level below it.) The layout of the WFS Display Page is shown in Figure 12.

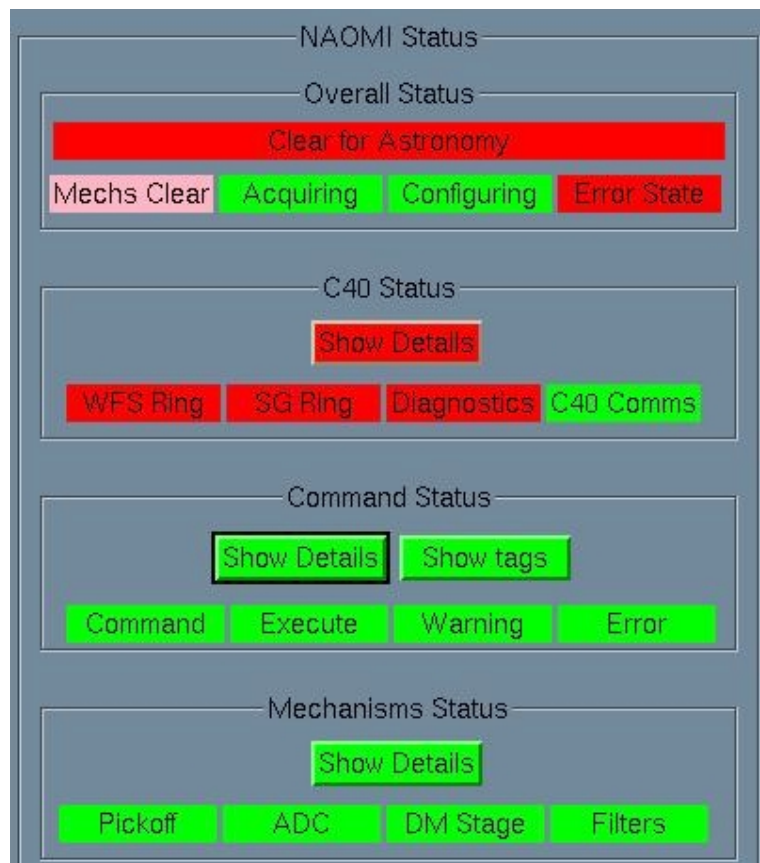


Figure 12: The Layout of the NAOMI Status Page

### 6.7.1 Overall Status (Frame)

#### 6.7.1.1 Clear for Astronomy (Label)

If NAOMI is in a state that is ok for astronomy, this label will be green. This is the status that is reflected in the colour of the *Show Status Details* button on the main page (See [Show Status Details \(Button\)](#) above). This indicator depends on the state of the four label indicators below it in this frame.

##### 6.7.1.1.1 Mechs Clear (Label)

This label will be green if the NAOMI mechanisms are all in a fit state for astronomy. It is dependent on both the Mechanism Status indicators (See [Mechanisms Status \(Frame\)](#) below) and on the mechanisms being in the correct position for astronomy.

#### **6.7.1.1.2 Acquiring (Label)**

This indicator is not yet implemented and is always green.

#### **6.7.1.1.3 Configuring (Label)**

This label will be green if all NAOMI mechanisms are stationary. If any is busy, the label will show the busy (blue) state.

#### **6.7.1.1.4 Error State (Label)**

This label will be green if no error has occurred in any of the NAOMI systems. For example, the status of the C40 Status (See [Show Details \(Button\)](#) below) or the Command Status (See [Show Details \(Button\)](#) below) will affect this indicator.

### **6.7.2 C40 Status (Frame)**

#### **6.7.2.1 Show Details (Button)**

The colour of this button indicates the overall status of the C40 system and is dependent on the state of the four label indicators below it in this frame. Pressing this button will bring up the *C40 Status* page where the status can be traced by colour to a lower level.

#### **6.7.2.2 WFS Ring (Label)**

The colour of this label indicates the overall status of the WFS C40 ring.

#### **6.7.2.3 SG Ring (Label)**

The colour of this label indicates the overall status of the SG C40 ring.

#### **6.7.2.4 Diagnostics (Label)**

The colour of this label indicates the overall status of the diagnostics C40 system.

#### **6.7.2.5 C40 Comms (Label)**

The colour of this label indicates the status of the *C40Comms* server that runs on the embedded Sparc *aocontrol1*.

### **6.7.3 Command Status (Frame)**

#### **6.7.3.1 Show Details (Button)**

The colour of this button indicates the overall status of the command system to the NAOMI sequencer and is dependent on the state of the four label indicators below it in this frame. Pressing this button will bring up a popup Command Status window.

##### **6.7.3.1.1 Get Status (Button)**

The command *Status* text area (See [Status \(Frame\)](#) below) is updated from the NAOMI EPM only when this popup is opened and when this button is pressed.

##### **6.7.3.1.2 Clear Errors (Button)**

This will send a command to the NAOMI sequencer to clear the state of the error variables to their default values. The *Status* frame will continue to show the error until *Get Status* is pressed.

### 6.7.3.1.3 Status (Frame)

The text area within this frame shows the status of the variables within the NAOMI EPM that relate to the command system. A problem with the command system or with the operation of a command will change one or more of these state variables from its default value. The default values are as follows:

|                 |   |
|-----------------|---|
| Command Failed: | False   |
| Exec Error:     | False (Note: This variable is no longer used) |
| Warning:        | None  |
| Error:          | None  |
| Last output:    | None  |
| Traceback:      | None  |

If a command knows that it has failed to execute correctly, it will set the variable *Command Failed* to True.

If a command generates a warning message, this will be shown as the value of the *Warning* variable.

If a command generates an error, the *Error* variable will contain either an error message from the command, or a Python traceback if the error was not handled by the command.

If a command provides any output, the output is copied to the variable *Last output*.

If a command crashes or fails to handle an error, a Python traceback will appear in the variable *Traceback*.

Figure 13 shows the Command Status popup window with an example of Status information where a command error has occurred. A warning has been issued. The command caused an error that has not been handled and a python traceback is provided in the *Error* variable.



Figure 13: The Command Status Popup

### 6.7.3.2 Show Tags (Button)

Every command to the NAOMI sequencer has a NAOMI EPM tag associated with it. This tag holds the full status of the relevant command. A full description of the EPM tag system is beyond the scope of this manual. *TopGui* creates and frees tags as it sends commands to the NAOMI sequencer. This button brings up a popup window that allows access to any tags that currently exist in the EPM. Access to these tags is provided mainly for program development and debugging.

#### 6.7.3.2.1 Tag List

The names of all outstanding tags in the EPM appear here. Tags have names of the form *tag\_nnn* where *nnn* is a number.

#### 6.7.3.2.2 Tag number (Spinbox)

To request details of a tag from the EPM, enter the number part of its name in the Tag number spinbox. The tag identified with a particular command can be found by sending the command with the *Verbose* option set. (See [Verbose \(Toggle\)](#) below).

#### 6.7.3.2.3 Refresh Display (Button)

The tag details in the EPM may change at any time. This button will update the tag details displayed from the EPM.

#### 6.7.3.2.4 Tag details (Unnamed text area)

The details of the tag are displayed in this text area. If the message *\*\* Tag does not exist \*\** appears, the numbered tag requested has been deleted from the EPM.

### 6.7.3.3 Command (Label)

The colour of this label indicated the status of the *Command Failed* EPM variable. It is green if the value is *False*.

#### **6.7.3.4 Execute (Label)**

The colour of this label indicates the status of the *Exec Error* EPM variable. This variable is no longer used and the label is permanently green.

#### **6.7.3.5 Warning (Label)**

The colour of this label indicates the status of the *Warning* EPM variable. It is green if the value is *none*.

#### **6.7.3.6 Error (Label)**

The colour of this label indicates the status of the *Error* EPM variable. It is green if the value is none.

### **6.7.4 Mechanisms Status (Frame)**

#### **6.7.4.1 Show Details (Button)**

The colour of this button indicates the overall status of the NAOMI mechanisms and is dependent on the state of the four label indicators below it in this frame. Pressing this button will bring up the Mechanisms page (See [Mechanisms Page](#) below) where the status can be traced by colour to a lower level.

#### **6.7.4.2 Pickoff (Label)**

The colour of this label indicates the status of the Pickoff assembly.

#### **6.7.4.3 ADC (Label)**

The colour of this label indicates the status of the ADC assembly.

#### **6.7.4.4 DM Stage (Label)**

The colour of this label indicates the status of the DM Stage assembly.

#### **6.7.4.5 Filters (Label)**

The colour of this label indicates the status of the Filters assembly.

## **6.8 Locks Page**

The NAOMI sequencer is a parallel system that by default will execute any multiple commands concurrently. To prevent clashes or to enforce serial behaviour (One command must be done before another), a set of locks is provided. These are acquired and released automatically. This page is provided to show the status of the locks, and provide the facility to break a lock where necessary. (EG If *TopGui* acquires a lock and crashes without releasing it). DO NOT break locks unless you are sure it is safe to do so. Each lock entry consists of the lock name followed by its status (*Acquired*, *Released* or *Unknown*), followed by a *Break* Button. The layout of the locks page is shown in Figure 14.

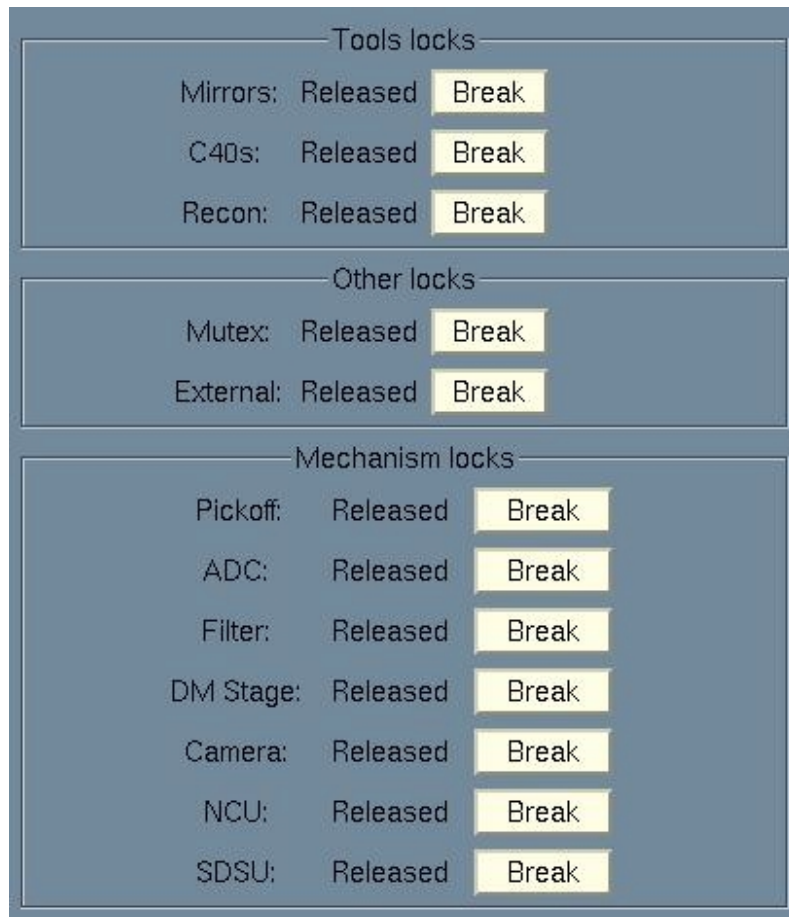


Figure 14: The Layout of the Locks Page

### 6.8.1 Tools Locks (Frame)

The *Mirror Control* (Mirrors), *C40 Control* (C40s) and *Realtime* (Recon) pages have locks that are acquired by TopGui when the page is opened and released when it is closed. If a second copy of TopGui is run whilst one of these pages is open on the first copy, attempts to open the relevant page from the second copy will fail and cause a lock error. Access to these facilities is thus limited to one user at a time.

### 6.8.2 Other Locks (Frame)

#### 6.8.2.1 Mutex (Label)

The *Mutex* lock is set by commands that wish to execute when no other command is executing. They have exclusive use of the sequencer until they release the *Mutex* lock. This is little used in the current NAOMI system.

#### 6.8.2.2 External (Label)

The *External* lock exists but is not yet used.

### 6.8.3 Mechanism Locks (Frame)

Each of the NAOMI mechanism assemblies, including the SDSU controllers, has a lock associated with it. This lock must be acquired before the relevant mechanism can be operated. Thus, if the Pickoff is being moved by another application, TopGui will



be unable to move it. An attempt to do so results in a lock error. If TopGui is already moving a mechanism and the user attempts to move it again, a lock error will also be generated.

## 6.9 Mechanisms Page

Access to NAOMI mechanisms is available from this page at the assembly level only. Lower level access to the NAOMI device records is provided by separate EPICS DM GUIs. These may be accessed from the main menu bar via *Eng GUIs -> Mechanisms DM*. These facilities are documented elsewhere. The layout of the Mechanisms page is shown in Figure 15.

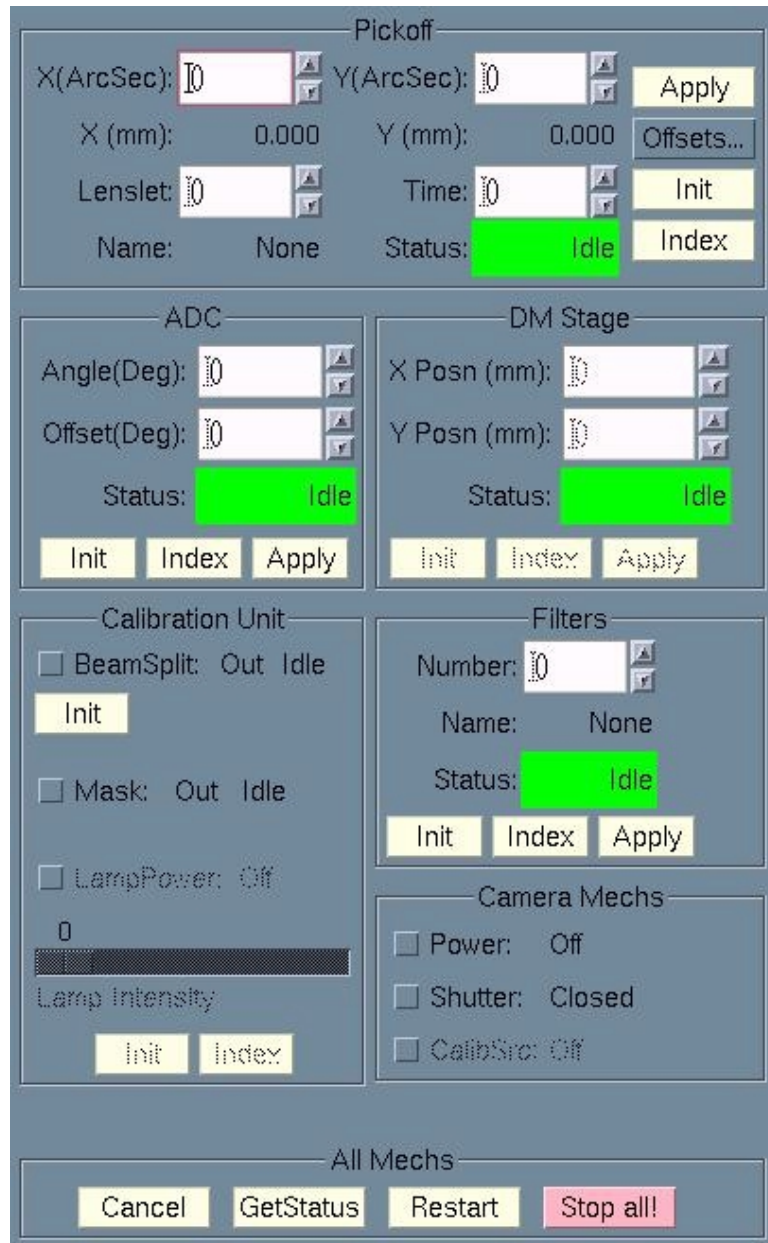


Figure 15: The Layout of the Mechanisms Page

### 6.9.1 Pickoff (Frame)

All controls and indicators within this frame refer to the NAOMI *Pickoff* assembly. Several values may be changed at once. The spinboxes display the current values on a



white background. If these values are changed, they will be shown on a cyan background. Hitting the Apply button will send commands to the sequencer to update any parameters that are marked as changed.

**6.9.1.1 X(ArcSec) (Spinbox)**

New values for the X position of the WFS pickoff mirror may be entered here as floating point numbers in arc seconds.

**6.9.1.2 Y(ArcSec) (Spinbox)**

New values for the Y position of the WFS pickoff mirror may be entered here as floating point numbers in arc seconds.

**6.9.1.3 X(mm) (Label)**

The text string following this label shows the X position of the WFS pickoff mirror in engineering units (mm).

**6.9.1.4 Y(mm) (Label)**

The text string following this label shows the Y position of the WFS pickoff mirror in engineering units (mm).

**6.9.1.5 Lenslet (Spinbox)**

The lenslet wheel may be rotated to select any of the 6 available NAOMI lenslets by entering a number between 1 and 6. The lenslets available are defined in Table 2.

| Lenslet Number | Lenslet Name    |
|----------------|-----------------|
| 1              | reticule        |
| 2              | f195_1.1        |
| 3              | doublet         |
| 4              | f95_1.1         |
| 5              | f195_1.1_offset |
| 6              | f95_2.2         |

Table 2: NAOMI Lenslets

**6.9.1.6 Name (Label)**

The text following this label is the name of the NAOMI lenslet that is currently selected.

**6.9.1.7 Time (Spinbox)**

A number of seconds may be entered here as the time to be taken for all motions of the NAOMI pickoff. The velocity will then vary depending on the size of the motion. This *Time* setting may or may not be used depending on variables set at the device level of the Pickoff assembly.

**6.9.1.8 Status (Label)**

The colour and value of the text string following this label reflects the status of the NAOMI pickoff assembly. (EG The value will be *Busy* on a blue background when the pickoff is moving).

### 6.9.1.9 Apply (Button)

Any parameters within the *Pickoff* frame that have been changed (cyan background) will be sent to the sequencer for execution when this button is pressed.

### 6.9.1.10 Offsets... (Button)

This will bring up the Pickoff offsets popup as shown in Figure 16. Any offsets that are entered are added to the X and Y position of the WFS pickoff.

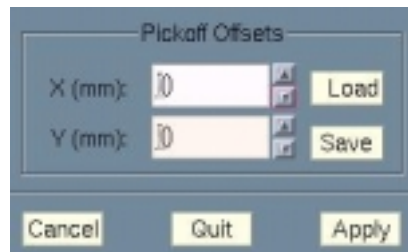


Figure 16: The Pickoff Offsets Popup

#### 6.9.1.10.1 X(mm) (Spinbox)

The value of the X offset can be entered here as a floating point number in mm.

#### 6.9.1.10.2 Y(mm) (Spinbox)

The value of the Y offset can be entered here as a floating point number in mm.

#### 6.9.1.10.3 Load (Button)

The offsets by default are zero. The current offsets file (*/software/Electra/save/Mechanisms/Pickoff.Offsets*) can be loaded by pressing this button.

#### 6.9.1.10.4 Save (Button)

Any new offsets that are set can be saved to file by pressing this button. The values will be saved to: */software/Electra/save/Mechanisms/yyyymmdd-hhmm* where *y* is year *m* is month *d* is day *h* is hour and *m* is minute as well as to the default file */software/Electra/save/Mechanisms/Pickoff.Offsets*.

#### 6.9.1.10.5 Cancel (Button)

If this button is pressed any new values entered in the spinboxes are cleared.

#### 6.9.1.10.6 Quit (Button)

Closes the *Pickoff Offsets* Popup.

#### 6.9.1.10.7 Apply (Button)

Any new values in the spinboxes (Cyan background) will be applied.

### 6.9.1.11 Init (Button)

This button will initialise the Pickoff Assembly EPICS record. This is only normally done prior to an Index (See [Index \(Button\)](#) below).

### 6.9.1.12 Index (Button)

This button causes the *Pickoff* assembly to run through its Index cycle. An Init (See [Init \(Button\)](#) above) should normally be done first. All of the pickoff assembly elements, including the *Lenslet* wheel, will be initialised in a highly complex way. This can take up to 5 minutes to complete.

## 6.9.2 ADC (Frame)

The angle and offset of the NAOMI Atmospheric Dispersion Corrector can be set from this frame.

### 6.9.2.1 Angle(Deg) (Spinbox)

The ADC angle can be set as a floating point number of degrees in this spinbox.

### 6.9.2.2 Offset(Deg) (Spinbox)

The ADC offset angle can be set as a floating point number of degrees in this spinbox.

### 6.9.2.3 Status (Label)

The colour and value of the text string following this label reflects the status of the NAOMI ADC assembly. (EG The value will be *Busy* on a blue background when the pickoff is moving).

### 6.9.2.4 Init (Button)

This button will initialise the *ADC* assembly EPICS record. This is only normally done prior to an Index (See [Index \(Button\)](#) below).

### 6.9.2.5 Index (Button)

This button causes the *ADC* assembly to run through its Index cycle. An Init (See [Init \(Button\)](#) above) should normally be done first.

### 6.9.2.6 Apply (Button)

Any parameters within the *ADC* frame that have been changed (cyan background) will be sent to the sequencer for execution when this button is pressed.

## 6.9.3 DM Stage (Frame)

The NAOMI deformable mirror X/Y stage is currently not in use. The controls in this frame are therefore greyed out.

## 6.9.4 Calibration Unit (Frame)

The elements of the NAOMI Calibration Unit (NCU) can be controlled from this frame.

### 6.9.4.1 Beamsplit (Toggle)

The *Beamsplitter* has only 2 states, *In* and *Out*. It should be out to select light from the sky for astronomy. It should be in to select light from the NCU calibration lamp. If the beamsplitter is in, the *Mechs Clear* status (See [Mechs Clear \(Label\)](#) above) will be a warning as, therefore will *Clear for Astronomy* (See [Clear for Astronomy \(Label\)](#) above). The BeamSplit label is followed by two further labels. The first of these is the state of the beamsplitter (IE In or out); the second is the colour coded status of the beamsplitter mechanism.

#### 6.9.4.2 Init (Button)

The beamsplitter has no index feature, but requires an initialisation at power up, provided by this button.

#### 6.9.4.3 Mask (Toggle)

Light from the calibration lamp can pass through a motorised pinhole mask held in the NCU. This can be deployed by this toggle. It has only two states, *In* and *Out*. The Mask label is followed by two further labels. The first of these is the state of the mask (IE In or out); the second is the colour coded status of the mask mechanism. The pinhole mask in the maskholder can be manually changed for another mask.

#### 6.9.4.4 Calibration Lamp

The various controls of the NAOMI calibration lamp are currently not active and are greyed out.

#### 6.9.5 Filters (Frame)

NAOMI has 6 filters in a filter wheel. This mechanism is controlled from this frame. The filters available are shown in Table 3.

| Filter Number | Filter Name |
|---------------|-------------|
| 1             | gg_495      |
| 2             | V_wide      |
| 3             | red         |
| 4             | blank1      |
| 5             | blank2      |
| 6             | blank3      |

Table 3: NAOMI Filters

##### 6.9.5.1 Number (Spinbox)

A new filter is selected by entering its number in this spinbox.

##### 6.9.5.2 Name (Label)

The text string after this label is the name of the currently selected filter.

##### 6.9.5.3 Status (Label)

The colour and value of the text string following this label reflects the status of the NAOMI Filter wheel assembly. (EG The value will be *Busy* on a blue background when the pickoff is moving).

##### 6.9.5.4 Init (Button)

This button will initialise the *Filter* assembly EPICS record. This is only normally done prior to an Index (See [Index \(Button\)](#) below).

##### 6.9.5.5 Index (Button)

This button causes the *Filter* assembly to run through its Index cycle. An Init (See [Init \(Button\)](#) above) should normally be done first.

### 6.9.5.6 Apply (Button)

If the filter number has been changed (cyan background) it will be sent to the sequencer for execution when this button is pressed.

## 6.9.6 Camera Mechs (Frame)

### 6.9.6.1 Power (Toggle)

The SDSU camera power can be toggled between *On* and *Off*.

### 6.9.6.2 Shutter (Toggle)

The WFS has a shutter that can be closed to protect it from high ambient light levels. The shutter has two states, *Open* and *Closed*. Toggle between them with this control. If the shutter is closed, the *Mechs Clear* status (See [Mechs Clear \(Label\)](#) above) will be a warning as therefore will *Clear for Astronomy* (See [Clear for Astronomy \(Label\)](#) above).

## 6.9.7 All Mechs (Frame)

The controls within this frame apply to all of the mechanisms on the mechanisms page.

### 6.9.7.1 Cancel (Button)

If any data values have been changed (cyan background), all of them are cleared by pressing this button.

### 6.9.7.2 GetStatus (Button)

The values and status displayed on this page should always represent the actual positions and status of the mechanisms. If for any reason they do not, (EG If a low level EPICS GUI has been used) this button will cause all of the current values to be read from the EPICS system and displayed. If the values are already correct, no effect will be seen.

### 6.9.7.3 Restart (Button)

If the *Stop all* button (See [Stop all \(Button\)](#) below) has been used, none of the mechanisms can be moved until a *Restart* is issued by pressing this button.

### 6.9.7.4 Stop all (Button)

This is an emergency stop button for all of the NAOMI mechanisms. If it is pressed, any mechanism that is moving will stop. A *Restart* (See [Restart \(Button\)](#) above) must then be issued before any mechanisms can again be moved. Most will then require re-initialising and indexing for correct operation. This button is coloured pink to remind the user not to press it except in emergencies.

## 6.10 SDSU Control Page

Control of the SDSU cameras and their associated controllers used for the WFSs in NAOMI was originally via EPICS. This system was abandoned and replaced by a terminal emulation system from this page via the NAOMI sequencer to the VME/VXworks system that drives the SDSUs. Note that the VXworks system can support only 1 login at a time. Thus any manual login to the SDSU VME crate must be closed for correct operation of the controls on this page. In this version of TopGui,

all commands are directed at the master SDSU. The slave SDSU is not available and synched modes are not supported. The layout of the SDSU Control page is shown in Figure 17.

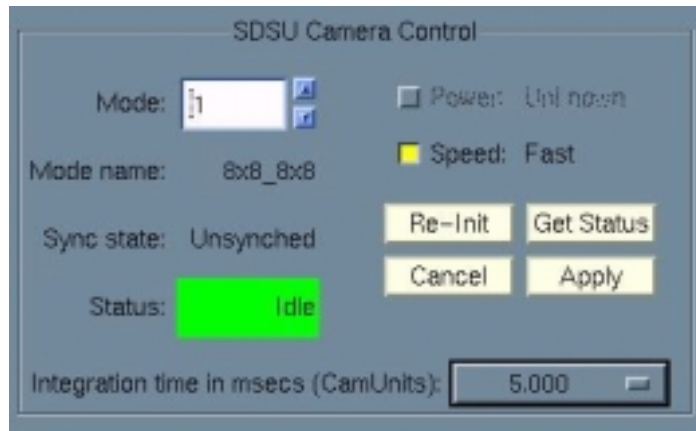


Figure 17: The Layout of the SDSU Control Page

### 6.10.1 Mode (Spinbox)

Any of the 10 modes provided by the NAOMI SDSU camera and controller can be selected by entering its number here. Currently, only non-synched modes are available. (Modes 1,2,3,8,9,10). Note that modes 1 to 7 are downloaded to the SDSU controller at initialisation. Modes 8 to 10 must be downloaded when they are selected. The latter can be quite slow and the sequencer will disable the WFS ring from framing whilst the new mode is downloaded. It will re-enable WFS ring framing when the SDSU is in the new mode.

### 6.10.2 Mode name (Label)

There is a name for each SDSU mode in *TopGui*. The text field to the right of this label is the mode name for the currently selected mode. These names are designed to indicate the form of the mode as shown in Table 4:

| Mode number | Mode name | Description   |
|-------------|-----------|---|
| 1           | 8x8_8x8   | 8 by 8 sub-aperture; 8 by 8 pixels per sub-aperture |
| 2           | 8x8_2x2   | 8 by 8 sub-aperture; 2 by 2 pixels per sub-aperture |
| 3           | 8x8_4x4   | 8 by 8 sub-aperture; 4 by 4 pixels per sub-aperture |
| 8           | 4x4_4x4   | 4 by 4 sub-aperture; 4 by 4 pixels per sub-aperture |
| 9           | 4x4_2x2   | 4 by 4 sub-aperture; 2 by 2 pixels per sub-aperture |
| 10          |           |   |

Table 4: SDSU Modes

### 6.10.3 Sync State (Label)

The synched modes of the NAOMI WFSs are not yet available. The text string following this label should always read *Unsynched* in all the currently available modes.

#### 6.10.4 Status (Label)

The colour and value of the text string following this label reflects the status of the SDSU camera control system. (EG The value will be *Busy* on a blue background when the SDSU control system is busy).

#### 6.10.5 Integration Time (Menu)

The time for which each WFS frame is exposed can be set here. Only certain discrete values may be set. The current value in mille-seconds is displayed on the menu. Clicking on the menu brings up the available options as shown in Figure 18.

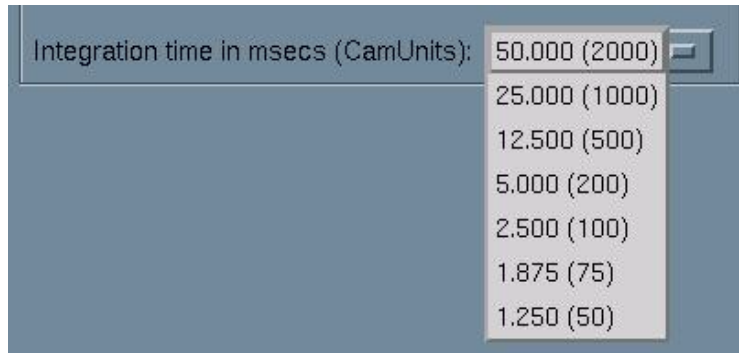


Figure 18. The SDSU Integration Time Menu

Selecting one of the menu options will send a command to the SDSU controller, via the NAOMI sequencer, to set that new integration time. The values actually sent to the controller are 'Camera Unit'. These are indicated on the menu in brackets.

#### 6.10.6 Speed (Toggle)

The WFS SDSU controller supports readout of the CCD at two different speeds. The default (Toggle set) is the fast readout mode. This toggle can be used to set the SDSU controller into the slow readout mode (Toggle reset). The readout noise of the camera is slightly lower in the slow readout mode.

#### 6.10.7 Re-Init (Button)

At power up, the SDSU controllers must have the relevant software downloaded to them. This process is controlled by the sequencer. The relevant commands are sent when the Re-Init button is pressed. If the SDSU does not respond to normal commands, or appears to be in a strange state, it can be re-initialised at any time. The software will be downloaded and the SDSU will re-start with all the default settings.

#### 6.10.8 Get Status (Button)

The values and status displayed on this page should always represent the actual values set in the SDSU controllers. If for any reason they do not, this button will cause all of the current values to be read from the SDSU controllers and displayed. If the values are already correct, no effect will be seen.

#### 6.10.9 Cancel (Button)

A new mode number (Cyan background) can be cleared by pressing this button.

### **6.10.10 Apply (Button)**

The new mode value will be sent to the SDSU controllers when this button is pressed.

## **7 The 'File' Menu**

All files that are relevant to the operation of *TopGui* can be loaded or saved from options within this menu. Most of these options are also available from controls on pages to which they are directly relevant.

### **7.1 Mirror... (Menu Option)**

All files relevant to mirror control can be loaded or saved from here.

#### **7.1.1 Load DACs... (Menu Option)**

This option will bring up a file selector for loading a 'Mirror flat' that contains a saved mirror shape file. If a file is loaded, its contents will be loaded to the deformable mirror DACs. (See [Load... \(Button\)](#) above for details).

#### **7.1.2 Save DACs (Menu Option)**

This option will save the current deformable mirror shape or DAC values to file. The file will be given a default name based on the system date/time. (See [Save \(Button\)](#) above for details).

#### **7.1.3 Save DACs as... (Menu Option)**

This option will bring up a file selector for the user to select the name of the mirror shape or DACs file to be saved. These files are better saved with a default name (See [Save DACs \(Menu Option\)](#) above).

#### **7.1.4 Load Zernikes... (Menu Option)**

This option will bring up a file selection popup. The user can select a file of Zernikes that has previously been saved and apply them to the deformable mirror. (See [Load... \(Button\)](#) above for details).

#### **7.1.5 Save Zernikes as... (Menu Option)**

This option brings up a file selection popup. The user can enter the name of a file to which to save the current mirror Zernike values. (See [Save as... \(Button\)](#) above for details).

### **7.2 Realtime... (Menu Option)**

The parameters of the C40 AO control system can be saved and loaded to/from file from here.

#### **7.2.1 Load Settings... (Menu Option)**

This option will bring up a file selector for loading 'Realtime' files. Note that these are NOT applied automatically. Open the realtime page (See [Realtime Page](#) above) and press apply to send the values to the C40s. (See [Load \(Button\)](#) above for details).

#### **7.2.2 Save Settings (Menu Option)**

This option will save the current realtime settings to file. The file will be given a default name based on the system date/time. (See [Save \(Button\)](#) above for details).



### 7.2.3 Save Settings as... (Menu Option)

This option will bring up a file selector for the user to select the name of the realtime file to be saved. These files are better saved with a default name (See [Save Settings \(Menu Option\)](#) above).

## 7.3 WFS... (Menu Option)

Files associated with the wave front sensor can be saved and loaded from here.

### 7.3.1 Load Offsets... (Menu Option)

This option will bring up a file selector for the user to select the name of a WFS offsets file to be loaded. Note that the offsets will be applied as soon as the file is loaded. (See [Load... \(Button\)](#) above for details).

### 7.3.2 Save Offsets (Menu Option)

This option will save the current WFS offsets to file. The file will be given a default name based on the system date/time. (See [Save \(Button\)](#) above for details).

### 7.3.3 Load Zernikes... (Menu Option)

This option will bring up a file selector for the user to select the name of a WFS Zernike file to be loaded. (See [Offsets... \(Menu Option\)](#) above for details).

### 7.3.4 Save Zernikes as... (Menu Option)

This option will bring up a file selector for the user to select the name of a WFS Zernike file to be saved. (See [Offsets... \(Menu Option\)](#) above for details).

## 8 The 'Options' Menu

These options are provided mainly for debugging and program development purposes. They should not normally be changed.

### 8.1 No EPM (Toggle)

This toggle is not normally set. If it is set, *TopGui* will no longer request data from the NAOMI EPM state monitor. The status displayed will therefore no longer represent the state on the AO system. This facility is provided so that *TopGui* can be run for development or debugging when the NAOMI EPM is not running or not available. *TopGui* can be run when the EPM is unavailable by adding the flag *-noepm* at startup. This automatically sets the *No EPM* toggle at startup.

### 8.2 No Commands (Toggle)

This toggle is not normally set. If it is, *TopGui* will no longer send any commands to the NAOMI sequencer. Instead, a popup message will appear similar to that provided by the verbose option (See below). This facility is provided so that *TopGui* can be run for development or debugging when the NAOMI Sequencer is not running or not available.

### 8.3 Verbose (Toggle)

This toggle is not normally set. If it is, whenever a command is sent from TopGui to the NAOMI sequencer, a NAOMI message popup will appear of the type shown in Figure 19.



Figure 19. NAOMI Verbose Command Example

The text of the Python command sent to the sequencer is shown along with the returned command status and the relevant EPM command status tag name. This facility is useful in identifying the tag name of the command so that the tag details can be examined. (See [Show Tags \(Button\)](#) above).

## 9 The 'Eng GUIs' Menu

Most of the facilities required to operate NAOMI are integrated into TopGui. There are some lower level and calibration procedures that are not. These are available from separate applications. These 'Engineering GUIs' can be run from the options of this menu.

### 9.1 Reconstructor (Menu Option)

The reconstructor matrix is created and downloaded to the C40s from this application. It will be integrated into the *Realtime* page of *TopGui* in later versions. The GUI can also be launched from the *Realtime* page. (See [Engineering GUI \(Button\)](#) above).

### 9.2 Fisba (Menu Option)

The Fisba interferometer is used in the calibration procedure that involved flattening the deformable mirror. This required two applications to be running. The required software on the Fisba computer must be started manually. The 'navis' GUI application can be launched from this option.

### 9.3 Ingrid Align (Menu Option)

The GUI for performing the simplexing process with the IR camera Ingrid can be launched from here.

### 9.4 Mechanisms DM (Menu Option)

*TopGui* provides access to the NAOMI mechanism via the EPICS system only at the assembly record level. If access is required at the device record level or other low level EPICS facilities are required, the NAOMI EPICS *Display Manager* (DM) GUIs can be launched from this option. These GUIs are documented in detail elsewhere.

## **10 The 'Help' Menu**

### **10.1 About NAOMI/ELECTRA Control... (Menu Option)**

This option brings up a popup window that identifies which version of TopGui is running by date.

### **10.2 Help... (Menu Option)**

On-line help is not available.