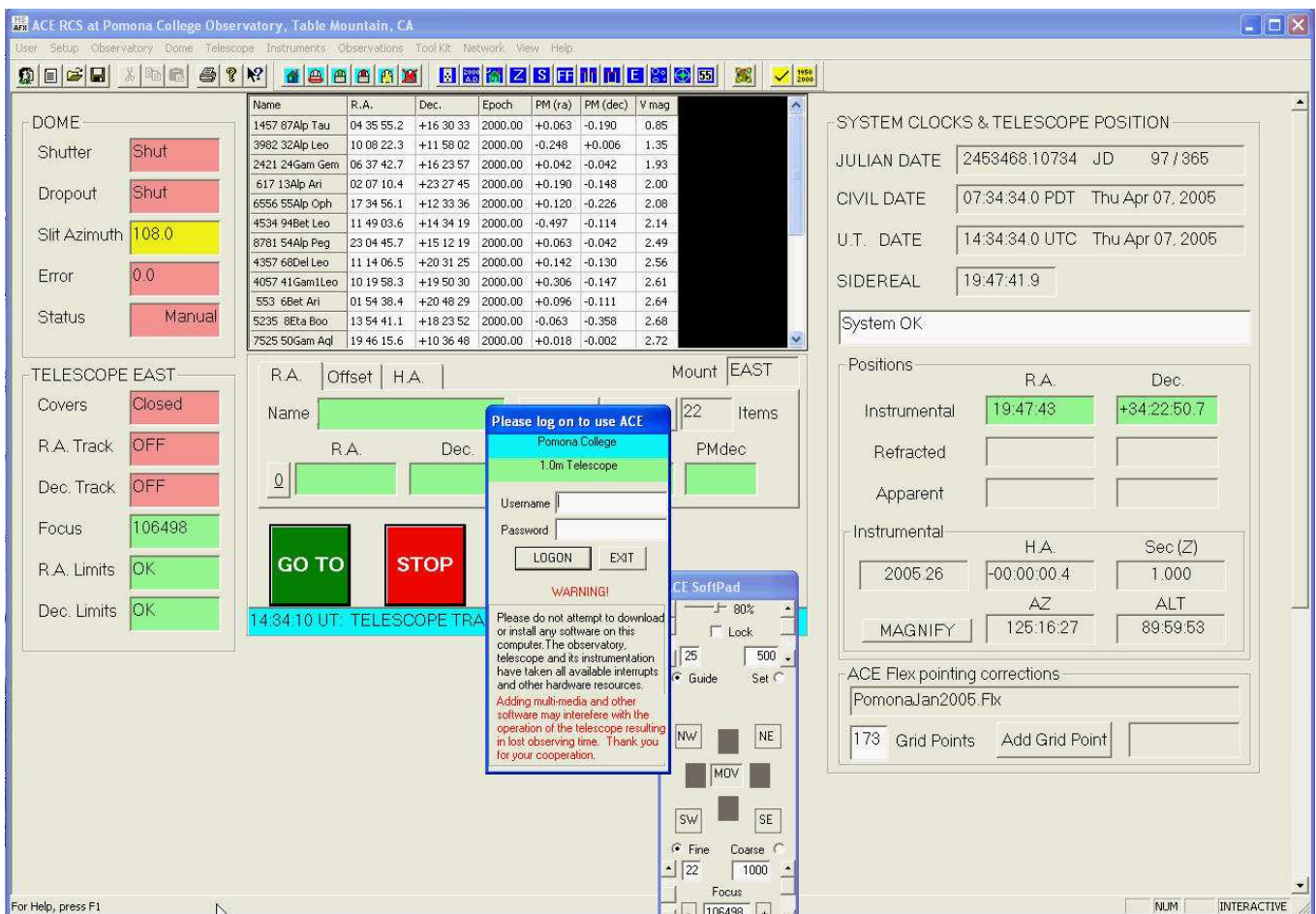


ACE Control System

1.0-m Pomona College Telescope Table Mountain Observatory

ACE User Manual

April 2005 Revision 1.1



© 1999-2005. All rights reserved.

Astronomical Consultants & Equipment, Inc.

P.O. Box 91946
Tucson

Tel: 520 219 8722
Fax: 520 219 7989

AZ 85752-1946, USA

Web: www.astronomical.com

System Overview.

The control system utilizes two computers, one called “*TELSECOPE*” and one called “*CAMERA*”. The camera can either be operated in stand-alone mode or, preferably, through the telescope computer.

This manual described the ACE Control System software which controls the telescope, observatory, and cameras.

The computers should be left powered up so that remote access is available to the system at all times.

Remote access is available through vnc (Virtual Networked Computers) and a free version can be downloaded to your computer (www.realvnc.com). Your remote computer can be a Windows®, Linux or SunOS® workstation.

The IP addresses of the computers are:

TELESCOPE	192.138.101.146
CAMERA	192.138.101.148

Authorized users will be sent a password to access the computer. Please note that the observatory firewall also requires that your IP address be registered. You must therefore access the observatory using a pre-authorized network address.

Logging onto ACE.

A user name and password are required to log onto ACE.

There are three levels of User access.

User Level	Typical User	Comment
1	Minimal Access	Suitable for student / public access
2	Standard Observer	Unable to build a new pointing model and other engineering functions. This should be the normal observing level.
3	System Engineer	Full access to engineering system functions. This level restricted to a few fully trained staff.

Please log on to use ACE

Pomona College

1.0m Telescope

Username

Password

LOGON EXIT

WARNING!

Please do not attempt to download or install any software on this computer. The observatory, telescope and its instrumentation have taken all available interrupts and other hardware resources. Adding multi-media and other software may interfere with the operation of the telescope resulting in lost observing time. Thank you for your cooperation.

The Observatory Manager will issue users with a Logon name and password. When you have finished using the telescope please log out (using the menu User->Logout).

Please note that this is a dedicated telescope control computer. Users are not expected to play computer games, download music, etc., which can slow down the computer and interfere with the telescope controller. Please use your own computer for such activities!

The ACE main window.

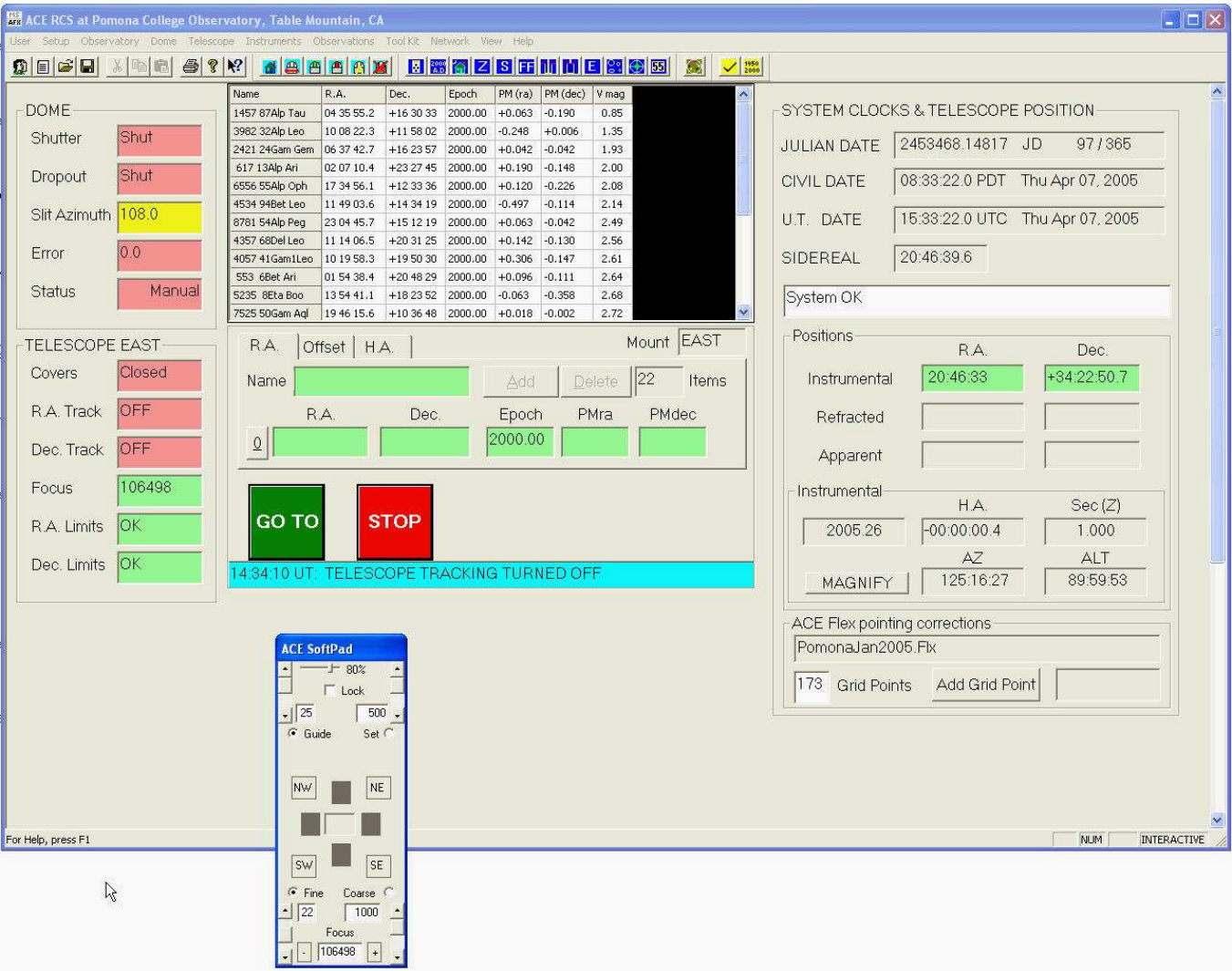
The background of the main window is split into three logical areas.

The left side of the screen shows the current status of the DOME and TELESCOPE .

Many of the fields are color coded according to a standard traffic light where:

RED = STOP	Something is stopped, closed, or not ready.
YELLOW = CHANGE	Something is about to change or at a home position
GREEN = GO	Ready. All boxes should be green (or yellow) when observing

Therefore, one can tell at a glance that the dome and the telescope tracking are not ready in the window below:

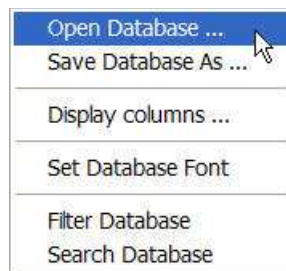


The right side of the screen shows the position of the telescope and various clocks. All this information is written to the image FITS headers together with a host of observatory and instrument settings.

Object Acquisition

The center part of the screen deals with object acquisition.

To open a catalog right-click the mouse anywhere on the screen to access a pop-up menu:



Select Open database and chose either a standard or custom catalog. ACE_BSC5.cat is a modified copy of the Yale Bright Star Catalog version 5.

Name	R.A.	Dec.	Epoch	PM (ra)	PM (dec)	V mag
1457 87Alp Tau	04 35 55.2	+16 30 33	2000.00	+0.063	-0.190	0.85
3982 32Alp Leo	10 08 22.3	+11 58 02	2000.00	-0.248	+0.006	1.35
2421 24Gam Gem	06 37 42.7	+16 23 57	2000.00	+0.042	-0.042	1.93
617 13Alp Ari	02 07 10.4	+23 27 45	2000.00	+0.190	-0.148	2.00
6556 55Alp Oph	17 34 56.1	+12 33 36	2000.00	+0.120	-0.226	2.08
4534 94Bet Leo	11 49 03.6	+14 34 19	2000.00	-0.497	-0.114	2.14
8781 54Alp Peg	23 04 45.7	+15 12 19	2000.00	+0.063	-0.042	2.49
4357 68Del Leo	11 14 06.5	+20 31 25	2000.00	+0.142	-0.130	2.56
4057 41Gam1Leo	10 19 58.3	+19 50 30	2000.00	+0.306	-0.147	2.61
553 6Bet Ari	01 54 38.4	+20 48 29	2000.00	+0.096	-0.111	2.64
5235 8Eta Boo	13 54 41.1	+18 23 52	2000.00	-0.063	-0.358	2.68
7525 50Gam Aql	19 46 15.6	+10 36 48	2000.00	+0.018	-0.002	2.72

R.A. | Offset | H.A. |

Mount | EAST

Name | 4534 94Bet Leo | Add | Delete | 22 | Items

R.A. (Catalog) | Dec. | Epoch | PMra | PMdec

0 | 11 49 03.6 | +14 34 19 | 2000.00 | -0.497 | -0.114

GO TO

STOP

14:34:10 UT: TELESCOPE TRACKING TURNED OFF

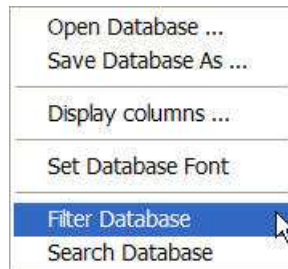
Scroll through the database then select the desired object by double-clicking on the object name. This will load the object into the green entry boxes denoting a (RA, DEC) coordinate system.

The database fields can be sorted (in ascending or descending order) by clicking on the desired header.

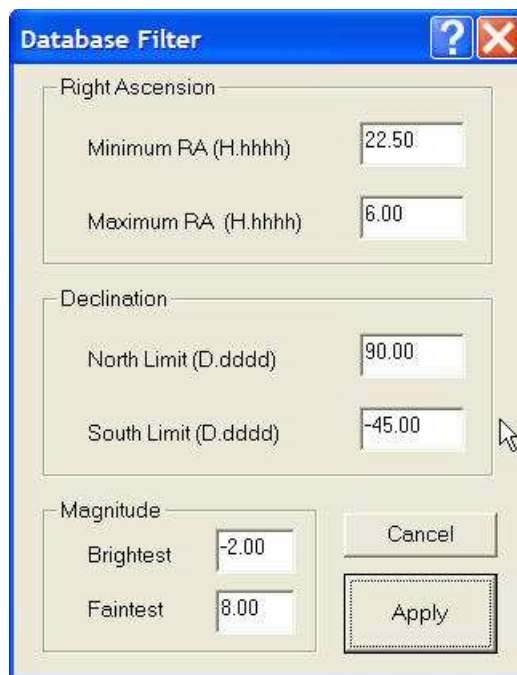
The bright star catalog defaults to being sorted by magnitude. If, for some reason, you wanted to have a catalog default to being listed in ascending order of declination simply sort the file that way and save it. The next time it is loaded it will list in that sort order.

Database Filtering

To filter a catalog right-click the mouse anywhere on the screen to access a pop-up menu:



In the example below all objects greater than RA 22h30m and less than RA 06h00 will be selected.



If the database is saved with the filter applied then only those objects that pass through the filter will be saved. This is a convenient way to make sub-catalogs. Save the database using the pop-up menu.

Objects can also be entered manually using the keyboard. Click on the 0 button to clear the fields. This will place the cursor in the Name box. If the name box is left empty the control system will assign the name (RA, DEC) with values according to those fields.

The screenshot shows the ACE control system interface. At the top, there are tabs for 'R.A.', 'Offset', and 'H.A.', with 'R.A.' selected. To the right is a 'Mount' tab set to 'EAST'. Below the tabs is a 'Name' field, an 'Add' button, a 'Delete' button, and a display showing '2328 Items'. Below this is a table with columns: 'R.A.', 'Dec.', 'Epoch', 'PMra', and 'PMdec'. The 'R.A.' and 'Dec.' columns have green input boxes. The 'Epoch' column shows '2000.00'. The 'PMra' and 'PMdec' columns show '+0.000'. A '0' button is located to the left of the 'R.A.' input box. Red arrows and text labels point to specific elements: 'Style Tab' points to the 'R.A.' tab, 'Clear data' points to the '0' button, and 'Number of objects in the database' points to the '2328 Items' display.

Data can be entered as RA(HH MM SS.s or HH MM.m) and DEC (DD MM SS.s or DD MM.m).

However, upon pressing the GoTo button the system will check data entry and convert to the standard format for saving in the catalog. The ACE system automatically checks data entry as it is typed, to prevent incorrect input.

The screenshot shows the ACE login screen. At the top, it says 'Please log on to use ACE', 'Pomona College', and '1.0m Telescope'. Below this are fields for 'Username' and 'Password', and buttons for 'LOGON' and 'EXIT'. A 'WARNING!' message is displayed below the login fields, stating: 'Please do not attempt to download or install any software on this computer. The observatory, telescope and its instrumentation have taken all available interrupts and other hardware resources. Adding multi-media and other software may interfere with the operation of the telescope resulting in lost observing time. Thank you for your cooperation.'

Three different Style Tabs are available, R.A., Offset and H.A.

The R.A. tab has green colored entry boxes and is the default setting.

The Offset tab has yellow colored entry boxes with red text.

The screenshot shows the 'Offset' tab selected in a control panel. The 'Mount' dropdown is set to 'EAST'. The 'Name' field contains 'Center CCD'. Below, the 'R.A.' field is '9.36' and the 'Dec.' field is '30.91', both in yellow boxes with red text. A unit dropdown is set to 'arc_seconds'. A small '0' in a box is visible to the left of the R.A. field.

Offsets can be in arc_seconds or in (seconds of time, arcseconds).

The H.A. tab has orange colored entry boxes. Moves in this mode park the telescope at the desired position and turn the drives off.

The screenshot shows the 'H.A.' tab selected. The 'Mount' dropdown is 'EAST'. The 'Name' field contains 'ZENITH PARK'. Below, the 'H.A.' field is '00 00 00.0' and the 'Dec.' field is '+34 22 54.6', both in orange boxes with black text. A small '0' in a box is visible to the left of the H.A. field.

Once the data has been successfully entered click on the GoTo to move the telescope. A confirmation dialog is issued, the appearance and color coding changing depending on the style tab.

The 'MOVE TELESCOPE' dialog box is shown. It contains the following fields:
- (R.A., Dec.) Apparent Position: R.A. 22:08:03.4, Dec. 21:43:23.8
- Apparent Position with refraction: R.A. 22:08:03.4, Dec. 21:43:37.0, Epoch 2005.27
- H.A. 00:01:23.7, Sec (Z) 1.025
- Azimuth 181:28:42.5, Altitude 77:20:29.0
Buttons: 'Move Telescope' and 'Cancel'

When the telescope starts to slew to the object the GoTo button is replaced by a CANCEL MOVE button and a pair of progress bars (denoting H.A., DEC) that report how far the telescope has left to move.

R.A.	Offset	H.A.	Mount EAST		
Name	1017 33Alp Per		Add	Delete	284 Items
R.A. (Catalog)	Dec.	Epoch	PMra	PMdec	
0 03 24 19.4	+49 51 40	2000.00	+0.024	-0.025	
Slewing:					
Slewing:	1017 33Alp Per				
CANCEL MOVE		STOP			
01:31:46 UT: MOVE RA (apparent): (03:24:44.3 49:52:50 2005.26)					

Finally, there is a series of up to three “Most Recently Observed” buttons for each tab field. In the example above there is only one button as this was the first move of the night.

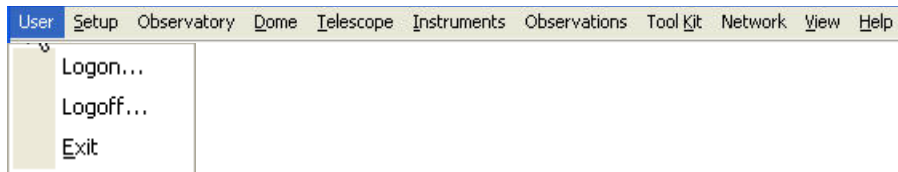
R.A.	Offset	H.A.	Mount EAST		
Name	8438 25 Peg		Add	Delete	1101 Items
R.A. (Catalog)	Dec.	Epoch	PMra	PMdec	
0 22 07 50.3	+21 42 10	2000.00	-0.047	-0.069	
GO TO		STOP			
		8438 25 Peg			
		8267 5 Peg			
		8781 54Alp Peg			
16:54:54 UT: TARGET ACQUIRED					

Simply double-click on the button to re-send the telescope back to that object.

MENUS

The menus and the associated toolbars give access to a host of other services. The menus vary depending upon factors such as the User Level, the equipment installed, and the type of telescope.

The User menu



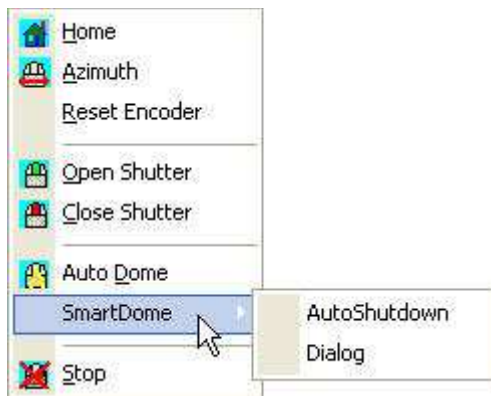
Allows user LogOn and LogOff and exit of the application. At the end of an observing session the user should LogOff. Alternatively, LogOff and exit ACE. Either of these operations will turn power off to all the motors and leave the system in a safe storage condition.

The Setup Menu is primarily used by the *SystemEngineer* and is discussed in Appendix A.

The Observatory Menu

If a weather station is installed the current data can be displayed using this menu.

The Dome Menu

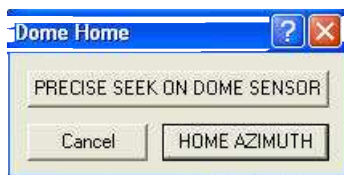


The dome looks after itself if AutoDome is selected. The status boxes on the main screen turn green.

To manually control the dome the following functions are available:

Dome Home

To moving the dome past the home sensor will reset the encoder azimuth. To go past home and reset use HOME AZIMUTH. To place the dome at the sensor use PRECISE SEEK ON DOME SENSOR which will taken longer to complete.



Dome Azimuth

specified azimuth enter the



To manually move the dome to a value in this dialog.

Dome Reset Encoder

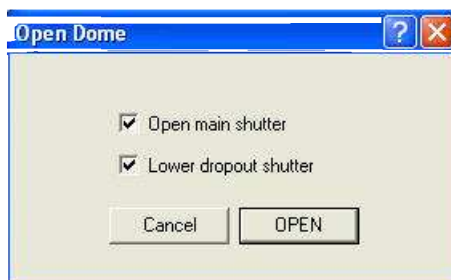


This dialog should not have to be used. If there is a problem with the azimuth encoding simply pass home. The system remembers all data even during a power loss.

Please note that if the dome is on the home sensor this dialog will have no effect because the dome azimuth is reset to home when at home.

Dome Open Shutter

Dome Close Shutter



The Open and Close functions permit one or both doors to be operated.

When opening the main shutter must be fully opened before the lower shutter can be operated.

When closing the lower door must be fully closed before the main shutter can be operated.

Dome SmartDome

When used in conjunction with an ACE SmartDome™ the software constantly polls the status of the SmartDome™. In the event of a prolonged communications failure the some will automatically close. It will also automatically close if the rain-snow sensors are enabled and activated.

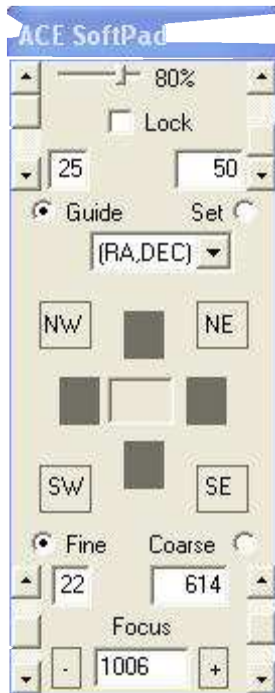
The Telescope Menu



Access these functions from the Menu or from the Toolbar.

TelescopeSoftPaddle...

Displays the ACE SoftPad™ which is a screen-based hand paddle. The physical hand paddle reads the software paddle settings.



There are three fundamental settings in the hand paddle, called **Guide**, **Set**, and slew. For safety reasons slew is only available with the physical hand paddle, located in the dome, or by using the **GoTo** button in the main ACE software window.

The settings are adjustable by the *System Engineer*, and are typically 1 to 25 arc_seconds/second for guide and 50 to 1000 arc_seconds/seconds for guide. Use the slide bars to select the desired guide and set speeds. If you always want to use the same settings the **Lock** button will simplify the dialog.

The four black buttons represent the cardinal directions N, S, E, W. It is also possible to select two-axis moves, NW, NE, SE, SW. Simply press and hold down the left mouse button over the desired button. Moving the mouse over a different button will automatically change to that direction. The current direction is shown in the box located at the center of the black buttons.

The telescope focus has similar settings, called fine, coarse and slew. The focus value is displayed in several locations including at the bottom of the hand paddle.

Finally, the slider bar at the top of the dialog is used to adjust the slew speed of the physical hand paddle. Most observers cannot react as quickly as the computer and so the slew speed of the telescope can be changed from 20% to 100% of the computer slew speed, with 80-% being the default.

TelescopeZenith Park

TelescopeStow Telescope

TelescopeDomeFlatPark

The park utilities all have the same properties, namely moving the telescope to a fixed (HA,DEC) and turning off the drives.

Zenith Park is used before closing the mirror petals on the Pomona Telescope because this telescope has a special condition that the petals can only be opened or closed when within 5 degrees of the zenith.

Stow Telescope is used to park at some other pre-determined position. This might be required for filling a dewar, etc.

DomeFlatPark is used to align the telescope so it is pointing at the flat field screen, positions the dome at the correct azimuth, and opens the mirror petals.

TelescopeOpenMirrorCover

TelescopeCloseMirrorCover

Special case for Pomona Telescope where the telescope must be at an altitude > 85° for the covers to open. All other telescopes can open without restriction. Typical open / close time < 15 seconds.

TelescopeResetEncoders

For use on telescopes with incremental encoders.

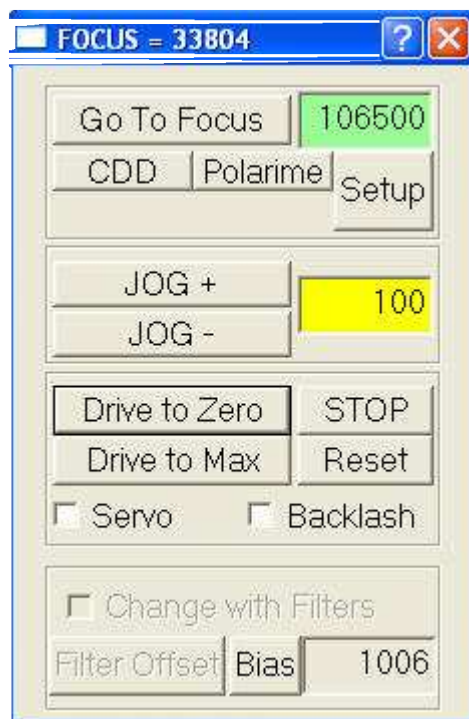


Software limits resetting to (RA, DEC) when tracking or (HA, DEC) when not tracking. If the encoders are reset by more than 1 degree then a warning is issued before resetting.

The coordinates are picked up from the last GoTo move but can be edited if necessary.

Under normal circumstances you should not have to reset the encoders. Check the pointing model is turned on and that there are sufficient grid points in the model. If not add the current known position to the model.

TelescopeFocus



The telescope focus tool is another floating dialog that can be used to move the focus ram to pre-selected positions.

The current focus is read out at the top of the box.

Pressing the **Go To Focus** button will move the ram to the absolute value shown in the green edit box.

For telescopes with multiple instruments up to four pre-determined values can be stored, and named, using the **Setup** function. In this example there are four instruments called S2KB, Moasaic, Eyepiece, and Port 4. Pressing on one of these buttons will load the preset value into the green edit box.

Incremental manual focus adjustments can be made using Jog+ and Jog- buttons which moves the ram by the number of counts entered in the yellow box.

Drive to Zero moves the ram all the way out (maximum distance between mirrors) and resets the encoder to zero. **Drive to Max** moves all the way to the maximum focus limit. **STOP** can be used to quit motion when the telescope is almost in focus. The **Backlash** button is used to remove lead-screw backlash. **Servo** is used to keep the focus ram at the same counts as the telescope moves. It is currently only used at a retrofit telescope at Kitt Peak National Observatory.

Change With Filters allows the focus ram to be automatically moved as the filters are changed. Once a given filter has been focused use the **Bias** button to set the filter zero-point. Then use the **Filter Offset** button to establish offsets for the other filters when they are in focus. This procedure only needs to be performed each time new filters are installed.

TelescopeTrackEnable

Toggles the tracking on/off.

A warning is issued.



TelescopeTrackRates

Base Rates		
	R.A. Rate	Dec. Rate
Selected	15.02	0.000
Sidereal	15.02	0.000
Lunar	14.45099	0.000
Solar	15.04106	0.000
CUSTOM	15.000	0.000

Superimpose Solar System rates		
	R.A. Rate	Dec. Rate
☐ Disable		
☒ Rate, P.A.	10	74
☐ Rate, Rate		

Save Rates Track Enable ☒

Help Cancel OK

The telescope track rates can be changed using this dialog.

Nominal values are 15.0000 ± 3.0000 arc_seconds/sidereal second but larger values can be entered if so desired.

In declination the nominal rate is 0.0000 ± 3.0000 arc_s/s.

Again the rate can be increased by the System Engineer (it is set at this nominal rate to prevent large data entry errors).

Custom rates can be saved for later retrieval.

Finally, it is possible to superimpose Solar System rates. Enter the rates of the NEO or other object and these will be added to the base tracking rates.

The Track Enable button will change the tracking state if it is currently different to the requested value.

TelescopeCenter CCD

X: 520

Y: 600

Setup Center Star

Center Ap47 CCD

X 520
Y 600

Center Star

Setup

☒ Slew without prompting

Select detector

☒ CCD-1 Ap47
☐ CCD-2

Orientation

CCD Rows

☒ E-W ☐ FlipRows
☐ N-S ☐ FlipCols

Scale

Binning Factor 1

Arcsec per unbinned pixel 0.276

Unbinned Cols 1056

Unbinned Rows 1024

Used in conjunction with the CCD Camera Interface. The user clicks the mouse on the desired object to be centered. That (X, Y) value is entered into the edit box. Pressing **Center Star** will move the telescope to place that object at the center of the CCD.

The **Setup** button expands the dialog for changing the basic scaling parameters. Up to two different CCD's can be stored.

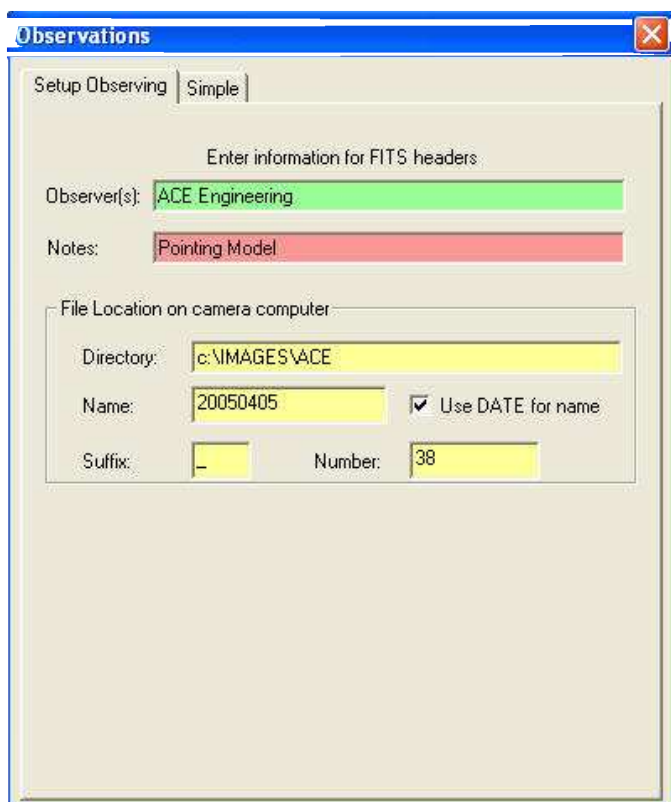
The Instruments Menu will vary depending on the current equipment installed.

InstrumentsVideo Cameras



The Video Cameras permits up to eight cameras to be switched and either a single camera, the first four cameras, or the last four cameras to be displayed. In addition it is possible to turn on low-wattage camera lights.

ObservationsSetup;
ObservationsSimple;
ObservationsSequence



Observations [X]

Setup Observing | Simple

Enter information for FITS headers:

Observer(s): ACE Engineering

Notes: Pointing Model

File Location on camera computer:

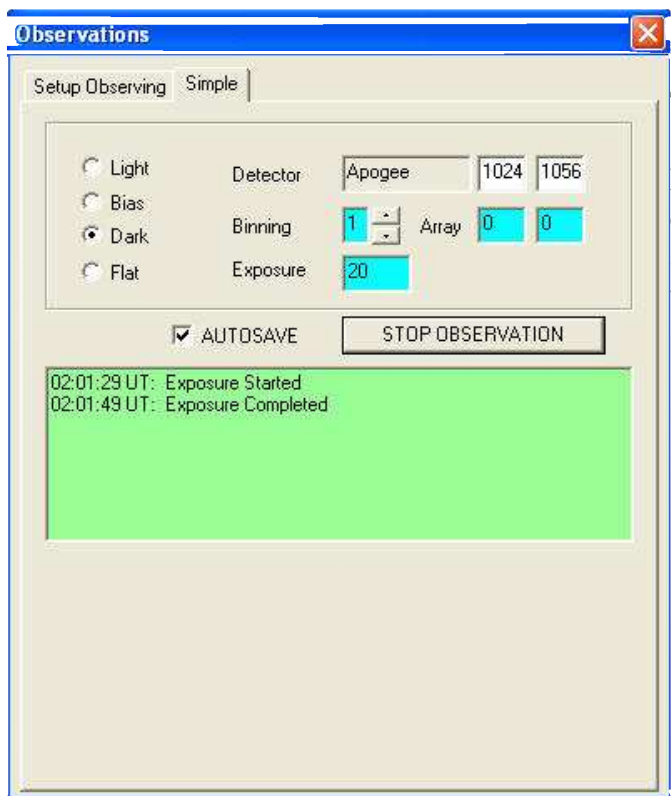
Directory: c:\IMAGES\ACE

Name: 20050405 ☒ Use DATE for name

Suffix: _ Number: 38

Use the setup menu to put in the observer names and any temporary notes like “non-photometric”.

Then select the directory and name structure for the images. The image numbers are automatically incremented.



Observations [X]

Setup Observing | Simple

☐ Light
☐ Bias
☒ Dark
☐ Flat

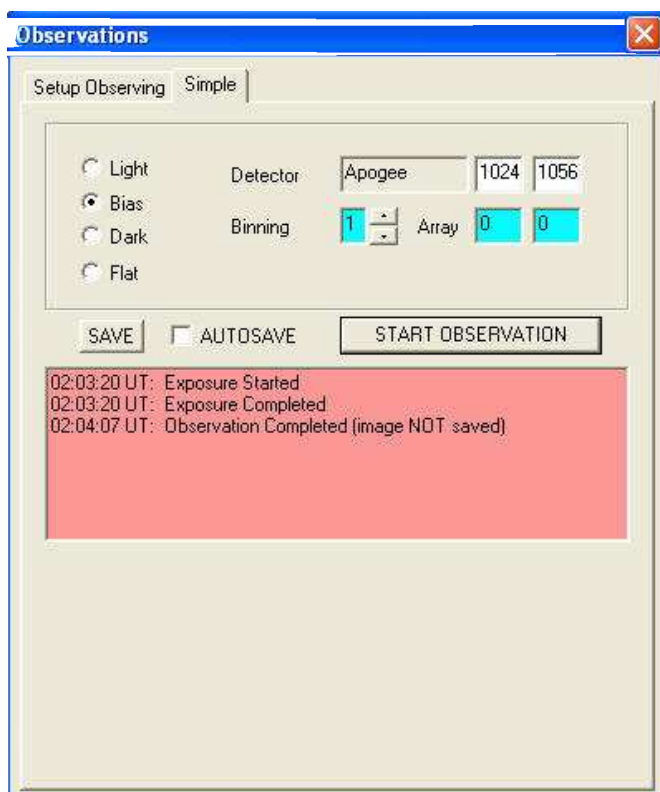
Detector: Apogee 1024 1056
 Binning: 1 Array 0 0
 Exposure: 20

☒ AUTOSAVE STOP OBSERVATION

02:01:29 UT: Exposure Started
02:01:49 UT: Exposure Completed

Take single exposures using the Simple dialog

Real-time feedback is available. The report box changes color where yellow is idle, green is exposing and the image will be saved, and red is exposing and the image is not saved.



When the system is not in auto-save mode the **SAVE** button becomes available. You can save an image at any time.

Appendix A: *System Engineer* and the Setup Menu

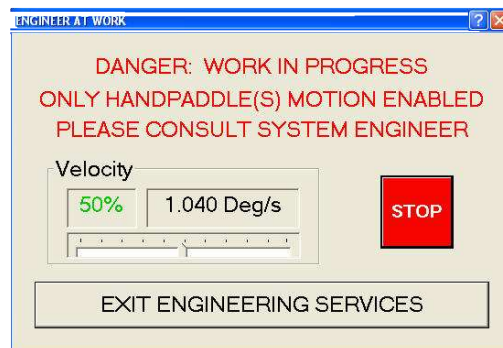
The System Engineer is able to change the fundamental operating parameters of the telescope. Access to these functions are password protected and only fully trained persons should attempt to alter parameters. If there is a problem with the setup parameters please contact ACE for assistance before making changes.

The number of menus that appear depends on the User Level. The appearance for a normal observer is shown below.



SetupEngineering Services...

Prevents a remote user from operating the system when the telescope is being serviced.



It is also possible to set the hand paddle velocities to a fractional custom level so the operator can limit the maximum slew rate while operating overhead cranes, etc, during instrument changes or top-end secondary changes.

Press Exit Engineering Services to exit the dialog.

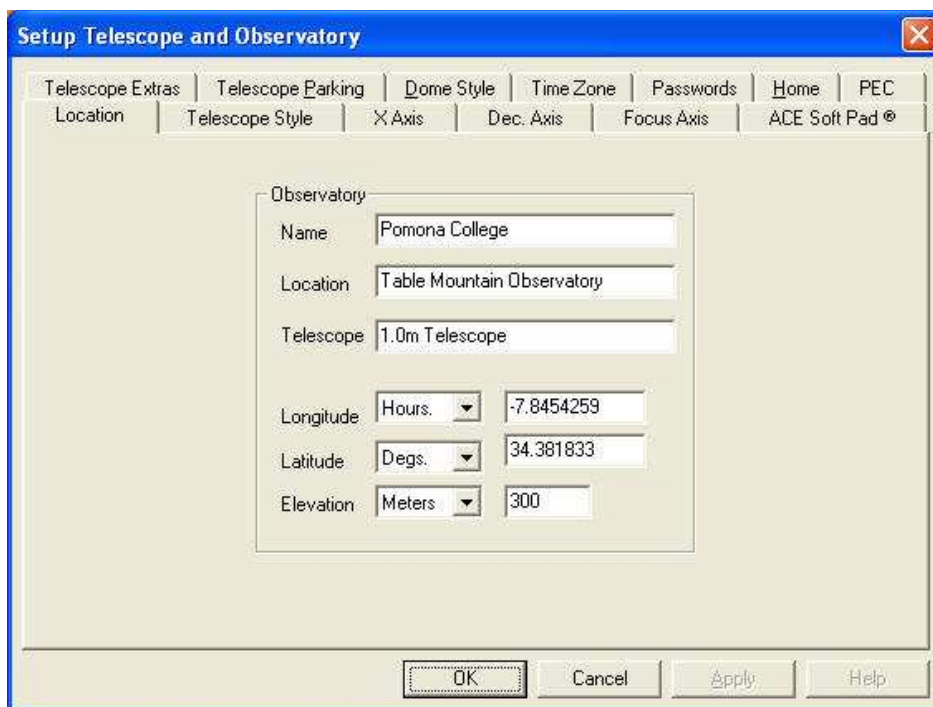
Setup System Parameters...

This menu gives access to a complex series of tabbed dialogs to set fundamental parameters of the telescope, such as longitude, latitude, encoder ratios, and other features which the regular user cannot change.

The menu is password protected and brings up the following dialog:



The contents of the setup dialogs are shown here for reference only. Complete details are in the Technical Reference Manual. Some information is taken from these files and written to the image FITS headers.



Setup Telescope and Observatory

Telescope Extras | Telescope Parking | Dome Style | Time Zone | Passwords | Home | PEC
 Location | Telescope Style | X Axis | Dec. Axis | Focus Axis | ACE Soft Pad ®

H.A. Motor

Motor Driver Resolution: 12800
 Steps per arcsecond: 25.52
 Slew Velocity (degrees/s): 1.625
 Acceleration (degrees/s/s): 0.5
 Deceleration (degrees/s/s): 0.5
 Emergency stop deceleration: 1.5

H.A. Encoder

☐ None ☐ Incremental
☒ Absolute ☐ Both

Servo telescope on encoder position: ☒
 Encoder rigidly coupled to motor: ☒
 Encoder decoupled from motor: ☐
 Pulses per revolution: 4096
 Number of revs. per motor rev.: 1
 Slip detection (arcseconds): 1
 Absolute Step (arcseconds): 0.6603

H.A. Position Approach Parameters

600 Slew deadband in arc seconds 0.4 Positioning deadband in arc seconds 0.5 Gain

Setup Telescope and Observatory

Telescope Extras | Telescope Parking | Dome Style | Time Zone | Passwords | Home | PEC
 Location | Telescope Style | X Axis | Dec. Axis | Focus Axis | ACE Soft Pad ®

DEC. Motor

Motor Driver Resolution: 25000
 Steps per arcsecond: 25
 Slew Velocity (degrees/s): 1.75
 Acceleration (degrees/s/s): 1
 Deceleration (degrees/s/s): 3
 Emergency stop deceleration: 4

DEC. Encoder

☐ None ☐ Incremental
☒ Absolute ☐ Both

Servo telescope on encoder position: ☒
 Encoder rigidly coupled to motor: ☒
 Encoder decoupled from motor: ☐
 Pulses per revolution: 4096
 Number of revs. per motor rev.: 1
 Slip detection (arcseconds): 1
 Absolute Step (arcseconds): 0.659

DEC. Position Approach Parameters

600 Slew deadband in arc seconds 0.4 Positioning deadband in arc seconds 0.8 Gain

Setup Telescope and Observatory

Telescope Extras | Telescope Parking | Dome Style | Time Zone | Passwords | Home | PEC
 Location | Telescope Style | X Axis | Dec. Axis | Focus Axis | ACE Soft Pad ®

Motor

Microstep Driver Resolution: 25000
 Automatic Power Shutdown: ☒

Resolution and Focus units

Resolution (Scale Factor): 10
 Maximum Focus (units): 1418590
 Maximum Velocity (units/s): 5000
 Acceleration (units/s/s): 500000
 Deceleration (units/s/s): 500000
 Backlash takeup (units): 100

Encoder

Installed: ☒
 Rotary Encoder: ☒
 Linear Encoder: ☐
 Pulses per revolution: 1850
 Error Lock-in Range: 1
 Stall detection deadband: 1000

Homing

Homing Velocity (% Max.): 2
 Homing backup (% Max.): 1

OK Cancel Apply Help

Setup Telescope and Observatory

Telescope Extras | Telescope Parking | Dome Style | Time Zone | Passwords | Home | PEC
 Location | Telescope Style | X Axis | Dec. Axis | Focus Axis | ACE Soft Pad ®

Direction

GUIDE SPEED MIN: 1
 GUIDE SPEED MAX: 25
 SET SPEED MIN: 50
 SET SPEED MAX: 500
 SET SPEED DELTA: 25

Focus

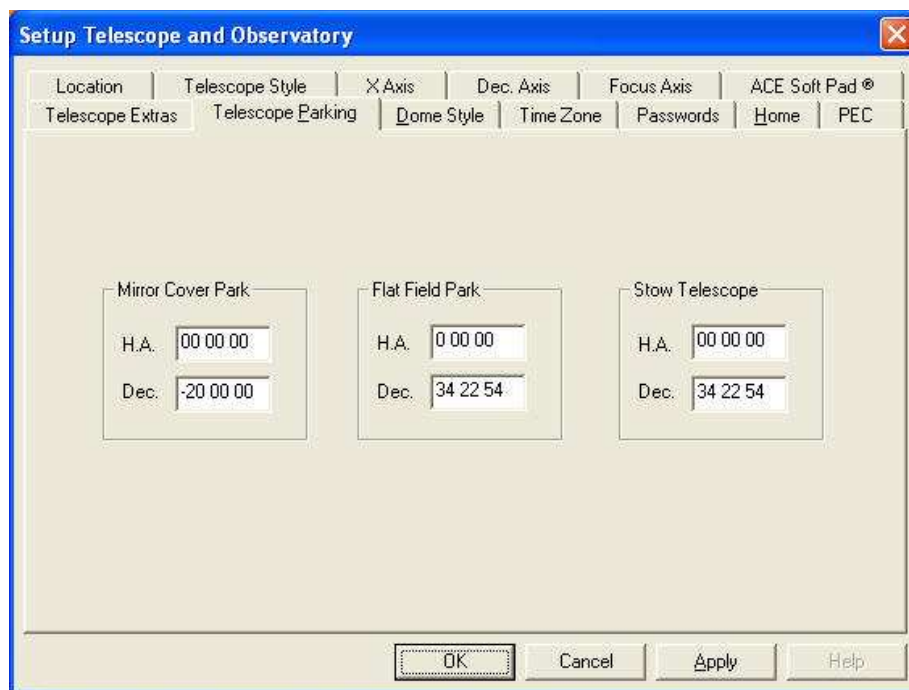
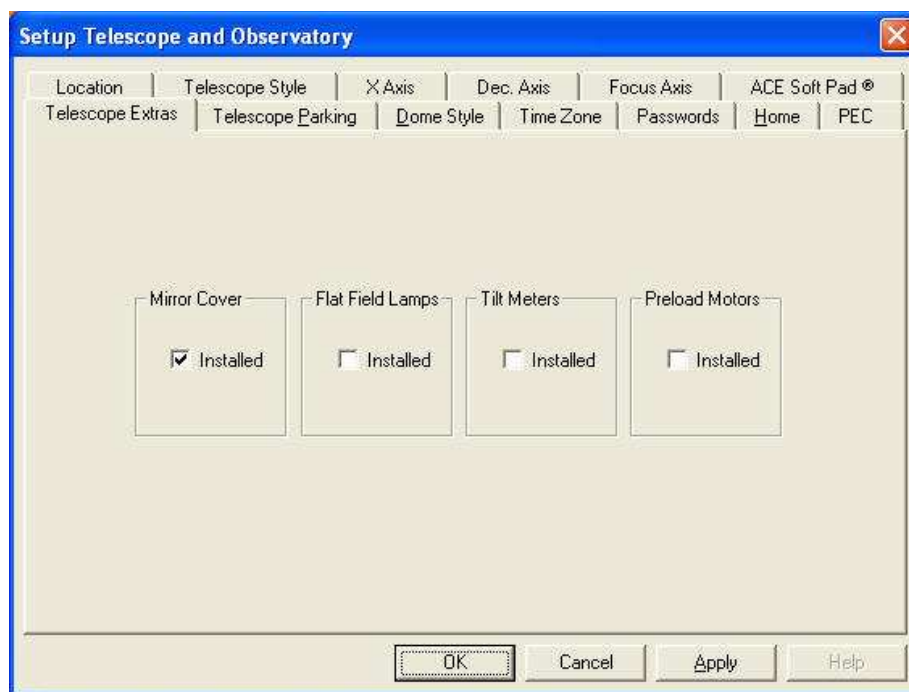
FINE FOCUS MIN: 1
 FINE FOCUS MAX: 50
 COARSE FOCUS: 100
 COARSE FOCUS: 1000
 COARSE FOCUS: 100

Enhancements

☒ Standard
☐ Alt-Az
☐ Coude

OK Cancel Apply Help

The values in the ACE SoftPad™ are also read by the physical hand paddle.



Mirror Cover Park was designed for telescopes without automated covers. For telescopes with fully automated covers the option does not appear in the telescope park menu. Flat Field Park is for aligning the telescope and dome with a calibration screen. Stow Telescope is for a standard home position.

Setup Telescope and Observatory

Location | Telescope Style | X Axis | Dec. Axis | Focus Axis | ACE Soft Pad ®
 Telescope Extras | Telescope Parking | Dome Style | Time Zone | Passwords | Home | PEC

Dome Style
☐ Roll-off Roof
☒ Classical Dome

Encoding & Timing
 Enable Calibration ☐
 Encoder Factor 109.2
 Azimuth Deadband 0.25
 Azimuth Coast 1.5
 Open / Close Time 300

Dimensions
 Slit width (m) 2.1
 Dome diameter (m) 6.248
 Slit Length (Deg.) 108
 Dropout Angle (Deg.) 30
 Offset N-S (m) 0
 Offset E-W (m) 0
 Tube offset (m) 1.143
 Vertical offset (m) 0

Home & Nudge Functions
 Home (degrees) 105
 Continuous Slip Rings ☒
 Enable nudging ☐

Automation
 Main shutter ☒
 Dropout shut ☒
 Up-Down sh ☐

SD Port
☒ Com 1
☐ Com 2
☐ Com 3
☐ Com 4

OK Cancel Apply Help

The software handles an offset-axis telescope and the telescope being offset from the dome center.

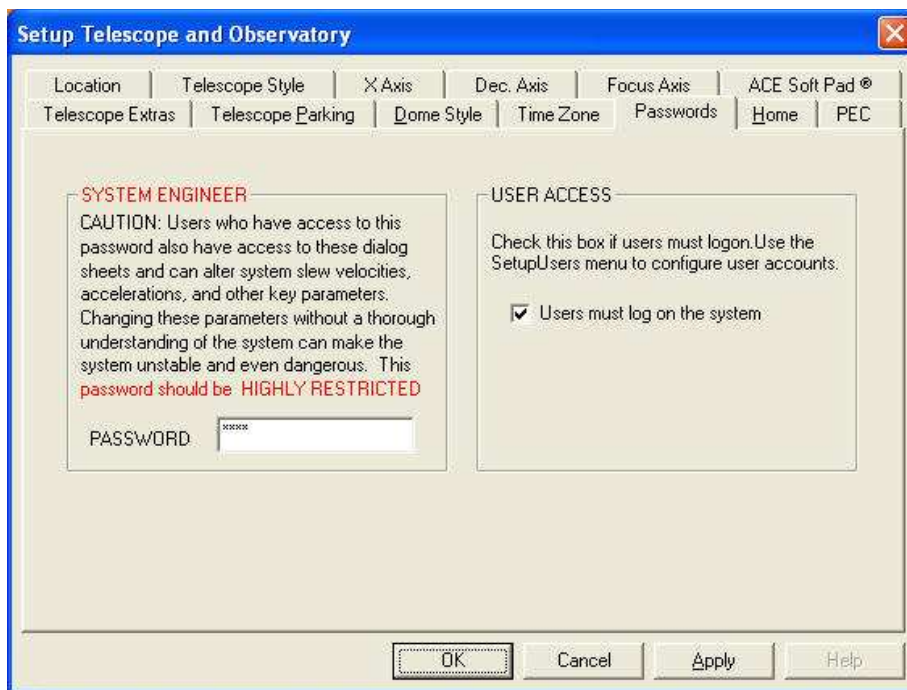
Setup Telescope and Observatory

Location | Telescope Style | X Axis | Dec. Axis | Focus Axis | ACE Soft Pad ®
 Telescope Extras | Telescope Parking | Dome Style | Time Zone | Passwords | Home | PEC

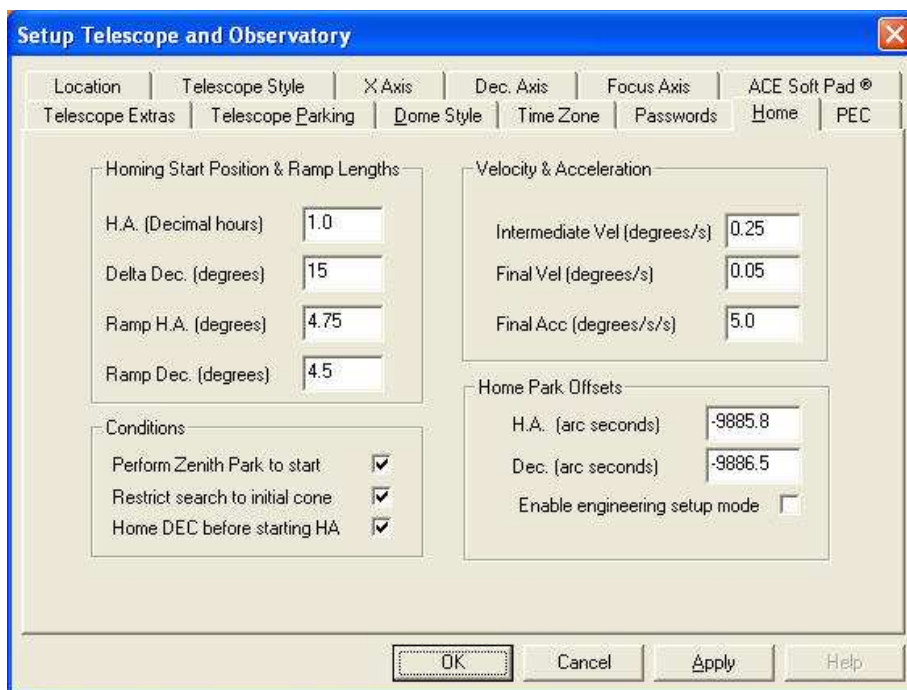
Time Zone in HOURS from Greenwich (E = -, W = +) 8
 3 Letter abbreviation for STANDARD time zone PST
 3 Letter abbreviation for DAYLIGHT SAVINGS PDT

OK Cancel Apply Help

If the DAYLIGHT SAVINGS field is left empty the system will always report standard time.



This dialog controls access to the setup menus and enables or disables the User Logon feature.



This dialog is used with telescopes having incremental on-axis encoders. It is not used for absolute encoders systems.

Setup Equipment Installed...

Another password-protected series of tabbed dialogs that with auxiliary instrumentation. Only those dialogs relevant to your system are shown here.

The image displays three sequential screenshots of the 'Setup Auxiliary Equipment' dialog box, which features a blue title bar and a close button (X) in the top right corner. Each screenshot shows a different tab selected in the top navigation bar.

First Screenshot (Detector Style tab): The 'Detector Style' section has four radio buttons: 'None', 'External paddle Inputs', 'Maxim-DL' (selected), and 'Mosaic Serial Port'. The 'ComPort' section has a 'None' radio button selected, and a group of eight radio buttons numbered 1 through 8. An 'Ignore Dec.' checkbox is also present. At the bottom are 'OK', 'Cancel', 'Apply', and 'Help' buttons.

Second Screenshot (Video Selector tab): The 'Video Selector Installed' checkbox is checked. There are three main sections: 'Everplex 8CQ' with four 'ComPort' radio buttons (1-4), 'Prostar YH485C' with no options, and 'ACE DIO CARD' with a selected radio button and a numeric input field containing '8'. The 'Enable Quad displays' checkbox is checked. At the bottom are 'OK', 'Cancel', 'Apply', and 'Help' buttons.

Third Screenshot (Weather Station tab): The 'Weather Station' section has three radio buttons: 'Not Installed', 'Vantage Pro' (selected), and 'Monitor II'. The 'CLOSE Conditions' section has five rows, each with a checked checkbox, a numeric input field, and a label: '3 Rain-Snow sensors active', '-10 Minimum Outside Temperature', '86 Maximum Relative Humidity', '40 Maximum Wind Speed', and '60 Lightning Distance'. The 'COM PORT' section has five radio buttons: 'None', '1', '2' (selected), '3', and '4'. At the bottom are 'OK', 'Cancel', 'Apply', and 'Help' buttons.

SetupControlCardVersion

Reports the revision number of the telescope motion control card.

SetupControlCardControl Card Diagnostics

The first dialog, AXES PARAMETERS, reports low-level motor and encoders counters registers, limit switches, home sensors, current velocity, direction and other card parameters. Used by the *System Engineer* as a diagnostic tool.

The screenshot shows the 'AXES PARAMETERS' tab of the 'ACE-RCS Diagnostics' window. It features a 'Select Card' dropdown menu with 'CARD 1' selected. Below this is a table with four columns labeled X, Y, Z, and T. The rows represent various parameters: Motor Position, Encoder Position, Current Velocity, Limits, Direction, Home, Slip, and Done Flag. The 'Limits' row has green highlights for X, Y, and Z, and a red highlight for T. The 'Done Flag' row has a magenta highlight for Z.

	X	Y	Z	T
Motor Position	4534723	4479223	-7213726	0
Encoder Position	4533874	4479223	-564125	0
Current Velocity	384	0	27027	0
Limits	0	0	0	1
Direction	1	1	-1	1
Home	0	0	0	0
Slip	0	0	0	0
Done Flag	0	0	1	0

The second dialog, Control InOut, reports the low-level status of the digital i/o bits. The Names button permits customization to suit the hardware installed.

The screenshot shows the 'Control InOut' tab of the 'ACE-RCS Diagnostics' window. It features a 'Select Card' dropdown menu with 'CARD 1' selected. Below this is a 'Names' button. The main area is divided into two columns of inputs, each with a list of 16 items (00-15) and a checkbox. The first column lists 'Handpad' inputs (N, S, E, W, Set, Slew, Focus +, Focus -). The second column lists 'Handpad Dome' inputs (R, L), 'PIR Sensor', 'Petals Opened/Closed', and 'Rain-Snow' inputs (#1, #2, #3). The 'PIR Sensor' checkbox is checked.

Inputs	Inputs
00 ☐ Handpad N	08 ☐ Handpad Dome R
01 ☐ Handpad S	09 ☐ Handpad Dome L
02 ☐ Handpad E	10 ☒ PIR Sensor
03 ☐ Handpad W	11 ☐ Petals Opened
04 ☐ Handpad Set	12 ☐ Petals Closed
05 ☐ Handpad Slew	13 ☐ Rain-Snow #1
06 ☐ Handpad Focus +	14 ☐ Rain-Snow #2
07 ☐ Handpad Focus -	15 ☐ Rain-Snow #3

SetupControlCardAbsolute Encoders



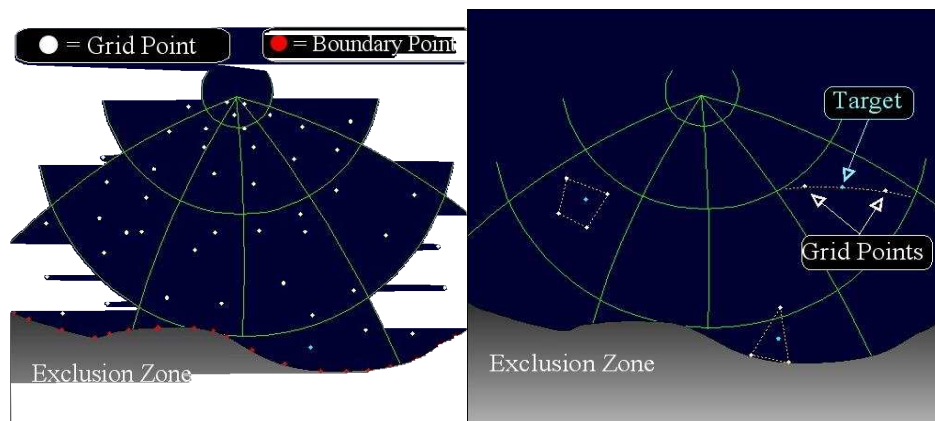
This is another diagnostic tool. It shows the absolute encoder counts. The encoders have 8192 pulses per revolution and up to 4096 revolutions. Image capture shows the H.A worm at 5300 pulses on rotation number 12. Telescope is therefore in the west (positive rotation) at 95412 total counts and declination is North by 174811 counts. The H.A. worm is 5300/8192 of the way through its rotation. This can be used to map out periodic errors.

The zeropoints should be at 0. If not, press ResetZeropoints.

When the telescope is tracking the HourAngle encoder should be constantly increasing. This tool is a easy way to check encoder functionality.

The ACEFlex™ Pointing Model.

The ACE Control System uses a grid map to determine the pointing corrections. This has distinct advantages to alternative methods based on mechanical and optical modeling of the telescope. First, the grid point method is independent of the telescope and hence the same technique can be used for all telescopes. Second, the grid point model is able to learn in real time and as more points are added the system is capable of extremely high accuracy.



The ACEFlex™ pointing model uses a series of grid points, fixed in (HA, DEC) or (AZ, ALT), which are randomly scattered around the sky. Although the positions of the grid points is random, a spacing of about 5 degrees on average, around the whole sky, will yield optimal results. Corrections are stored for each grid point and the model takes into account mechanical mount flexure, tube flexure, bearing errors, polar misalignment errors and refraction as a function of temperature and atmospheric pressure.

Depending on the grid density and the position of the target a 1, 2, 3 or 4 neighboring grid points will be used in the model. Under normal circumstances 5 neighbors are used.

How to apply a Pointing Model.

You must have a sufficient User Level privileges to apply a model. Otherwise the menu option will not be available.

Setup **ACEFlex Pointing Model** **Apply Model** displays the following dialog:

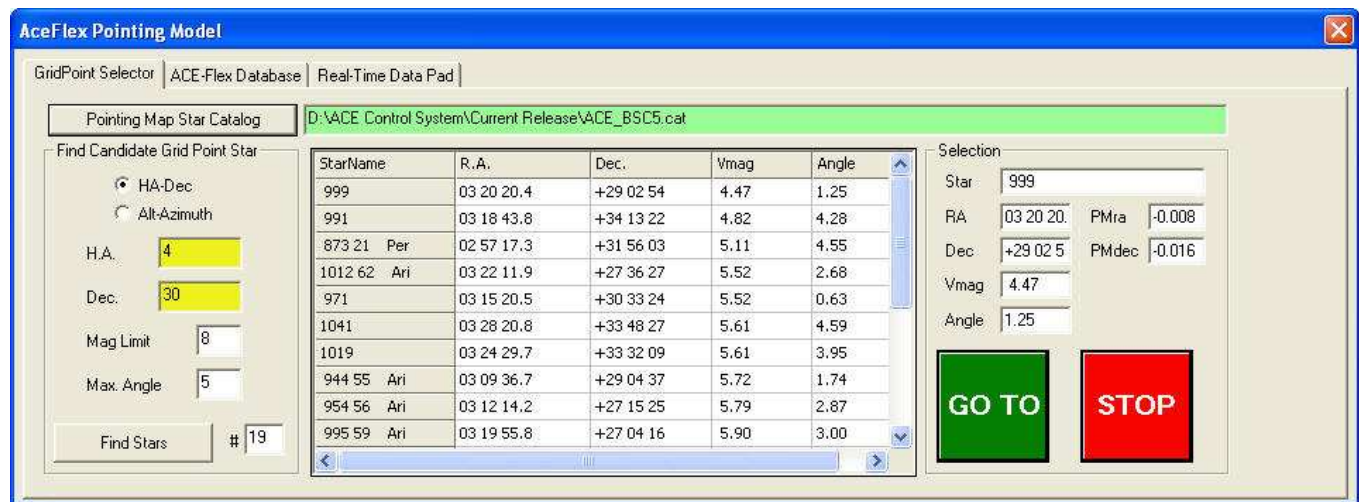
	Pole	Zenith	Elsewhere
Within this radius (Degrees) of	15	5	
Radial Distance (Degrees)	15	15	20
Hour Angle (Hours)	24	4	2
Azimuth (Degrees)	30	360	40

Under normal circumstances the user does not need to enter this dialog. It is possible to select different models depending on the instrumentation installed. Also, as more points are added to the grid it becomes more efficient to decrease the search radius around the target star. A distance-weighted solution will bias the correction to apply more weight to the closer grid points. The temperature and pressure are stored for each grid point. The current temperature can either be read by the weather station (if installed) or manually entered (which is the main reason an observer might want to use this dialog). Finally, the number of elements in the ephemeris is used to calculate the position of the telescope as a function of time. If an auto-guider is used the ephemeris is ignored, otherwise the telescope positions are corrected to match the ephemeris.

How to create a Pointing Model.

You must have a sufficient User Level privileges to create a model. Otherwise the menu option will not be available.

Setup **ACEFlex Pointing Model** **Apply Model** displays the following tabbed dialogs:



The **Grid Point Selector** is used to find suitable grid-point stars. To use this dialog first open a catalog using the **Pointing Map Star Catalog** button. The catalog ACE_BSC5 should be used. This is a formatted copy of the Yale Bright Star Catalog #5. The name of the catalog appears in the green edit box.

Next select a candidate grid point in terms of (HA, DEC) or (Az, Alt). For an equatorial telescope we suggest using (HA, DEC) and when building the model to make rasters in HA at different declination bands, typically, 0, 10, 20, 30, etc and then come back and fill in at band 5, 15, 25, etc.

The screen capture shows a selection at (HA=4, DEC=30) using all stars down to 8th magnitude within a radius of 5 degrees of the grid point. A total of 19 stars were found. The stars are then listed in magnitude order. To select by distance from the grid point select the **Angle** header. Double-click on the desired star name and the selection will appear at the right side. Warning: Clicking on the GoTo button will move the telescope without further prompting. As you have *System Engineer* status we assume that you know what you are doing and have removed “annoying” reminder dialogs.

Once the telescope has arrived at the destination take an image, then use **Telescope Center CCD** to calculate the residual correction. Once the telescope has been centered it is time to save the grid point.

Click on the **ACEFlexDatabase** tab to select the other tabbed dialog. If a flex map is not open click on **Open FlexMap** to open an existing file or create a new one. The name of the catalog appears in the green edit box. Then use the **Star Centered? Click to ADD** button to add the new grid point. Grid points have a unique ID based on the U.T. Date and the UT Time. To remove a grid point highlight that point and click on the **Delete** button. The total number of grid points is also shown.

The database also keeps track of the current observer so that points can be removed based on date, observer and other parameters.

AceFlex Pointing Model

GridPoint Selector | ACE-Flex Database | Real-Time Data Pad

Open FlexMap | D:\ACE Control System\Current Release\PomonaJan2005.Flx | GridPoints 136

Grid Point ID	Star ID	H.A.	Dec.	Delta Ha	Delta Dec	Azimuth	Altitude	Delta Az	Delta Alt	E/W
20050404-094538	4301 50Alp UMa	3.7126468	61.5861128	740.2701018	-487.1536772	325.6180289	45.8924832	-788.9525420	-244.3263798	E
20050404-094759	3757 23 UMa	5.2867042	62.9266286	791.1152859	-432.9672160	326.9424490	34.9291618	-459.4187283	-418.2114566	E
20050404-095053	3391 3Pl 1UMa	6.2084952	64.9618403	929.7736555	-200.4592240	330.9489401	29.5104369	-74.0084458	-436.5327085	E
20050404-095351	2975 51 Cam	7.1324383	65.4183808	933.2173518	-176.9222946	334.0946113	24.4077680	43.1017190	-424.4822784	E
20050404-095549	2809	7.4863224	66.2772775	974.7100684	-259.1901448	336.1441106	23.0185152	2.7767931	-469.5785176	E
20050404-100930	3075	7.1725210	73.8327125	1358.2167894	-329.2459670	342.4675400	28.2250356	-142.8249567	-484.5852409	E
20050404-101208	3719	5.7574492	74.9696706	1409.9820202	-410.2225564	341.8128910	33.9844112	-442.8309355	-407.8518400	E
20050404-101415	4126	4.6750340	75.5561806	1459.8083030	-467.3902378	342.6608299	38.0856355	-664.0361346	-277.4696770	E
20050404-101607	4687	2.9821716	74.9711350	1446.3769532	-542.4769865	345.2471378	44.2201683	-918.3775846	18.5351499	E
20050404-101923	5305 3 LMi	1.2412906	74.4031136	1483.6887765	-536.9332527	352.4882672	48.9548035	-878.5602223	335.4096482	F

Star Centered? Click to ADD | Delete | SaveAs | 0 | 0

A screen capture showing the construction of a pointing model.

ACE RCS at Pomona College Observatory, Table Mountain, CA

User: Setup Observing Dome Telescope Instruments Observations Toolkit Network View Help

Center Apr 7 CCD

Slit Azimuth: 202.0
Next Move: 09:14
Status: Auto Dome

TELESCOPE EAST

Covers: Opened
R.A. Track: 15.02
Dec. Track: 0.000
Focus: 106499
R.A. Limits: OK
Dec. Limits: OK

SYSTEM CLOCKS & TELESCOPE POSITION

JULIAN DATE: 2453465.63755 JD: 95 / 36
CIVIL DATE: 20:18:05.0 PDT Mon Apr 04, 2005
U.T. DATE: 03:18:05.0 UTC Tue Apr 05, 2005
SIDEREAL: 08:21:28.7

Observations

Setup Observing Simple

Light: ☒ Bias: ☐ Dark: ☐ Flat: ☐
Detector: Apogee 1024 1056
Binning: 2 Array 512 528
Exposure: 0.07
SAVE ☐ AUTOSAVE ☐ START OBSERVATION

03:17:20 UT: Exposure Started
03:17:21 UT: Exposure Completed
03:17:34 UT: Observation Completed (image NOT saved)

AceFlex Pointing Model

GridPoint Selector | ACE-Flex Database

Pointing Map Star Catalog | D:\ACE Control System\Current Release\ACE_BSC5.cat

Find Candidate Grid Point Star

HA-Dec: ☒ Alt-Azimuth: ☐
H.A.: 2.5
Dec.: -1.0
Mag Limit: 8
Max Angle: 5
Find Stars: 21

StarName: 2004 53Cap Ori R.A.: 05 47 45.4 Dec.: -09 40 11 Vmag: 2.06 Angle: 0.46
1998 142et Lep R.A.: 05 46 57.3 Dec.: -14 49 19 Vmag: 3.55 Angle: 4.82
2085 166ta Lep R.A.: 05 56 24.3 Dec.: -14 10 04 Vmag: 3.71 Angle: 4.52
1937 49 Ori R.A.: 05 38 53.1 Dec.: -07 12 47 Vmag: 4.80 Angle: 3.76
2128 3 Mon R.A.: 06 01 50.4 Dec.: -10 35 53 Vmag: 4.95 Angle: 3.21
2108 2 Mon R.A.: 05 59 04.3 Dec.: -09 33 30 Vmag: 5.03 Angle: 2.53
2031 55 Ori R.A.: 05 51 22.0 Dec.: -07 31 05 Vmag: 5.35 Angle: 2.57
2021 R.A.: 05 49 36.5 Dec.: -14 29 01 Vmag: 5.49 Angle: 4.46
2065 R.A.: 05 54 43.6 Dec.: -11 46 26 Vmag: 5.66 Angle: 2.25
2150 R.A.: 06 05 27.0 Dec.: -10 14 34 Vmag: 5.87 Angle: 4.06

Selection: Star 2227 5Gm Mon R.A.: 06 14 51 PMra: -0.008 Dec.: -06 16 29 PMdec: -0.019 Vmag: 3.98 Angle: 3.82

GO TO STOP

ACE SoftPad

80% Lock
25 50 NUM INTERACTIVE
Guide Set
NW NE SW SE
Fine Coarse
22 1000
Focus 106499

Capture Help

0:18 PM