

## **Nudger the Lunar Solar Auto Guider Version 2.0 - by George Varros** (updated December 9, 2013)

**Overview** - Nudger is a Windows based "Telescope auto-guider" application that uses ASCOM drivers to auto-guide telescope mounts. It was developed to be used in conjunction with lunar meteor impact observations and corrects for the imperfections in lunar tracking rates embedded in computerized mounts. It relieves the operator of constantly needing to make corrections with a hand controller. Nudger monitors an existing low light level video feed using a 'screen capture' technique and analyzes the region surrounding the position of an identified tracked object or lunar feature. When changes in the objects position are detected, Nudger steers the telescope mount using "Pulse Guide" commands thus "nudging" it back on target. Nudger requires the latest ASCOM drivers for your mount to be installed correctly on the PC it is operating on. If you can already connect to your mount using ASCOM drivers, Nudger should also be able to connect.

Nudger is intended to be used to track lunar features that are illuminated by "Earth shine" such as Aristarchus, or bright sun-lit features near the terminator such as a mountain top that is surrounded by shadows, or where the terminator transitions from dark to light. See Figures 1 - 2 for further reference.

**Requirements:** Runs on Windows XP and Windows 7 based computers with ".NET 4.0" installed. It is questionable as to whether Nudger will run correctly on Windows 7 64 bit. It has not been tested on Vista to my knowledge and probably never will. The latest version of ASCOM drivers should already be installed on the computer and known to be working with your telescope's mount. Download the latest ASCOM drivers at <http://ascom-standards.org/> As of Dec 9,2013 the version is known as "ASCOM Platform 6, SP3". Nudger might not work with ASCOM drivers installed specifically by other applications. You can check the ASCOM Platform by accessing the Control Panel, Programs, and then clicking Uninstall. Don't actually uninstall anything, simply verify the latest ASCOM Platform version is installed.

The mount must be able to accept "Pulse Guide" commands. The computer must be capable of running a video window with a live video feed that is displayed at 30 frames per second and is 24 bits uncompressed or raw although it may work with 16 bit feeds.

Nudger doesn't require it's own video input device but simply "watches" an existing video window, such as the preview window of an application that is recording an AVI file of the moon. The video preview window should be normal sized and not zoomed or scaled down in any way. The video preview window must also play on a "VGA Palette" and not "Video Overlay", as video overlay prevents the ability to use screen capture techniques. However, there are settings that can change this behavior (see Video Overlay towards the end of the document). Typically, Nudger wants as fast as computer and video card as possible. It does not cause frame dropping with several AVI recording applications tested (all of which seem to use very little system resources).

Nudger is intended to be used on a 24 bit color system and only monitors the red color byte for processing. It is assumed the video feed is monochromatic and that the Red, Green and Blue pixels are all equal in value. Nudger can be configured to work with preview windows that display less than full color although there is most likely a lower limit to its ability to do so. For instance, a video preview window may reduce the video from 24 to 16 bits. This directly impacts subtle grey scale gradations by reducing the overall dynamic range of the video and if the contrast of the tracked object is too low, Nudger might not be able to track it. Using a video capture program with a 24 bit raw preview window works best.

Nudger does not need to know the relationship between FOV size and number of screen pixels to calculate resolution or anything else. It merely corrects the mount's pointing by slowly bringing the target back on center in the telescope's field of view. If the target heads a little toward any direction, the mount is nudged once per loop-cycle until it is re-centered. Typically, your AVI recording application's "preview window" should be of normal size and not reduced, enlarged or zoomed in. If the preview screen is smaller than the width and height of the video stream, Nudger will have less resolution to work with and its guiding capability will be diminished. When imaging the moon for impacts, it is expected that nearly half the moon (its shadowed surface) will be visible in the camera's FOV.

**Installation:** Nudger resides in a zip file which has a directory structure similar to this:  
\\Deploy\_Nudger\\Application Files\\Nudger\_2\_0\_0\_0  
\\Deploy\_Nudger contains setup.exe and Nudger\_Instructions.PDF  
\\Deploy\_Nudger\\Application Files\\Nudger\_2\_0\_0\_0 contains the Nudger.exe executable file and the DLL interfaces.

You can either run setup.exe to install Nudger or simply run the executable file:  
\\Deploy\_Nudger\\Application Files\\Nudger\_2\_0\_0\_0\\Nudger.exe

If a previous version of Nudger is installed, you may need to manually uninstall that version before installing the new one. Do this by accessing the Control Panel, Programs, and then clicking Uninstall. Click on the Nudger application and then click Uninstall.

#### **Quick start guide:**

This assumes you have a video preview window running and a telescope mount that is physically connected to the computer and is known to work with the latest ASCOM drivers, and that you've experimented with the setup and have a feel for the software.

1. Run Nudger.exe
2. Use the arrows in the "Screen Capture Position" area to locate the area of the video feed that has the object you want to track.
3. Configure Screen RA/DEC; set the RA+ (east) and DEC+ (north) to camera's view
4. Click on "Select Scope" and select the ASCOM driver for your mount and click ok. In some cases, Nudger might not be able to open specific telescope drivers. An alternative

way to connect your telescope is to use the POTH Hub. From the Start Menu, run the POTH Hub and connect to your telescope. Then, connect Nudger to the POTH Hub.

5. Click the “Connect” button. The mount’s RA and DEC positions should be displayed in a few seconds, after the connection is made.
6. Click the E (RA+) and N (DEC+) slewing buttons to make sure the scope slews in the right direction; use the “Swap EW” and “Swap NS” buttons to swap east and west or north.
7. Click the mouse on the target you want to track
8. Click the Start Guiding button

**Default settings:**

Pulse Guide check box	checked – auto-guides using Pulse Guide commands
RA Duration	250 - length of time for a Pulse Guide command for the RA axis
DEC Duration	250 - length of time for a Pulse Guide command for the Dec axis
Target Size	20 - size of area to target and track
Contrast	<b>8</b> - zoom window contrast
Cycles	15 - number of screen captures before correcting pointing
Refresh Rate ms	100 - how often to capture the screen

**Nudger’s screen:** Nudger is tracking Earth-shine illuminated Aristarchus in figure 1 and a bright object located at the terminator in figure 2.



Figure 1

Figure 2

## Using Nudger's controls

**Configure Screen RA/DEC** – The two list boxes labeled RA+ east and DEC+ north at the screen top are used to associate the mount's Right Ascension axis and Declination axis to the screen's Top and Bottom or Left and Right sides, as seen through the video field.

For instance; if the East (RA +) direction is towards the screen bottom, select "Bottom" for RA + (or whatever direction it may be). If the North (DEC +) direction is the left side of the screen, select "Left" for DEC + (or whatever direction it may be). See figure 1.

RA- (West) and DEC- (South) are assumed to be the opposite sides of the screen as identified by RA+ and DEC+ settings. Nudger does not care about incorrectly identified drive axes and will respond exactly as configured.

If guiding, these controls are not accessible.

**Select Scope / Connect** - Click the "Select Scope" button to select the driver for the telescope mount you are connecting to. This opens the ASCOM Chooser interface to the drivers installed on your computer.

In some cases, Nudger might not be able to open specific telescope drivers. An alternative way to connect your telescope is to use the POTH Hub. From the Start Menu, run the POTH Hub and connect to your telescope. Then, connect Nudger to the POTH Hub.

Once the telescope is selected and the OK button is clicked, click Nudger's "Connect" button to establish the connection to the telescope. In the event the mount can not accept "PulseGuide" commands, the application will not connect to the mount and will be of no real use. If needed, click on the label "**Diag**" to view the telescope connection. The information returned is displayed in a message box and automatically copied to the clipboard and can be sent to [gvarros@gmail.com](mailto:gvarros@gmail.com) if needed. See the Additional Information area at the end of the document for a sample of the connection information returned from a mount.

**Disconnect** - Once connected to a telescope mount, the "Connect" button displays "Disconnect". Click "Disconnect" to disconnect from the telescope. This re-enables the "Select Scope" button.

**Negative checkbox** – for solar imaging, Nudger can use the negative of the video feed image, allowing dark sunspots to appear as bright trackable objects.

**Pulse Guide checkbox**- Nudger uses Pulse Guide commands only for auto-guiding and this setting will be forced to be checked when you start to auto-guide. The axes speeds for auto-guiding are based on the RA and DEC Duration settings. If checked, the N,S,E and W buttons will pulse one time per click.

If the Pulse Guide check box is unchecked and you are connected to a mount that can use "Move Axis" commands, the "Speed" and "Duration" settings will be visible and the N, S, E and W buttons can be used to manually slew or move the pointing direction based on the speed settings.

**RA Duration** - amount of time in milliseconds, to slew telescope in RA + and RA – directions when "Pulse Guide" is checked; default = 250; this setting might need to be lowered or raised based on the telescope's reaction. Allow for up to a few seconds for the telescope to be re-centered on the object. If it can not be re-centered and seems to slowly drift away, raise the RA Duration or Dec Duration setting as needed, to allow the Pulse

Guide commands to be longer in duration. If the settings is too high, it could cause an overcompensation problem where an over correction in one direction forces an overshooting of the center point which then causes a correction in the opposite direction. It is okay if it takes a few seconds to for Nudger to re-center the target. The RA and DEC Duration settings are used only for Pulse Guiding.

Alternatively, you can raise or lower the “Cycles” or “Refresh Rate” settings to alter the length of time between re-centering calculations (see Cycles and Refresh Rate sections below).

**DEC Duration** - amount of time in milliseconds, to slew telescope in DEC + and DEC – directions when Pulse Guiding; default = 250; this setting might need to be lowered or raised based on the system’s reaction time. Allow for up to a few seconds for the telescope to be re-centered on the object. If it can not be re-centered and seems to slowly drift away, raise the DEC Duration setting to allow the Pulse Guide commands to be longer in duration. The RA and DEC Duration settings are used only for Pulse Guiding.

Alter these slewing rates or durations as needed. If the Pulse RA Duration and Pulse DEC Duration times are set too low, Nudger won’t be able to keep the target locked or may lag behind the target slowly losing ground. If the setting is too high, it could cause an overcompensation problem where an over correction in one direction forces an overshooting of the center point which then causes a correction in the opposite direction. It is okay if it takes a few seconds to for Nudger to re-center the target.

Alternatively, you can raise or lower the “Cycles” or “Refresh Rate” settings to alter the length of time between re-centering calculations (see Cycles and Refresh Rate sections below).

If Pulse Guiding is checked but you are not tracking, N, S, E and W buttons can be used to slowly move the telescope for up to 30 seconds, while the button is pressed. If Pulse Guiding is not checked, and the telescope is capable of using Move Axis commands, the buttons will slew at the “Speed” setting and continue to as long as the button is pressed.

**Swap EW, Swap NS** – If connected to a telescope mount, use these check boxes to make sure the scope slews in the correct direction. If you’ve configured the capture screen correctly for the RA + (east) and DEC + (north) directions, but the RA+ or DEC+ telescope position readings are decremented when using the slewing buttons (or go in the wrong direction of their respective buttons), alter these settings to reverse the direction for that particular axis.

**Rate** – (Manual slewing) - The box labeled “Rate” allows the MoveAxis command to be altered for responsiveness. When connecting to a driver, if the telescope can not use the MoveAxis command or can not access the mount’s axes’ minimum and maximum speed in degrees per second, MoveAxis commands will be disabled. If the mount can use MoveAxis commands, the Rate list box will be visible only when the “Pulse Guide” check box is unchecked and can only be used when you are not guiding. It will list a set

of rates either derived from Nudger (variable rates detected) or rates obtained from the telescope.

**Screen Capture Position** - This allows you to set up what portion of the screen Nudger will look at. Use the arrow buttons to navigate around the window or type in X and Y coordinates. Position the object to be tracked somewhere inside the Nudger window, well away from the edges. Before doing this, click the "Start Capture" button so that an image appears in Nudger's video window.

**Start Capture/ Stop Capture** - Click the "Start Capture" button to begin capturing the screen at the rate specified in the "Refresh Rate ms". Click the "Stop Capture" button to stop capturing video to the Nudger window. Stopping and restarting the screen capture reinitializes guiding.

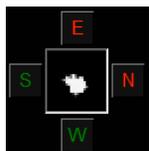
**Click the mouse on the target to track.** This identifies the object that Nudger will track. For centroid tracking, click the center of the object. For tracking an illuminated object such as a portion of the terminator, click near the transition from dark to light. Do not try to track objects that are horizontally flat. Select an object that is pointy as in Figure 2. In most cases, the "Brightest" setting should be used to track anything other than a dim object. See discussion at end of document on how Nudger sees things.

**Start Guiding / Stop Guiding** - After clicking on an object to track, click the "Start Guiding" button to start auto-guiding. This will force Nudger to use Pulse Guiding. Click the "Stop Guiding" button to stop guiding. Clicking the mouse on the target changes the "click point" that identifies the tracked object. Don't inadvertently click on the capture screen after initiating auto-guiding, it will track the new position.

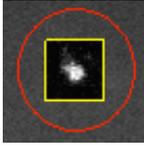
**Zoom Window and Slewing Arrows** - The small zoom window surrounded by the N S E and W buttons, displays the target region centered on the point of the actual mouse click that originally identified the target. The image in the Zoom window is altered in brightness and contrast when guiding, allowing for better visual feedback than what normal video brightness levels would provide. It merely allows you to see the tracking up close.



**Zoom window** where the brightness levels are altered for visual feedback, so you can see the object is actually being tracked. Use the "Contrast" setting to alter the contrast.



The N, E, S and W Buttons that surround the zoom window can be used to move the mount's pointing direction. When "Pulse Guide" is checked, Pulse guiding is used for one pulse. When Pulse Guide is not checked, Move Axis commands are used and the speed of slewing is based on the "Rate" setting. If your mount can't use MoveAxis commands, these settings will be disabled.



Sample shot of Aristarchus surrounded by the target circle;

**Target Size** - size of target area; min = 10; max = 50; default = 20; you want this to be a little larger than the object being tracked but not too small. The above picture is a good reference.

**Contrast** - This setting boosts pixel brightness levels in the Zoom Window for visual feedback purposes only if Enhanced is unchecked. If Enhance is checked, this setting is used in the enhancement of the target region. The setting decreases or dims pixel values lower than the calculated threshold level and raises pixel values that are higher.

**Range** - This setting is used to limit the number of pixels used for targeting. It should be set low (2 – 4) for objects such as Aristarchus and higher for illuminated objects near the terminator (see figures 1 and 2). The idea is to use a setting which seems to create good contrast in the zoom window. If set too low, Nudger will lose track of the target. If set too high, Nudger could wander aimlessly.

**Enhanced** - When checked, enhances the object being tracked and uses the Contrast and Range settings to alter the brightness of the tracked object. Use low settings for Contrast and Range if tracking surface features. Use a higher range setting if tracking the terminator.

**Cycles** - number of screen refreshes before resetting; default = 15; this setting multiplied by the “Refresh Rate” setting determine the amount of time the tracked object’s position is monitored before pointing corrections are made.

**Refresh Rate ms** - rate at which Nudger should capture the screen; default = 100ms (milliseconds); this setting multiplied by the “Cycles” setting determine the amount of time the tracked object’s position is monitored before tracking corrections are made.

**Offset track** – In an ideal world, with PEC and an accurate lunar tracking rate, Nudger would have little to do, or simply not be needed. Offset tracking can be used to nudge the telescope mount at very specific intervals, so that it is tracking as close to the lunar rate as possible. (It can also be used to track moving comets or asteroids)

After you start tracking for a few to several minutes, Nudger will have averaged the East versus West and North versus South corrections to fairly reliable values. These calculated averaged values are visible below the E/W and N/S counts (90 and -195) which in this

case mean there is one East PulseGuide command every 90 cycles and one West PulseGuide command every 195 cycles. Positive numbers = East and North while negative numbers indicate West and South.



There are two numeric text boxes below those calculated values where E/W or N/S tracking offset can be manually entered. The numbers entered will cause Nudger to pulse guide once in the specific direction after that number of screen refreshes occur. For instance, if the “Refresh Rate ms” is set to 250 and the Drift RA is set to 32, one pulse in the East direction will be issued every 32 refreshes (equal to 8 seconds). If Drift RA is set to – 32, a pulse in the West direction will be issued every 8 seconds. To check these E/W and N/S values use: (value = cnt \* cycles / (N-S)) (value = cnt \* cycles / (E-W))

Click on the little red and green Plus “+” sign between the two boxes to insert those calculated values into the EW and NS text boxes. If editing the values by hand, make sure Offset track is unchecked. Preferably, use the up and down arrows to change the values. Caution: do not set these values too low or they could completely tie up your computer as too many PulseGuide commands will be issued over too short a time span. The number range allowed is between -1000 and 1000. Any average higher than that is probably insignificant for offset tracking.

Once these values are set, click the “Offset track” check box to enable offset tracking. If tracking is lost with this setting checked, Nudger will continue to Offset track, if Blind Guide (see section below) is not checked.

Blind Guiding and Offset track basically do the same thing if tracking is lost. However, if the Offset track numbers are set incorrectly, the mount will track too fast or too slow on one or both axes, after tracking is lost. Blind Guiding also uses the calculated value versus the entered value.

Offset tracking continues after tracking is lost and can be used without Guiding. It does not compensate for periodic errors (which might be worth adding in at a later date) and won’t work with improperly set anti-backlash settings.

**Blind Guide** – if clouds are going to intervene with tracking, this setting can be checked so that Nudger will continue to calculate and execute guiding in the event tracking is lost. Nudger keeps track of the total number of North versus South corrections and East versus West corrections and uses the following calculations to determine how to continue guiding: : (value = cnt \* cycles / (N-S)) (value = cnt \* cycles / (E-W))

Once you are auto-guiding, click the “Start Guiding” button again, once the guiding has stabilized. This will zero out the count and remove the initial adjustments Nudger made while centering the target. If Offset track is checked and Blind Guide is not, Offset tracking will continue to occur if the target is lost due to clouds so they are interchangeable in a sense. Selecting both will allow Blind Guiding to be used as it will rely on the latest average numbers versus the Offset track numbers.

**Auto Recover** – Click Auto Recover to cause Nudger to try to reacquire the target if tracking has been lost. It will attempt to recover within 10 seconds and every 10 seconds thereafter, until tracking has been recovered.

**Audible Alarm** – when this setting is checked, Nudger beeps once when tracking is lost. If Blind Guiding, Nudger will beep for every slew. I’m not sure how obnoxious to make this.

**Summary of what these settings do:** in this case (see Figure 1), Nudger is watching a 30 x 30 square pixel area surrounding the object and the screen capture rate is 100 ms which recaptures the screen every 100 milliseconds. Nudger looks at 15 frames (or Cycles) and then averages the tracked object’s position. So in this case, the object’s position is calculated every 1.5 seconds and when a change in position is detected, Nudger sends commands of 250ms duration for slewing the Right Ascension axis and/or 250ms duration for the declination axis.

**Test Mode** - In order to experiment with or become familiar with Nudger before using it, check the "Test Mode" check box at the bottom of the screen. This will cause Nudger to nudge or move the screen to simulate the response of a telescope, when auto-guiding.

**Make sure "Test Mode" is not checked when you are really connected to a telescope and actually auto-guiding unless you are experimenting.** This is important and failure to un-check this box will result in pointing error as the simulated repositioning of the screen will counteract or react with commands sent to the telescope.

**Here's a Test Mode use scenario:** I've chosen Aristarchus as the object to track because it is visible on the shadowed side of the moon between waxing crescent and first quarter. I have ample footage that is loaded with manual corrections that can “simulate” a really sloppy mount or worse. Nudger is able to guide on the dimmest StellaCam II and WATEC 902H2 Ult video streams that I've tested so it is the optimum target to track during the evening waxing phase. Larger aperture telescopes with better low light cameras will yield additional trackable objects such as large craters. Earthshine cast on the shadowed lunar surface plays a big role in a camera’s ability to provide an image with good contrast.

Open a lunar impact video AVI file using Windows Media Player or some other AVI player. Move the Media Player's screen so that it is at the Top Left of the screen.

Move Nudger on the screen so it does not obstruct Media Player's video window. Click on "Start Capture" and Nudger will start capturing the screen based on the X and Y position indicated in the X and Y text boxes under "Screen Capture Position". Alter these X and Y coordinates manually or by clicking the arrow keys, until the Player's video window with the target is centered inside the Nudger window (or so the object to track is away from the edges of Nudger's video window). Positioning the screen like this can be accomplished faster by clicking an arrow button once and then holding down any key which will repeats the arrow command until that key is released. (This might not work with all keys)

Next, make sure the "Test Mode" check box is checked. Then, find Aristarchus in Nudger's window and click on it and then click the "Start Guiding" button. Nudger should start simulating auto-guiding by shifting the screen capture position in response to the corrections that would needed to accurately guide a telescope.

During this test, if Aristarchus drifts in the video window at all, Nudger will re-position its view of it to simulate tracking. If Aristarchus happens to move too rapidly, Nudger will loose track and the Start and Stop Tracking buttons turn yellow. Experimenting with Nudger before actually using it is definitely recommended.

### **Additional Information:**

**ASCOM** "The ASCOM Initiative is a loosely-knit group of developers and astronomical instrument makers that work together to bring vendor-independent and language-independent plug-and play compatibility between astronomy software and astronomical instruments. ASCOM stands for the Astronomy Common Object Model."  
-ASCOM site...

For information on ASCOM visit <http://ascom-standards.org/About/Index.htm>

**ASCOM PulseGuide** commands are used to slew the telescope at the slowest speed that the mount can operate at. The pulse is added to the current tracking rate (sidereal or lunar). Nudger requires a mount to be able to use PulseGuide commands.

**ASCOM MoveAxis** commands are used with the hand controller (N, E, S and W Buttons), to manually reposition the telescope's pointing direction, if the mount is capable of using different drive rates. Depending on the number of drive rates detected, Nudger will use either create the specific rates found or will create its own based on the minimum and maximum rates detected, and populate the "Rate" list box with them. The Pulse Guide check box must be un-checked to use MoveAxis commands. When guiding and when the PulseGuide check box is checked, the Rate list box is hidden from view.

**Anti-Backlash Settings**– Anti-backlash settings cause the gears on a mount to take up slack in the direction opposite of its last slew. If anti-backlash settings are set too low, the mount might not be very responsive. If set too high, the mount may be over responsive and jerk around when receiving a command. I have a Celestron 8-NGT and it works best if I set the anti-backlash to "01" for all RA and between "01 and 05" for DEC directions.

My hand controller's anti-backlash settings seem to reset every once in a while to "18". When that happens, the mount makes an audible chatter when slewing and can lightly wiggle the optical system. It is important that you perfect how your telescope responds.

**Hints for checking anti-backlash:** Hook up your telescope and computer like you'd normally do. Set the right ascension and declination settings to identify the drive axes. Connect to the telescope. Use the arrow keys to slew in the north-south directions and observe if the declination changes correctly. If not, click the Swap N/S checkbox and try again and they should be correct. On one side of the meridian you will have to set or unset this accordingly. Do the same for the RA east and west direction buttons. Make sure a slew to the east increases the right ascension reading and use the Swap E/W checkbox to correct them if needed.

Now, check the backlash. Click the Pulse Guide check-box on and click one of the direction buttons. Then, click the opposite button and see if the RA or DEC readings change just a little or quite a bit. Repeat this a few times to see if the slewing for each button responds similarly. Alter the RA Duration settings to see how fine a movement can be made. If you've gotten this far, you're pretty much ready to go!

**Testing** – most of the testing has been done using a Celestron C 8-NGT with a CG-5 ACS mount and Celestron 9.25 SCT with a CGEM mount. Testing is also being conducted using the "GPUSB Shoestring" drivers on a German equatorial mount via an auto-guider port, in which case Nudger only works using the Pulse Guide mode and does not return the Right Ascension and Declination positions. It is noted that the GPUSB drivers on a 64 bit Windows 7 system, required the POTH Hub to be used to connect to the telescope and then Nudger could connect to the POTH Hub but could not connect to the telescope drivers directly. It has been tested with an RCX400 setup with works although another RCX400 has a lack of response in the declination axis.

**How Nudger 'sees' things** – Before the original "Start Guiding" button is clicked, the target to track is identified by a mouse click. When that happens, Nudger keeps looking at the region of the click to determine where the brightest and darkest parts of the region reside. It looks a few pixels up, down, left and right of the clicked position. It keeps deciding which scanning direction is optimum to use when the "Start Guiding" button is finally pressed. There is a label to the right of the refresh rate list box and it displays "LR Down", "RL Down", "LR Up" and "RL Up" depending on what is optimum at the moment.

For an amorphous object like Aristarchus, it is pretty much undefined and the label may change rapidly. For an object near the terminator, Nudger sees the dark part and bright part and also keys on the slant of an object for left and right and how it is all positioned. When clicking on an object near the terminator, click at the very transition from bright to dark, sort of at the edge. Nudger wants to scan from the darkest to with consideration to vertical first and then the horizontal direction. This is based on the assumption that the moon in the FOV is situated with the North and South directions on the width axis (is

horizontally aligned) and East and West directions are on height axis or vertically aligned.

During actual Guiding, Nudger will scan top to bottom left to right or top to bottom right to left or bottom to top left to right or bottom to top right to left, whichever way that was correct at the moment the “Start Guiding” button was pressed.

Once the “Start Guiding” button is pressed, Nudger attempts to set a range of pixel brightness levels to work with and what to exclude. This is directly based on the “Range” setting value. Use a low number for dim objects and a higher number for terminator objects. The setting sets a Range of what range of brightness levels to look for. For dim objects of low contrast, the range is small, sometimes just a value of 3 or 4 across the target area. For terminator objects, the range is large, spanning from a brightness of 255 down to a dimness of 48 or 64 (or whatever) thus having a large range across the target region. Nudger considers all this and decides where the exact center of useful brightness is located.

Sometimes, depending on how guiding is doing, the direction may not actually be optimum. For instance, if the tracked object is rapidly moving up, and the scan direction is UP LR or UP RL, the target might appear to almost get away and it may have been better off scanning the other way. I may put in (yet another) list box that allows the user to manually set this.

### **“Diag” Output from a Celestron C-8 NGT CG-5 Advanced GT**

Driver info: ASCOM Celestron Telescope Driver V2 5.0.13  
Developed by Chris Rowland  
Copyright © 2003 - 2008, Chris Rowland  
Chris Rowland <chris.rowland@dsl.pipex.com>  
Scope Type ASC 4.13

AlignmentMode: German Polar  
Equatorial System: J2000  
Can pulse guide True  
Can move axis 0 True  
Can move axis 1 True  
Right Ascension: 20.6952052116394  
Declination: -8.34162712097168  
CanSetRightAscensionRate True  
CanSetDeclinationRate True  
Can set guide rates True  
RA guide rate: 0.00210535791224666  
DEC guide rate: 0.00210535791224666  
Drive Rate axis 0 ra: min rate: 0 max rate: 4 deg/sec  
Axis 0 has Variable Drive Rates  
Drive Rate axis 1 dec: min rate: 0 max rate: 4 deg/sec  
Axis 1 has Variable Drive Rates

**“Diag” Output below is from the POTH Telescope Simulator:**

Driver info: POTH->I\_Simulator  
POTH (Plain Old Telescope Handset) 5.0.4  
Developed by Jon Brewster. Focuser part by P.de Ponthiere.  
Copyright © 2003, Jon Brewster  
An ASCOM scope, dome and focuser hub

Connected to a scope driver with the following information:  
ASCOM Telescope Simulator 5.0.9  
Developed by Robert B. Denny, DC-3 Dreams, SP  
Copyright © 2001, SPACE.com Canada, Ltd.  
<http://ascom-standards.org/> <http://www.starrynight.com/>

AlignmentMode: Polar  
Equatorial System: J2000  
Can pulse guide True  
Can move axis 0 True  
Can move axis 1 True  
Right Ascension: 5.98472971709186  
Declination: 13.809035324512  
CanSetRightAscensionRate True  
CanSetDeclinationRate True  
Can set guide rates True  
RA guide rate: 0.00417807461655151  
DEC guide rate: 0.00417807461655151  
Drive Rate axis 0 ra: min rate: 0 max rate: 8 deg/sec  
Axis 0 has Variable Drive Rates  
Drive Rate axis 1 dec: min rate: 0 max rate: 8 deg/sec  
Axis 1 has Variable Drive Rates

**Video Overlay** – To disable Video Overlay; For Windows XP, right click on your desktop and click Properties => Settings => Advanced => Troubleshoot and move the slider all the way to the left. This will stop all overlays, system-wide.

In Windows Media Player, you do this by following Tools => Options => Performance and setting the Video Acceleration to “None”; then select => Advanced. There are two checkboxes here to turn overlays on or off. One is for DVDs and the other is for everything else.

For Windows 7, you may need use Legacy Firewire drivers or possibly disable video drivers in order to use Nudger while a video file is being recorded. Some video drivers only use “overlay” to display live feeds where others allow one to disable video hardware acceleration. The goal is to get Nudger to be able to view the screen that is recording video, while it is recording an AVI file.

To disable hardware acceleration in Windows 7:

- Open the Control Panel.
- Double click on Personalization and select Display Settings.
- Click Advanced Settings.
- Click on the Troubleshooting tab and click on the Change Settings button.

Note: if the Change Settings button is disabled, you won't be able to disable hardware acceleration here, you'll have to possibly remove your video drivers)

Move the Hardware Acceleration slider all the way to the left to None.

Click Apply and then click OK to accept the new setting.

Click OK to close the Display Properties dialog box.

Restart Windows.

For Windows 8, it is unknown if Nudger will work.

## **Update History**

**Update 2.0** – Changed deprecated chooser call to new method. Updated development platform to Visual Studio Express 2010. Installed ASCOM Development Platform 6 Developers Components-SP3. Recompiled and rebuilt application. Updated documentation.

### **Updated Nudger updated video overlay instructions (10/16/2013)**

**Update 1.0.0.23, 1.0.0.24 and 1.0.0.25** were unreleased test versions.

**Update 1.0.0.22** – Added “Negative” checkbox to allow for negative view of a solar image; causes dark sunspot to appear bright allowing Nudger to track them.

**Update 1.0.0.20** – Offset Track checkbox flashes green when Offset Tracking is being performed. Status label changed to show offset tracking. Clicking the Blind Guiding check box clears the status label.

**Update 1.0.0.20** – rewrote Blind Guiding because it was implemented improperly. Tweaked Offset Tracking and added a little button to insert calculated drift numbers into Offset track E/W and N/S text boxes; Removed Blind Guide button that was for more for testing in previous versions. Internal changes.

**Update 1.0.0.19** – Added “Auto recover” to allow Nudger to try to reacquire target if clouds have disabled tracking and Blind Guiding has taken over.

Added Offset Tracking to allow a RA or DEC offset to be entered.

**Update 1.0.0.18** – Changed "Gamma" to "Contrast"

Changed “Drift History” label to show North, South, East and West drift.

Added some background panel panic colors for when tracking is lost.

Added in an "Enhanced" function that uses a feedback loop to produce gain and image stability of the tracked object. Atmospheric motion is smoothed somewhat reducing tracking. I have not tested this in the wind but suspect the target will become somewhat

stabilized. By default, Nudger will start in this new mode. Uncheck the box to track without enhancing the image. It works much better if checked.

Enhanced when checked, enhances the object being tracked. For objects such as Aristarchus, use settings of Contrast = 4 and Range = 4 and then adjust them so that the object is nice and smallish. I use settings of 4 and 1 for my test footage which reduces Aristarchus to a small tight blob with a nice brightness curve. It also allows Nudger to ride the change in brightness when clouds intervene, before losing track. You experiment!

Both Gamma and Range settings are now used in the Enhanced feedback where they are not if Enhanced is un-checked. Changing these settings while tracking could cause tracking to be lost as the feedback loop adjusts to the new range of pixel values over a few frames.

This will now track a magnitude 11.2 star easily, using an 8" f/5 reflector and Watec 902H2 Ult at prime focus.

**Update 1.0.0.17** – Internal housekeeping; Found variable that could degrade ability to track a terminator object.

**Update 1.0.0.16b** – Resized vertical height of Nudger to be less than 768 pixels tall so that it fits inside a 1024 X 768 window.

**Update 1.0.0.16** - Changed manual PulseGuide functions to continue to PulseGuide as long as the direction button remains pressed or 30 seconds has elapsed. Manual PulseGuiding stops when the button is released or 30 seconds has elapsed. Prior versions allow only one pulse per click.

Added in a connection test function labeled “**Diag**” that when clicked on, displays the results of querying the telescope for what movement and tracking rates settings are available. The results are copied to the clipboard so they can be sent to me if needed.

**Update 1.0.0.15** – removed Brightness/Centriod buttons. Finished Blind Guiding functionality; swapped N/S based on East or West direction; when south of north and east of the central meridian, north is positive; when on the west side of the central meridian, north is negative. This may require you to toggle the Swap N/S check box. Added “Range” list box that is used to bias the target region. Use a lower setting for darker objects and higher setting for terminator objects.

If you have questions, please contact George Varros at [gvarros@gmail.com](mailto:gvarros@gmail.com)