



Eclipse Orchestrator v3.7 User Manual

Thank you for purchasing Eclipse Orchestrator, a product of Moonglow Technologies (a subsidiary of DayStar Instruments LLC).

For customer support, please email sales@moonglowtech.com or call +1 (660) 747-7782 during 9AM-5PM Central Time, Monday thru Friday.

- Watch the eclipse, not your camera! This software controls cameras during a solar eclipse so that you can be free to concentrate on observing the event visually. Preprogram all exposures using our handy script wizard customized for your exact coordinates and camera. Enter your latitude/longitude coordinates and the software will automatically calculate local circumstances for you. Then, all camera actions can be timed in reference to these specific eclipse events. All features are optional, so the program can be used for as little or as much as desired.
- Available in two versions, Free and Pro (\$109).
- First developed for the 2002 total solar eclipse, it has since been used around the world by hundreds of users.
- Because digital cameras are still in their infancy, extensive rehearsal and testing is recommended to ensure success.
- This is Windows software, for XP, Vista, 7, 8, and 10 operating systems.

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Supported Cameras for exposure control

Please note that we only test the software with a handful of camera models, as we cannot keep up with the pace of releases. If you encounter a compatibility issue with a camera, please let us know and we will see if it can be fixed.

Canon:

- 1D^{1,2}, 1D Mark II¹, 1D Mark II N¹, 1D Mark III, 1D Mark IV, 1D X, 1D X Mark II, 1D C
- 1Ds^{1,2}, 1Ds Mark II¹, 1Ds Mark III
- 5D, 5D Mark II, 5D Mark III, 5D Mark IV, 5DS, 5DS R, 6D, 7D, 7D Mark II
- D30^{1,2}, D60^{1,2}, 10D^{1,2}, 20D¹, 20Da¹, 30D, 40D, 50D, 60D, 60Da, 70D, 80D
- Digital Rebel^{1,2}, XT, XTi, XSi, XS, T1i, T2i, T3, T3i, T4i, T5, T5i, T6, T6i, T6s, SL1
- 100D, 300D^{1,2}, 350D, 400D, 450D, 500D, 550D, 600D, 650D, 700D, 760D, 1000D, 1100D, 1200D, 1300D, 8000D
- Kiss Digital^{1,2}, F, N, X, X2, X3, X4, X6i, X7, X7i, X8i, X50, X70, X80, Hi
- Cameras not on this list are NOT supported.
- Not supported: M, M2, M3, M10

¹ Note: Not compatible with Vista/onwards, due to instability or lack of Canon driver.

² Note: Menu option "Setup | Support Old Canons" must be checked to use one of these cameras on XP.

Nikon:

Camera must be set for PTP or MTP, not Mass Storage.

- D3, D3X, D3S, D4, D4S, D5
- D40, D40X, D60, D80, D90
- D200, D300, D300s, D500, D600, D610, D700, D750, D800, D800E, D810, D810A
- D7000, D7100, D7200, D7500
- Newer cameras in the same series of a supported camera are usually supported.
- Not supported: D1, D1H, D1X, D100, D2H, D2Hs, D2X, D2Xs, D50, D70, D70s, D3000, D3100, D3200, D3300, D3400, D5000, D5100, D5200, D5300, D5500, D5600

Shutter cable sources and instructions

Serial port shutter cables significantly enhance the shooting speed and reliability of Eclipse Orchestrator, and are strongly recommended. If you do not have an RS232 serial port on your computer, a USB to serial converter works very well.

Note that Parallel cables are not supported by Eclipse Orchestrator.

http://www.store.shoestringastronomy.com/products_ds.htm

<http://imaginginfinity.com/astrocables.htm>

http://www.beskeen.com/projects/dslr_serial/dslr_serial.shtml

Getting Started Guide

Install

Insert the provided disc or USB memory stick, or download the software from our website, and install it on your Windows XP, Vista, 7, 8 or 10 computer. We do not recommend using virtual machines or emulators.

Connect Camera

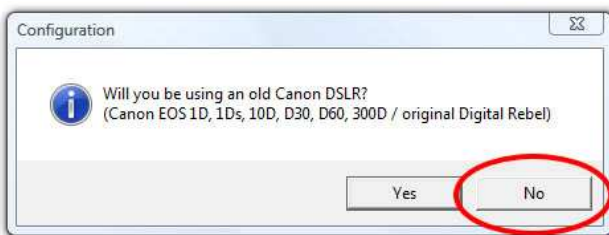
Set your camera to 'M' mode, lens to manual focus, and turn off your camera's "Auto Power Off" feature via the camera menus. Then connect your camera with a USB (or Firewire) cable to your computer and wait for the computer recognize it.

Start Eclipse Orchestrator

Double click the Eclipse Orchestrator icon on your desktop or in your Start menu.

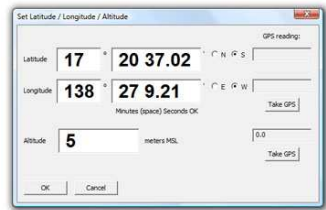
Old Canon User?

A dialog will pop up. Click 'No' unless you will be using one of the listed cameras, introduced in 2000 thru 2003.



Enter Your Viewing Site

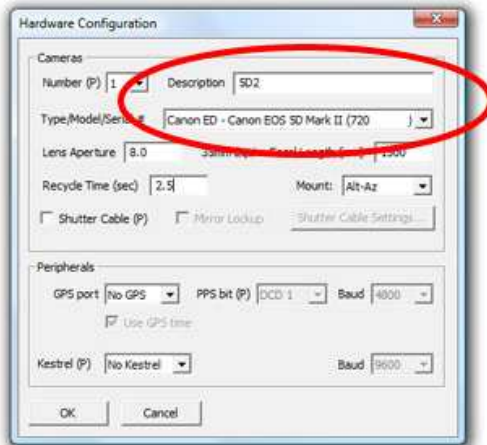
Enter the latitude and longitude of where you will view the eclipse, ideally to an accuracy of 100 meters. Once at your viewing site on eclipse day, you should use a GPS and get the exact latitude and longitude of your location.



Name Your Camera

Make sure your camera is selected in the pulldown 'Type/Model/Serial #' box, and then since the full name is so cumbersome, give it a short nickname in the 'Description' box.

If you have a Garmin GPS connected via USB, select 'USB' from the GPS port pulldown. If you have a hand wired GPS 18(x) LVC or other NMEA compatible serial cabled GPS, select the COM port and later choose the bit where the PPS signal is soldered after you register the software.



Register The Software

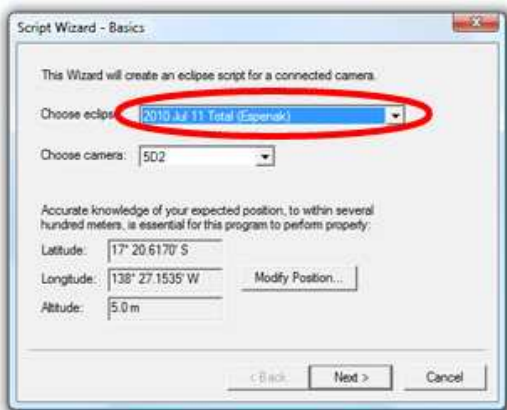
Go to the Help | Enter Serial Number... menu option. If you purchased a boxed physical copy of EO, leave the Name field blank and enter the serial number included on the CD sleeve, otherwise you need to enter the name associated with the registration. Click Register.

Restart The Software

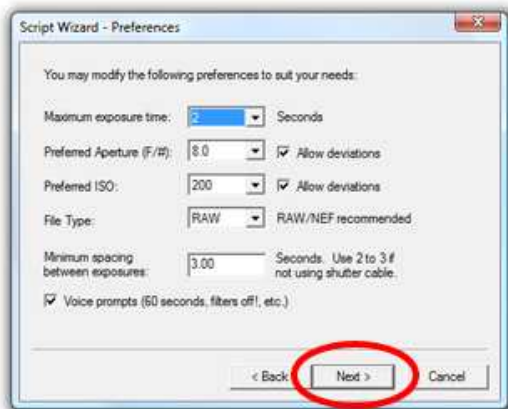
You will be prompted to close and restart the software. Please do so now, or else your changes won't take effect.

Generate a Script

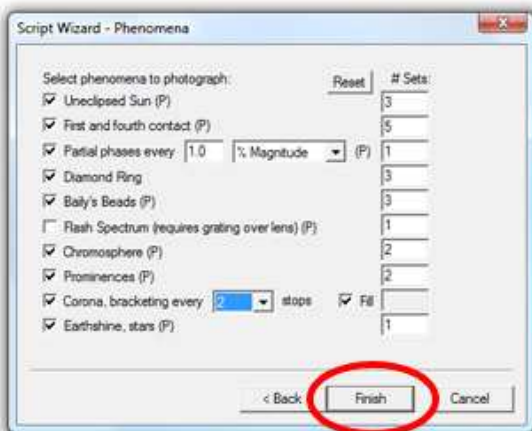
The easiest way to get going is to use the Script Wizard to generate a basic script for you. A script is a list of times at which to perform listed actions or exposures. Select 'File | Script Wizard...' from the menu bar. On the first screen, select which eclipse you're generating a script for.



On the second screen, adjust the settings to your liking or just click Next to use the defaults.



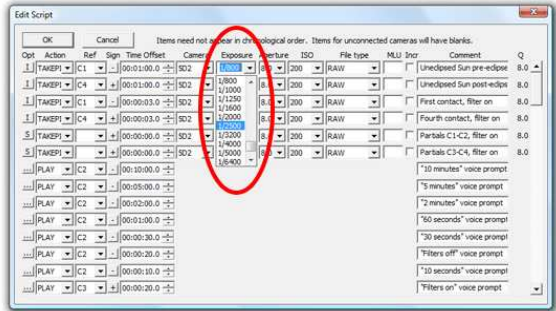
On the third screen, enable or disable the phenomena you wish to photograph. The '# Sets' numbers indicate how many sets of exposures



will be taken of each phenomenon. You'll probably be coming back here to tweak the numbers based on how long totality lasts. Unless you've registered Eclipse Orchestrator Pro, you won't have all these options available.

Customize Your Script

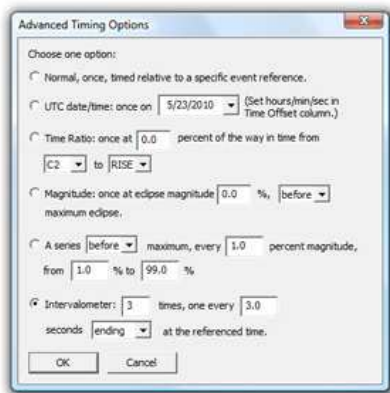
Now you have a basic script that needs tweaking to your preferences. Open the Script Editor by selecting 'File | Edit...' from the main menu bar. In the example below we are changing the shutter speed.



Items in the script need not be in order - the program will sort out the sequencing order later. That way you can group things in a more logical order. For rearranging or copying several exposures, it's probably quicker to use Notepad (menu item 'File | Edit in Notepad...').

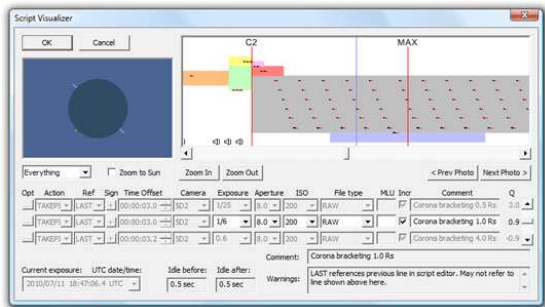
Even though scripts are in the .csv file format, do not open them with Microsoft Excel as it will confuse the shutter speeds and time offsets and wreck the file.

To access advanced features, click on one of the small buttons at the left of the editor, and then click 'Options...' on the popup menu. This will give you the ability to do bursts of exposures with the Intervalometer, or to trigger the exposure off other events.



Visualize Results

New in Version 3.2 is the Script Visualizer, a photo by photo list of exposures. By dragging a scroll bar or clicking Next/Prev Photo, you can step through your



script, see an exposure in relation to other exposures, and a crude preview of what it will look like. The graph at the upper right plots exposures over time, with vertical axis height plotting each exposures' "Q", or absolute exposure setting (factoring in shutter speed, aperture, and ISO). Black boxes show when the shutter is actually open, with red tails representing the 'Recycle Time', which is how long before the camera is ready to take another exposure.

The vertical blue line overlays the selected exposure. Down below, the first and third exposure lines don't do anything other than provide reference. As you can see, only a subset of parameters can be modified here. You'll have to go back to the Script Editor to make more substantial changes.

The colored boxes in the graph represent suggested exposure times and settings for various phenomena. A good script will bracket in such a way as to fill out the boxes, to cover differences in camera sensitivity, atmospheric transparency, etc. The color code is:

Orange = Partial phases

Green = Diamond Ring

Yellow = Baily's Beads

Violet = Earthshine (the face of the Moon)

Red = Prominences

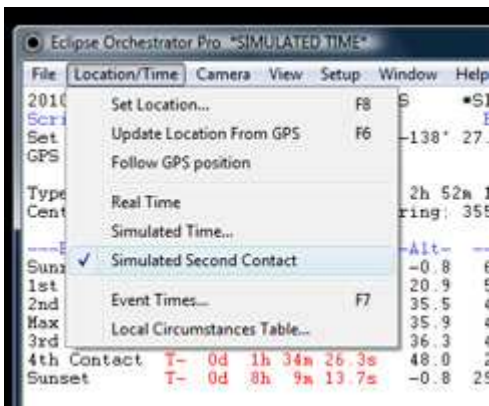
Gray = Corona

Pink = Chromosphere

Test Your Script

To do this, select 'Location/Time... | Simulated Second Contact' from the main menu bar. The time will jump ahead to 45 seconds before second contact. Listen to the camera and watch the exposure list on the main window as time progresses. If the camera misses an exposure or locks up, you've probably programmed too short of a time between exposures, and will need to delete an exposure or space them out more. With just a USB cable connected, 2-3 seconds between exposures is generally necessary.

**Key to success
is testing your
script, over and
over. And over.**



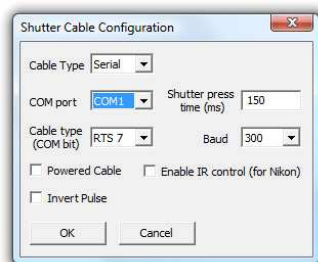
Once you determine the minimum amount of time between exposures that works reliably, visit the 'Setup | Hardware Configuration' dialog and update the 'Recycle Time' to that minimum time spacing, so that the Script Visualizer's red tails are the proper length.

Improving Performance

As you've probably found, the camera can be rather sluggish over USB. To improve performance, we recommend adding a serial shutter cable. A serial shutter cable acts as an electronic cable release, allowing much less time between exposures. The USB cable connection is still required to send shutter speed, aperture, and ISO changes, but the time consuming task of triggering an exposure can be offloaded to the serial shutter cable. In this way, up to about 2 to 3 exposures can be made each second, depending on the speed of your camera.

The biggest advantage to EO Pro is the support for using serial port shutter cables. These special cables (ordered from a third party or built yourself) use a signal from your computer's RS232 serial port to release the shutter on your camera, while the exposure commands still travel over the USB cable. This way, your camera's internal buffer can be used to allow more rapid sequences of photos. Don't have an RS232 serial port on your computer? USB to serial converters work just fine, or the [Shoestring Astronomy DSUSB adapter](#) works great too.

To get started, connect the cable to your computer, then enable 'Shutter Cable' in the 'Settings | Hardware Configuration' menu. Then go to the Shutter Cable Configuration screen and adjust the settings to match the type of cable you are using. Remember that you still need the USB cable connected. You will have two cables running from your laptop to the camera; the USB cable does the changes in exposure/aperture/ISO, while the shutter cable triggers the exposure to begin.



Top Ten Causes of Non-Success

1) Taking too many photos too fast. Better to settle for one photo every three seconds than trying for five per second and getting zero. See #5.

2) Insufficient rehearsal.

3) Changes between testing and eclipse day. No new hardware, no firmware updates, no last minute untested script changes, no Windows Updates allowed.

4) Waiting until the last week. I am always amazed when people expect me to be sitting at my desk by the phone on eclipse day. I am an eclipse chaser too!

5) Not using a serial port shutter cable. This cable is your turbo button. Use it.

6) Testing with the lens cap on – point it at a light bulb so test files aren't zero bytes. Real image files will buffer slower than test ones.

7) Forgetting to remove the solar filter. I'll remind you if you include my voice prompts in your script.

8) Bumping focus when removing the solar filter. Duct tape is your friend.

9) Failure to refocus after the temperature drops. Use live view!

10) Bad time or position on the PC. Use a GPS for cryin' out loud.

Advanced Topics

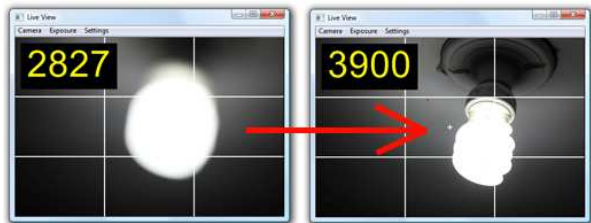
Multiple Cameras

The second big advantage to Eclipse Orchestrator is the ability to connect and control multiple cameras. This is a new feature, still in the experimental stage. Not all combinations of cameras will be successful, and this adds a lot of complexity and points for failure, so only use multiple cameras if you are convinced you need it. All supported Nikons seem to play together OK. As of 2009 only Canon models Canon 1D Mark III, 1Ds Mark III, 5D Mark II, 7D, 40D, 50D, 450D/Rebel XSi, 500D/Rebel T1i, 550D/Rebel T2i, and 1000D/Rebel XS can be used in combination with each other.

Each camera has completely independent shutter speed, aperture, ISO, and file type control. Exposures can be synchronized among cameras to an accuracy of typically 0.5 seconds or better, or each camera can "do its own thing".

Live View

The Live View window with its Sharpness indicator is a

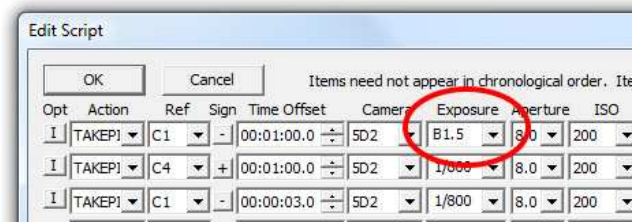


fantastic tool to achieve pinpoint focus on Eclipse day. Select 'Window | Live View' from the main menu bar, then pick your camera from the 'Camera' menu in the Live View window. You can optionally turn on the Sharpness metric and grid lines. The higher the number, the sharper the image. For best accuracy, we recommend selecting 'Settings | Zoom In'

once or twice. Try not to let the Sun move out of the field of view while focusing, as this will skew the results.

Bulb Mode

New in version 3.2 is full support for Bulb mode, allowing arbitrary exposure lengths. To create a bulb exposure, simply type the letter 'B' followed by the duration in seconds into the Script Editor. Bulb mode has a precision of about 0.01 seconds, so only exposures longer than 1/10 second are recommended.



For the Canon 1D Mark III, 1Ds Mark III, 5D Mark II, 7D, 40D, 50D, 450D/Rebel XSi, 500D/Rebel T1i, 550D/Rebel T2i, and 1000D/Rebel XS, no serial shutter cable is required. For all other camera models, a serial shutter cable is required to trigger bulb mode, in addition to the USB cable connection.

A few camera models like the original Canon 5D cannot mix bulb exposures with normal exposures. For this camera you'll have to manually turn the mode dial to 'B' instead of 'M' on the camera.

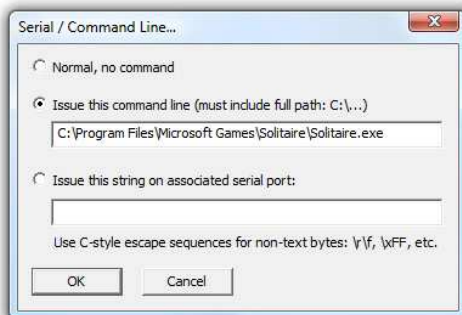
Mirror Lock Up

If you are using a serial shutter cable, you may use Mirror Lock Up to reduce the amount of vibration in an exposure. First, enable MLU in your camera's Custom Functions. Then in the Hardware Configuration menu, enable MLU. Finally, in the Script Editor, under the MLU column,

enter the amount of time to wait between raising the mirror and opening the shutter. The default is 0.35 seconds if no value is entered.

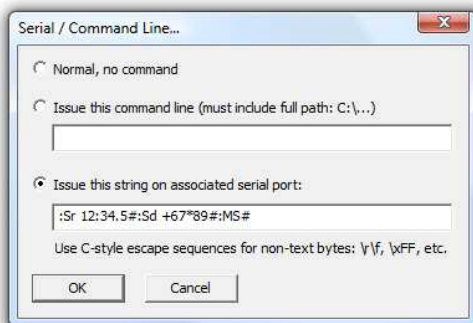
Command Line Actions

External programs can be invoked at scripted times, for example to execute special tasks or take data. In the example shown below we will start the Solitaire game.



Serial Port Actions

For the truly advanced user, arbitrary strings can be programmed to be transmitted out a serial port during a script. One possible use is to repoint a telescope, perhaps to build up a high resolution mosaic. The example string shown below could command a Meade LX200-compatible telescope to slew to a right ascension of 12h 34.5m and a declination of +67°89'.

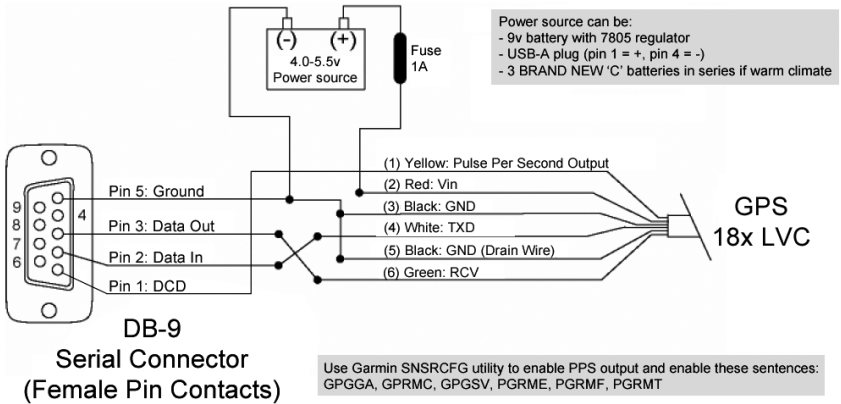


GPS Pulse Per Second

A USB connected Garmin GPS is usually accurate to better than one second.

For deep subsecond accuracy, a more reliable timing source is needed. EO Pro can monitor the Pulse Per Second signal from a special GPS receiver such as a Garmin 18x-LVC, for an accuracy measured in milliseconds. This usually involves soldering the cable together yourself using our instructions below.

Eclipse Orchestrator Pro GPS PPS Wiring Diagram: For Garmin 18-LVC or 18x-LVC.



Setup and checkout (long before Eclipse Day)

1. Configure your computer to **disable any sleep, hibernation mode, or screen savers**. You don't want your computer to shut itself off during the eclipse, ruining your photos!
2. If you'll be connecting your Canon camera via USB or Firewire, **make sure any needed camera drivers are installed on the PC and the camera connects OK**. For Canon cameras, Install and run Canon's EOS Capture or RemoteCapture software to verify that the camera can be controlled remotely. If you can't control the camera from Canon's software, there is NO WAY it's going to work with this software. For Nikon cameras, browse the camera via Explorer to see if images saved on the camera are visible. For Canon cameras: If your camera has a "Communication" menu option, make sure to select "PC connect." or "Normal" instead of "PTP" or "Print/PTP". Consult Canon's troubleshooting instructions if you run into issues. Once you've got it working, close Canon's software (EOS Capture or whatever), but leave the camera connected and powered on. For Nikon cameras, select PTP or MTP mode, not Mass Storage.
3. **Set up your camera(s)**. For USB/Firewire control, set the camera to manual exposure ("M" mode) and manual focus. Set the "Auto Power Off" mode OFF or disabled. Turn off Auto Exposure Bracketing mode. Turning off "Review" mode or reducing the review time can speed up things.
4. **Start the software** (double click the 'Eclipse Orchestrator' application). If this is your first time running it, it will ask whether you will be using old Canon cameras. Answer yes or no. Next, please **enter the expected latitude, longitude, and altitude** at your observing site. You'll need to come back and update the lat/lon/alt using your GPS on eclipse day when you select your actual observing site, since even small differences can shift the eclipse time significantly. Click the OK button when

you're done. This will update the displays to reflect your location. Finally, the Hardware Configuration dialog will pop up. For your first camera, enter a short descriptive name (like 5D2 instead of Canon EOS 5D Mark II), and select the camera from the dropdown list. If using a fixed or manual aperture lens, enter the aperture of the lens so that the Q and EV calculations will be correct. Enter the focal length of the lens (the focal length may be used in future versions of the software). If using a shutter cable, select the box and click the "Shutter Settings" button and enter the required information. If using a Shoestring DSUSB/DSUSB2, drop down the 'Cable Type' box and select the appropriate item. Most serial cables are 'RTS' (DB9 connector pin 7) type. Finally, click OK to the Hardware Configuration and restart the software.

If you purchased the Pro version, now go to the Help | Enter Serial Number menu and enter your information and restart. Then you may configure additional cameras through the Hardware Configuration dialog in a similar manner as the first.

5. **Check that the calculated event times are reasonable.** Select 'Location/Time' and then the 'Local Circumstances Table...'
menu option. Check the values shown against another source, like your tour operator's predictions or the NASA bulletin. The times should be close to what other people are using. Don't fret if they aren't an exact match because this program calculates circumstances much more accurately than most other people, but if they are way out then check your coordinates. Note that all times in Eclipse Orchestrator are in UTC (aka GMT or Zulu time), to avoid confusion over local time zones versus the laptop's time zone.
6. At this point you may want to browse around the various menus to customize the settings of the more advanced options, see elsewhere in this help file for a description of each menu item.

7. Now you should **test the cameras**. Click the 'Camera' menu, select the 'Push Shutter' option, and then pick one of the cameras that are listed. Hopefully you will hear the camera take a picture, and the camera's memory card light should illuminate to indicate that it's saving a photo to the card. If the camera doesn't work, recheck the connections, play around with the hardware configuration, etc.
8. Now you need to **start developing a camera script**. The script is a text file that tells the software when to take photos with what settings. Click 'File | Script Wizard'. And modify the information as you feel fit. When completed, you will have a basic script which can be used as a starting point. Now go to the 'File | Edit Script' menu option and a large dialog will launch. You can scroll through all of the scheduled exposures, modify settings, change comments, etc. If you wish to adjust shutter speed, aperture, or ISO while holding the Q/EV (effective exposure) constant, you will need to adjust another of shutter speed, aperture, or ISO to compensate. You can click the 'Opt' button at left, (typically showing ... or a letter) to access choices such as duplicate, delete, or advanced timing options.
9. Alternatively, you can use one of the included scripts as a starting point. `basic.csv` is a very simple script to get you started. `deluxe.csv` shows most of the possible features of the scripting language. Your script will probably end up somewhere in between. The "Notepad" editor should be launched with the file you selected. Browse through the file. If a script line starts with the character '#' that line is a comment that is ignored by the software. Otherwise each line has comma delimited fields specifying information. The first task you need to do is update the camera names, since odds are that you aren't using the same camera as these stock scripts. Do a find and replace or a manual change of the camera name from 'EOS 5D' to your camera's name. This name must EXACTLY match the

nickname/description given in the hardware configuration dialog. Another thing that must match EXACTLY is the file type/quality setting, so be sure to check the Edit Script dialog to see what you can pick from. Go ahead and start modifying the script to whatever you desire. Keep in mind that the eclipse predictions could be in error up to 1-2 seconds, so allow for some leeway around contact times (or just take a bazillion photos to cover all possibilities). When you're done, be sure to save it.

10. To **test the script out**, select 'Time' and then 'Simulated Time...' or 'Simulated Second Contact'. The software time will jump ahead while leaving the PC clock alone. You should hear your camera clicking away taking photos according to the script. After a while, stop the script (do 'Location/Time | System Time', or 'File | Close') and compare the files stored on the camera to your script. You can also select 'File | View Exposure Sequence' and 'File | View Log' for lists of the planned and actual exposures taken. Pay attention to 'late by' values that are more than 0.5 seconds or so: delayed images indicate that your script is too aggressive. Take some stuff out or respace them and try again. Without using a serial port shutter cable, you may need to back off to 2-6 seconds or more in between exposures depending on the camera model, computer speed, and memory card speed.

A REALLY IMPORTANT POINT is to sanity check the camera's exposure/aperture/ISO settings. Surprisingly, sometimes the EXIF or camera screen data can be incorrect compared to what the camera actually took. I like to set up a "simulated eclipse" where I point and focus the camera on a lit diffuse light bulb, with a box or some other object situated near the camera partly blocking the light bulb. This allows me to make sure that the exposure, aperture, and ISO really did change from exposure to

exposure. The extent to which the box is in focus gives a clue about what aperture was used. At the end of a test I download the memory card to the computer to check the files carefully.

11. Once you've got a script you're happy with, **do a full end-to-end test**. Pretend it's eclipse day, set up everything. Set the simulated time to be a little before first contact or whatever and let the setup run non-stop all the way through your entire sequence. You want to make sure nothing goes to sleep, no batteries die, no memory cards fill up, the cameras don't spontaneously go to sleep or disconnect due to loose cables, etc. You should also practice removing solar filters and measure how long that takes to complete.
12. Once you're happy, make a backup copy of the script, that you can refer back to in case you screw it up later. Hint: use "Save As...".
13. To guard against bad weather where you may only get a quick glimpse of the eclipse through a hole in the clouds, you may wish to create an "emergency" script. It should be a bare-bones script that does a quick full range exposure bracket. An example is included as Scripts\emergency.csv. Once loaded into the program via *File | Set Emergency Script...*, it can be launched with a push of the F12 key. The previous script will be reloaded and continue on once the emergency sequence completes. It is OK to launch the emergency script again after it finishes, if the hole in the clouds is large enough, and you have the presence of mind to do it!

The day before Eclipse Day

1. Make sure your computer doesn't have sleep/hibernation/screen savers etc. enabled.
2. If you're already at the eclipse site, take GPS readings and update the lat/lon/altitude dialog. If you have a GPS connected and configured you can just go to the 'Set Lat/Lon/Alt...' dialog box and click "Take GPS" to copy the GPS readings.
3. If you have time, do a final test of the script.
4. Charge your batteries, make sure cables are working, etc.
5. Put fresh/empty memory cards in your cameras. Clean the lenses, etc. On early 1-Series Canon cameras, make sure to reset the file counter if it's getting close to rolling over.

On Eclipse Day

1. **Connect and power everything up.** Don't do it too early or you'll deplete your batteries! If you are connecting a Kestrel 4000, set it to Auto Store On, Store Rate 2 or 5 seconds, and Overwrite On.
2. For USB/Firewire control, set the camera to manual exposure ("M" mode) and manual focus. Set the "Auto Power Off" mode OFF or disabled. Turn off Auto Exposure Bracketing mode.
3. Start the software and **check or update your final position based on GPS**, in the 'Location/Time' 'Set Lat/Lon/Alt...' menu. If you're on a moving ship and have a GPS connected, hitting F6 will read the latest position and recalculate everything. If you don't know the intended coordinates at mid-eclipse, do this every once in a while to keep the position current.

4. **Check that the computer time is correct.** It should be set to 'Location/Time' 'System Time' and the UTC display in the upper left should be correct. Check it against a good timing source, like a GPS. If no GPS is connected and the computer clock is incorrect, fix it or use the 'Setup' 'Clock Error Adjustment...' feature to fudge the clock until it reads correct.
5. Make sure you've configured everything (software options, camera settings, memory cards, cabling, etc) the same as when you tested the setup. Today is not the day to make any big new changes.
6. **Load your script.**
7. As you progress into the partial phases, **keep an eye on the camera.** Make sure it stays pointed at the Sun. Make sure there is enough space left on the memory card for the rest of the eclipse. Depending on the transparency of the sky and altitude of the Sun, you may need to edit the script to adjust the exposure time of the partial phases to an optimum value. Check the focus of the cameras now and then. Tape the focus ring and AF/MF switch so they can't be bumped. Do not let anyone else handle or look through your camera. Make sure cables are routed or tied down so someone won't stumble over them.
8. If you need to change the battery or memory card on the USB/Firewire connected camera, exit the software. Turn the camera off and do whatever you need to do. Turn the camera back on, wait for it to connect to the computer (usually accompanied by a ding or other notification sound), wait another 30 seconds or so for good measure, then restart the Eclipse Orchestrator software, and check that the camera is again doing script items (or hit F1-F4 keys to manually fire the shutter). There is normally a 10-15 second delay after starting the software before it will be ready to take photos, during which time photos may be dropped.

9. Once you get **within 5 minutes of totality, stop checking the computer or camera.** If a problem crops up you will not have time to fix it, so just sit back and enjoy the eclipse. The excitement of totality often causes people to make mistakes or misperceive things, so it's now too late to be messing with complicated software or making last-minute changes. Trust me, don't do it! You may think it's broken, but usually it's actually not!
10. REMEMBER TO **TAKE SOLAR FILTERS OFF RIGHT BEFORE SECOND CONTACT.** This is the MOST likely thing to go wrong, because it's up to you to remember to do it. Don't let all of this fancy camera automation spoil you so much that you forget to take the filters off. The sound file playback feature was added for the sole purpose of having the computer remind me to take the filter off.
11. Watch totality!
12. Conversely, after totality make sure you **put the filters back on.**
13. After the eclipse: exit the software, shut down the computer, turn off the cameras, disconnect them, and **clean up.** Enjoy your photos and start planning your next eclipse trip.

Program Installation

1. Download the msi installation file to an empty directory on your disk.
2. Double click the msi file to launch the installer.
3. Follow the menus, changing installation preferences as needed.

Uninstalling the Software

1. Exit or close the Eclipse Orchestrator program.
2. Windows XP: Go to Start | Settings | Control Panel | Add or Remove Programs.
Windows Vista: Go to Start | Settings | Control Panel | Programs and Features.
3. Select Eclipse Orchestrator.
4. Click the Remove or Uninstall button.

Moving the Software to a new computer

1. Install the software on the new computer as you did on the old computer.
2. Copy the contents of the following folder from the old, to the new computer in the same location:

Windows XP and earlier:

C:\Program Files\Eclipse Orchestrator\Config

Windows Vista/8/10:

C:\Users*<username>*\AppData\Local\Moonglow Tech\Eclipse Orchestrator\Config

Troubleshooting & FAQ:

Q: My camera skips exposures or locks up!

A: You are trying to take too many exposures too fast:

- Space it out more. For the slowest cameras, three seconds or more may be needed.
- Buy a faster memory card.
- Enable the 'Incremental' checkbox in the Script Editor for most of your exposures, so that only CHANGES in exposure settings are transmitted to the camera.
- Consider upgrading to Eclipse Orchestrator Pro AND using a serial shutter cable (in addition to the USB connection).
- Determine the minimum time spacing between exposures that works reliably, by trial and error. Enter this spacing value in the Hardware Configuration's 'Recycle Time' box. Then use the Script Visualizer to scroll through the list of exposures and look for warnings about when the spacing between exposures is too short.

Q: I told the camera to take a photo of exposure time X but it took one of length Y?

A: This is almost always caused by too short of a time between exposures (see previous question). This can especially happen when Incremental is enabled and an important setting was missed because of short spacing. We recommend sprinkling non-incremental exposures throughout your script to recover from such problems during the eclipse.

Q: When using multiple Canons, why do I see '*Waiting on another camera*' in the status so often?

A: Unfortunately, the Canon driver only allows one camera to be commanded at a time. This message means that the camera has a

pending exposure that is being delayed because a different camera has not yet completed its exposure. Try changing the pattern of exposures in your script - 3-4 exposures on camera one, 3-4 exposures on camera two, then back to camera one may work better than alternating between cameras after only one exposure. Otherwise, space out the exposures more.

Q: What do I do when the battery goes dead on a camera?

A: Close EO (if it hangs, press Ctrl-Alt-Del, select EO, click End Process). Change the battery, wait for the camera to be recognized by the PC, then restart EO.

Q: My camera is not recognized!

A: There could be any number of causes:

- You started EO before the camera was recognized by the computer. Connect and turn on the camera, then wait until a dialog box or ding confirms the computer sees the camera, then start EO.
- Check that you are using the latest version of Eclipse Orchestrator, and whether the camera is officially supported.
- Check that no other software is trying to access the camera.
- If it's a Nikon, check the camera is set for PTP or MTP, not mass storage.
- If it's a Canon 5D, 20D, or 350D, check the camera is set for PC Connection, not PTP.
- Check that the USB cable is firmly connected and if the camera works OK with any other software.
- If running multiple cameras, remove the other cameras and see if that fixes the problem.

Q: The camera is recognized, but won't take a photo!

A: Perform the following checks:

- Is there free space on the memory card?
- Is the 'busy' light on the camera? It may be flushing exposures out to the memory card.
- If you are using a serial shutter cable, verify its COM port, COM bit and press time are set appropriately.
- Press F1 or select Camera | Push Shutter | *(camera name)*. This confirms whether basic shutter control is possible. If this doesn't work, try restarting your computer and the camera.
- Select Camera | Single Exposure with Settings | *(camera name)*. This confirms whether exposure control is possible. If this works, the problem is with your script. If Push Shutter worked but this didn't, please contact our support staff with a description of the steps and results you've taken to get here.

Q: It worked before, now it's not working, why?

A: Try these:

- Check that 'Auto Power Off' is disabled on the camera.
- Check that a camera battery hasn't gone dead.
- Make sure that your laptop doesn't go into sleep mode or hibernation while EO is running.
- Close EO and disconnect all cameras. Reboot the computer. Turn the cameras back on and wait for them to be recognized by the PC. Then start EO.

Q: I'm using a serial shutter cable and it's not working reliably.

A: On the Hardware Configuration screen click 'Shutter Cable Settings' then examine the 'Shutter Press Time (ms)'. This determines how long the shutter button is electronically pushed down. If you set it too long, the camera will take two exposures. If you set it too short, the camera won't take an exposure at all. So this value requires some experimentation for best results. On slow (3fps) cameras, try about 150ms. On fast (8fps) cameras, try about 50ms.

Q: Why are old Nikons not supported?

A: They work significantly different from newer models and demand has not been high enough to justify the significant development effort needed to add support for them.

Q: My GPS doesn't work!

A: Try different baud rates in the Hardware Configuration menu. 4800, 9600, and 19200 are most common. Beware of GPSes that reset their baud rate after changing their battery. Some models of GPS need to be set for NMEA output instead of their own proprietary format.

Other suggestions:

If the program acts weird or unpredictably or has garbled displays, go to the Config directory, delete the config.ini, setup.ini, and filetype2.ini files, then reenter all your configuration and preferences.

Directory locations:

Windows XP and earlier: C:\Program Files\Eclipse Orchestrator

Windows Vista: C:\Users*<username>*\AppData\Local\Moonglow
Tech\Eclipse Orchestrator

Shipborne Observation

When aboard a moving ship, your position will slowly change. Without frequent updates to your position from a GPS, the contact time predictions will grow more and more inaccurate.

With a GPS connected to the computer, we recommend enabling the 'Follow GPS position' feature on eclipse day to cause the script to be reloaded about once a minute to reflect the event times at your current position. Alternatively, you can manually pull your position from the GPS by hitting F5 periodically.

If no GPS is connected, we recommend manually keying in your current position, shortly before first and second contacts. If no GPS is available, contact the Captain or your trip organizer for the expected lat/lon at maximum eclipse.

Airborne Observation

Aircraft move very fast and can have unpredictable course changes. Eclipse Orchestrator does not currently support the algorithms necessary to accurately predict an aircraft's position at a future time. We recommend contacting the organizer of your flight to obtain a list of times for each eclipse contact event, and then manually programming them into EO by entering them at the beginning of the script file, or temporarily via the 'Location/Time | Event Times...' dialog. Once you have manually programmed them in, DO NOT connect a GPS or update your lat/lon position as this will overwrite the event times you entered manually.

Main Screen Description

First line (date/time):

- Date
- Time
- GPS Pulse Per Second status
- Clock error
- Standard deviation of GPS time measurements in seconds (less than 0.1 second is good)

Second line (script filenames):

- Script name
- Emergency script name

Third line (position information):

- Latitude being used for displays and local circumstances calculations
- Longitude being used for displays and local circumstances calculations
- Altitude being used for displays and local circumstances calculations

Fourth line (GPS information):

- GPS status
- Satellites in use / viewable satellites
- Estimate position error
- GPS receiver temperature (Garmin GPS18-LVC only)
- GPS heartbeat, changes at every received packet.

Sixth line (type/duration):

- Eclipse type at this location (Total, Annular, Partial)
- Penumbral duration at this location
- Umbral (totality) duration at this location

Seventh line (centerline information):

- Distance to eclipse center line (not necessarily the distance to the line of maximum duration)
- Bearing to the center line, measured east of true north.
- Duration at the nearest point on the center line.

Event information:

- Event name
- Countdown to the event
- True altitude of center of Sun at that event (not refracted apparent altitude)
- Azimuth of Sun at that event (east of true North)
- Contact North angle (P) at that event
- Contact Zenith angle (Z or V) at that event
- Eclipse magnitude at that event
- Moon/Sun size ratio at that event
- Extinction factor at that event (1 = no extinction, 2 = you should double your exposure times, etc)

Current local circumstances:

- Eclipse type now
- True altitude of center of Sun now
- Azimuth of Sun now
- Eclipse magnitude now

- Extinction factor now

Camera settings:

- Camera nickname
- Action
- Exposure time
- Aperture (Focal ratio)
- ISO
- Q or EV (exposure value), depending on the selection in the View menu.
- Mirror lock up wait time
- File size/quality
- Camera status or current activity.

Upcoming script items:

- Countdown until the item executes
- UTC HH:MM:SS.S when it executes
- Camera that will be used
- Action
- Exposure time
- Aperture (Focal ratio)
- ISO
- Q or EV (exposure value), depending on the selection in the View menu.
- Mirror lock up wait time
- File size/quality
- Incremental
- Comment

Main Window Menu control descriptions

File menu:

- **Script Wizard** - Launches the script generation wizard, to automatically create a script customized to your camera and location.
- **Open** - Load a script.
- **Edit** - Open the built-in script editor.
- **Edit in Notepad** - Open Notepad with the script file so you can modify the plain text script.
- **Reload (F5 key)** - Rereads the script file. Use this after you've edited the script in Notepad.
- **Visualizer...** - Opens the Script Visualizer, to graphically display your script.
- **View Exposure Sequence** - Opens Notepad with the script_debug.txt file, which shows a list of exposures scheduled after the current point in time. If you are using simulated time, for example at second contact, then exposures before second contact will not be listed. To see the complete list, use Real Time, or set the simulated time to a point before the first exposure.
- **View Log** - Opens Notepad with the actual_times.txt file, which shows a report of when exposures actually fired.
- **Generate MMV Cba File** - Creates .cba files in support of the [MMV project](#), if you are submitting your images to them in accordance with the [instructions](#).
- **Save** - save script.
- **Save As** - save script to a new name.
- **Close** - unload the current script, halting execution of exposures. Also can be used to create a blank script from scratch.

- **Set Emergency Script** - load an "emergency script", which can be invoked with a single keypress. Used to be prepared for a hole in the clouds, an emergency script is typically just the essentials, a quick bracket across a wide range of exposures.
- **Close Emergency Script** - unload the emergency script.
- **Exit** - terminate the program.

Location/Time menu:

- **Set Location... (F8 key)** - View or modify latitude, longitude, and altitude.
- **Update Location From GPS (F6 key)** - If a GPS is connected, update coordinates, then recalculate local circumstances and event times and reload the script.
- **Follow GPS position** - When a GPS is connected and working, recalculates local circumstances and reloads your script approximately every 60 seconds. Intended for use aboard a moving ship.
- **Real Time** - The software clock matches the PC clock (except for the optional clock error correction), this is "real time" and is what must be used on eclipse day.
- **Simulated Time...** - Use this to test your eclipse scripts, it sets the software to an arbitrary time without changing the PC clock.
- **Simulated Second Contact** - Sets simulated time to 45 seconds before second contact, for a convenient way to test the central portion of your script.
- **Event Times... (F7 key)** - View/edit event times for sunrise, sunset, first through fourth contacts, and maximum eclipse. If you wish to override automatically computed times, enter the event times into the script, and then make sure never to select "Update Location From GPS" or "Set Location..." or to change "Refraction Correction" or "Limb Profile Correction" as touching

any of these will wipe out your override (until you reload the script).

- **Local Circumstances Table...** - launches Notepad with a table of contact times for the current location.

Camera menu:

- **Push Shutter (F1-F4 keys)** - Takes a photo on the selected camera with the current exposure settings.
- **Single Exposure w/ Settings** - Allows you to select exposures settings for one photo and then take it.
- **Global Exposure Compensation...** - Allows you to make a mass, global change to all exposure times in the script, in case of clouds or haze. It does NOT modify the script file itself, so the nominal times will still be shown in the script editor.
- **Launch/Stop Emergency Script (F12 key)** - Starts/stops executing the emergency script. NOTE: If there are unsaved changes in the main script, they are saved to disk (overwriting the original) before the emergency script launches.

View menu:

- **Scale Font Size** - When enabled, scales the main window font size to match the window width, otherwise uses a small fixed font.
- **EV units** - Display EV (exposure value) in the upcoming exposure list.
- **Q units** - Display Q (similar to EV except referenced to ISO 1) in the upcoming exposure list.
- **Kestrel Plot Width** - Chooses the time span of the weather plots.

Setup menu:

- **Hardware Configuration...** - Use this to tell the software what equipment you are using.
- **Support Old Canons** - Check this to enable support for year 2000-2003 Canon cameras (1D, 1Ds, 10D, D30, D60, 300D).
- **Clock Error Adjustment...** - Apply a static correction to the PC clock to easily cancel out any timing error.
- **Rapid Screen Update Rate** - Normally on, this causes the displays to update every 0.1 second. Turning this option off will cause updates only every 1 second, for slower computers or if you are bothered by the rapid activity.
- **Show Contact Times** - If checked, then on the main screen the UTC and system times will be shown for each contact instead of a countdown timer. Note that system (computer) time is used. If you want to display local time, you will need to modify your computer's time zone setting to match the local time zone (right click the clock on the far lower right of your screen in the taskbar, and select Adjust Date/Time).
- **Refraction Correction** - Correct eclipse event times for refraction.
- **Limb Profile Correction** - If a limb profile correction data file is present, adjust the times of second and third contact to account for limb profile effects.
- **Limb Profile Data Source** - Select older and poor accuracy Watts profiles, or new and very accurate LRO/Kaguya profiles.
- **Choose Event** - Choose which set of Besselian elements to use in local circumstances calculations.

Window menu:

- **Basics** - Show or hide basic information in the main window (time, date, scripts, location, GPS status).
- **Details** - Show or hide detailed eclipse information in the main window (duration, centerline data, countdown to events).

- **Exposure Schedule** - Show or hide the list of camera settings and upcoming exposures.
- **Simulated View** - Show or hide the separate simulated view / countdown window.
- **Map** - Show or hide the separate map window.
- **Live View** - Show or hide the Live View window. NOTE: When the live view window is displayed, all scheduled exposures are dropped. Scheduled exposures will resume when the live view window is closed.
- **Kestrel Data (F11 key)** - Opens or closes a separate window that plots weather parameters downloaded from a Kestrel weather meter. Vertical lines in the plots mark event times and the current time.
- **Lunar Limb** - Show or hide the Lunar limb display.
- **Sky** - Show or hide the Sky View window.
- **Baily's Beads** - Show or hide the Baily's Beads simulation window.

Help menu:

- **Help Topics** - Open the help file.
- **Purchase EO Pro** - Allows purchase of Eclipse Orchestrator Pro from within the application.
- **Enter Serial Number** - Enter your registration details here to activate Pro features.
- **About** - Display the program version and other information.

Map View

Duration map:

- Primarily just eye candy, this map can also be used to determine where to move to increase your eclipse duration.
- Your current location is in the middle of the image at the white cross.
- North is up.
- The map width is shown in the map title bar in kilometers.
- Locations with a longer umbral duration than your set location are shown in green (go here).
- Locations with a shorter umbral duration are shown in red (stay away).
- Locations with no totality are shown in light blue.
- Locations with no eclipse are shown in dark blue.
- Zoom out far enough and locations not on Earth are in black.
- The map is fairly accurate, taking refraction and limb corrections into account when possible. Near sunrise/sunset at the ends of the eclipse track the map accuracy falls off, and it does not model a sunrise or sunset during totality.
- You may optionally overlay a moving shadow.

Satellite Image map:

- Your current location is in the middle of the image at the white cross.
- North is up.
- The map width is shown in the map title bar in kilometers.
- This is a near-true color map of the Earth. Full resolution is about 500 meters per pixel, although the standard installation file only includes a select few areas at that full resolution. Full resolution for the full planet can be downloaded separately.

- You may optionally overlay a shaded umbral path, and/or a moving shadow.

Map Window Menu control descriptions

Data menu:

- **Duration** - Switches map to duration view. Green areas have longer duration than your location. Red locations have shorter duration. Blue areas are not in the path of totality.
- **Satellite Image** - Switches map to satellite image.
- **Umbral Shadow** - overlays an animated umbral shadow.
- **Umbral path** - overlays a shaded umbral path.
- **Areas With Longer Duration** - on satellite maps, overlays a green zone where the eclipse has a longer duration than your current location.

View menu:

- **Zoom In Map (F9 key)** - Zooms in the map by a factor of 2.
- **Zoom Out Map (F10 key)** - Zooms out the map by a factor of 2.
- **Zoom Default** - Reset zoom to default.

Live View Description

- Once a camera is selected, this window shows a live image from the camera. The exposure will typically match the exposure settings of the most recent image taken. If the image is too dark or light with a Canon, go to the main window and select Camera | Single Exposure w/ Settings | (Camera Name) and modify the exposure setting. With a Nikon, close and restart Live View.
- If enabled, a sharpness metric will be displayed in the upper left. Larger numbers indicate better focus. Adjust manual focus to achieve the highest value.

Live View Window Menu control descriptions

Camera menu:

- **(Camera Name)** - Begin showing live images from this camera. If no cameras are listed, then Live View is not supported for those cameras.
- **Stop Live View** - Closes the Live View window and resumes scheduled exposures.

Exposure menu:

- **Set Exposure...** - Adjust the exposure of the Live View image, but do not take an exposure. Please note that the exposure selection is not saved after Live View is stopped.
- **Take Picture** - Take an image and store it to the camera memory card.

Settings menu:

- **Grid** - Overlay a thirds grid to assist in centering and composition.
- **Sharpness** - Overlay a sharpness metric. Larger numbers indicate better focus. Adjust manual focus to achieve the highest value.
- **Zoom In** - Zoom in the display.
- **Zoom Out** - Zoom out the display.

Sky View Window

- This window shows the entire sky, as it would appear through a circular fisheye lens pointed upward. Depending on the option selected, either North will be at the top, or the Sun will be at the bottom. When the 'Sun Down' option is selected, the view at the bottom portion of the display is correctly oriented for an observer facing the Sun.
- The background sky may be displayed as plain blue, or as a sophisticated simulation of the 'twilight effect' seen during total eclipses in which the Moon's shadow darkens the atmosphere. The sky can be set to second contact, maximum eclipse, or third contact.
- Gridlines may be displayed: local Altitude/Azimuth, Right Ascension and Declination, and the Ecliptic.
- Stars to magnitude 2.5 may be displayed, optionally with labels.
- Visual planets may be displayed, optionally with labels.
- The Sun will be portrayed as a small cartoon of the corona. For solar minimum eclipses, the longest streamers typically align with the Sun's equator, and are depicted as such.

Sky View Window Menu control descriptions

View menu:

- **Sun Down** - Orient the display such that the Sun is shown at the bottom. This makes it correct for someone facing the Sun.
- **North Up** - Orient the display such that North is up, like conventional maps. This makes it correct for someone laying on their back, head towards North.
- **Alt/Az Grid** - Show gridlines of 22.5° in altitude and azimuth.

- **RA/Dec Grid** - Show gridlines of 3 hours in right ascension and 45 degrees of declination.
- **Ecliptic** - Show the Ecliptic.
- **Labels** - Show labels for bright stars and planets.

Sky menu:

- **None** - Show the sky as a uniform blue background.
- **Low Res** - Show the sky as a simulation of the sky during the eclipse. Resolution is 120x120 pixels, 4km steps through the atmosphere.
- **High Res** - Show the sky as a simulation of the sky during the eclipse. Resolution is 360x360 pixels, 1km steps through the atmosphere. On slower computers, this calculation may take many minutes.
- **Second Contact** - Show the sky as seen at second contact (only of Low Res or High Res is selected).
- **Maximum Eclipse** - Show the sky as seen at maximum eclipse (only of Low Res or High Res is selected).
- **Third Contact** - Show the sky as seen at third contact (only of Low Res or High Res is selected).

Baily's Beads Window

This window allows you to simulate the appearance of Baily's Beads, either at preset times or matching the times of appropriate exposures in your script. Script exposures occurring within 60 seconds either side of totality (or for partials, maximum eclipse), with an exposure Q greater than 8.5 will be considered for simulation, as long as the eclipse maximum magnitude is more than 99%.

The simulation is done using an oversampled pixel grid, so there are limits to its accuracy. Large scale details will match well, but very small brightness features may be over or under emphasized.

Baily's Beads Window Menu control descriptions

The maximum eclipse magnitude must be more than 99% to use the Baily's Beads simulation.

File menu:

- **Save Image...** - Save the currently displayed Baily's Beads image to a JPEG or PNG format file, without overlaid text.

Display menu:

- **2nd Contact Sampler** - Show the second contact Baily's beads at seven fixed times.
- **3rd Contact Sampler** - Show the third contact Baily's beads at seven fixed times.

- **2nd Contact as Scripted (Camera 1)** - Show the second contact Baily's beads at times programmed in your script for Camera 1. The camera must be connected. Exposure is not modeled (your exposure settings are ignored). Any exposure with Q over 8.5 will have its time simulated.
- **3rd Contact as Scripted (Camera 1)** - Show the third contact Baily's beads at times programmed in your script for Camera 1.
- **Arbitrary Time...** - Show the Baily's Beads at the time specified, relative to C2, MAX, or C3. Areas outside the path of totality must reference MAX.
- **None** - Turn off the Baily's Beads display (useful on very slow computers).

Settings menu:

- **Oversampling...** - Set the level of oversampling for the Baily's Beads image. Larger numbers are more accurate, but slower and require more memory. Some computers may not even be capable of rendering at the highest oversampling settings.

Simulated View Description

Countdown display:

- Displays countdown until next event in large letters.

Sun Image:

- Zenith is up (view matches what you see through binoculars)
- Red tick mark denotes celestial north direction, which equatorially mounted telescopes will track. Two light tick marks show the Solar equator, along which a Solar minimum corona will probably extend, and along which SOHO spacecraft images are aligned. Note that the Solar equator can be as much as 7.25° from the ecliptic plane.
- The display is rather crude and just for general situational awareness. It does NOT accurately depict contact times, and does not consider Baily's Beads, refraction, etc.

Limb Profile Window

- The blue outer wiggly circle is the profile of the Moon's limb, the actual mountains, valleys, and craters on the surface seen edge on. With EO Pro, pointing your mouse at the limb tells you the name of the lunar feature you are seeing.
- The inner red line is the contact time correction curve, the amount of time change that the effect of the lunar limb has on second and third contacts in a total or annular eclipse. Again, mousing over the curve in EO Pro gives you the name of the lunar feature that determined that portion of the curve.
- Pointers for the Moon's north pole, second and third contact points, and the observer's local zenith (up) are also included.
- In the upper left is some general data: the Moon's libration angles, the source of the data (LRO/Kaguya or Watts), and the name of the lunar features at the C2 and C3 points.
- For example, if you see "C2 Determined by Mare Orientale", then the last light of second contact just before totality will be coming through the basin known as Mare Orientale.

Description of the script file format

Fields are comma delimited. Lines can be in just about any order with a few exceptions (times are calculated and sorted based on your latitude/longitude location). A '#' character in the first column indicates that the entire line is a comment that should be ignored.

Action

- TAKEPIC - set the camera to a specific exposure and take a photo
 - RELEASE - just push the camera shutter to take a photo without modifying exposure settings. When used with a serial port shutter cable, a value in the Exposure field determines how long to hold the shutter down (with questionable accuracy due to the nature of the Windows OS).
 - SETEXP - set camera to specific exposure, do NOT take a photo. Not supported in script editor.
 - PLAY - play a wav format sound file
 - DOWNLOAD - download weather data from a Kestrel weather meter
 - SERIAL - Send a serial string over one of the serial ports
 - COMMAND - Execute a string on the command line, to call an external application.
-

Date / Reference Event

Event times:

- RISE - Sunrise (warning: simplistic calculation, not very reliable)
- C1 - first contact (start of partial eclipse)
- C2 - second contact (start of total eclipse)
- MAX - maximum eclipse
- C3 - third contact (end of total eclipse)
- C4 - fourth contact (end of partial eclipse)
- SET - Sunset (warning: simplistic calculation, not very reliable)

Other possibilities:

- LAST - Reference the time to the last exposure in the **previous line** of the script.
- YYYY/MM/DD - absolute Year / Month / Day date
- MAGPRE xx - Eclipse magnitude is xx percent, before maximum eclipse. A rudimentary FOR loop is supported, see the example script files.
- MAGPOST xx - Eclipse magnitude is xx percent, after maximum eclipse.
- *event1 percent event2* - For example: "C1 50 C2" means halfway in time between first and second contact.
- EMERGENCY - Upon launching the emergency script, events will be referenced to the time the emergency was declared.
- (blank) - execute immediately upon script load. Does not execute again on Reload, to execute again: restart program or choose "Load Script". Deprecated, usage of this feature is not recommended.

Offset sign

Ignored when absolute Year/Month/Day specified.

- + (after)
 - - (before)
-

Time

This is an offset from the reference event, except when an absolute date was specified, in which case this is the UTC time of day.

- HH:MM:SS.S - hours, minutes, and seconds
 - MM:SS.S - minutes and seconds
 - SS.S - seconds
-

Camera Name

- EOS-1D Mark II (for example). Must match the nickname/description field in Hardware Configuration EXACTLY, including upper/lower case, spaces, dashes, etc. For example: EOS-1D and EOS-ID and EOS 1D are all different.
 - ...
 - ALLCAMS - Perform this exposure on all connected cameras. Due to sequencing, cameras are not guaranteed to fire simultaneously. Not supported in Script Editor.
-

Exposure

Only applicable to USB/Firewire camera.

- 1/4000 - time ratio, a fraction of a second
 - 0.5 - seconds
 - B60.0 - Bulb exposure, 60 seconds long (any exposure prefixed with 'B' is treated as a Bulb exposure, if Bulb mode is available.) Bulb exposures less than 1/10 second are not recommended.
 - 355.0/113 - something like this is technically allowed but ARE YOU NUTS?!
 - ...
-

Aperture

Only applicable to USB/Firewire camera.

- 16
 - 16.0
 - ...
-

ISO

Only applicable to USB/Firewire camera.

- 100
 - 200
 - ...
-

Mirror lock up time

- Seconds to wait after initial push. Ignored unless MLU is enabled. 'N' in the field means don't do MLU at all, even if this camera is supposedly configured for it (dangerous, for use when you are silly enough to think you'll turn MLU on/off in the course of an eclipse). If no value or exactly 0 given, then it defaults to 0.5sec wait between presses
-

File Quality

Only applicable to USB/Firewire camera. Use the built in script editor to see valid combinations for your camera.

Size

No longer used, size is now incorporated in the Quality field.

Incremental

Only applicable to USB/Firewire camera.

- Y - For each successive exposure, only update exposure time, aperture, ISO, OR file type if the setting was changed relative to the last exposure. Use this to cut down the required time between exposures.
- N - Force programming of exposure time, aperture, ISO, AND file type with every exposure. If you are using totally or mostly

incremental exposures, sprinkle a few of these in during lulls in activity just to be safe.

Comment

- (optional) freeform text, no commas allowed. Up to about 128 bytes long. How much gets displayed on screen will depend on your screen resolution.
- Serial command: Semicolon, followed by port number, followed by string. C-style escape sequences allowed (except that octal notation is not supported). Trailing spaces should be escaped: `\x20`.
- Command line command: Semicolon, followed by plain text command.

Log files

A log of the actual times that photos were taken is written to Data\actual_times.txt.

Parsed script is written to Data\script_debug.txt file.

GPS data is captured to Data\data.log file. Fields are (in order): Julian Date, GPS status, Time correction factor (difference between GPS and computer's clock in seconds), GPS temperature (if supported by the GPS), Latitude, Longitude, Altitude, Estimated position error.

Kestrel data is captured to Data\kestrel.dat file.

When NOT using a serial shutter cable on old Canons, image thumbnail is written to thumbnail.jpg.

For some cameras, file types are written to Config\Filetypes2.ini.

Directory locations:

Windows XP and earlier: C:\Program Files\Eclipse Orchestrator

Windows Vista: C:\Users*<username>*\AppData\Local\Moonglow Tech\Eclipse Orchestrator

Requirements

- Windows XP, Vista, 7, 8, or 10 with minimum 800x480 screen. 640x480 is usable but awkward.
- USB or 1394/Firewire port for Canon or Nikon DSLR (optional).
- For high speed shooting, Pro version plus Serial ports and serial-to-camera shutter cables (not included) are required. USB to serial converters are OK and multiple ones can be used, via a USB hub if necessary. In addition to the serial shutter cable, the USB cable to camera is still required.
- USB/1394-connected camera must be set so "Auto Power Off" feature is disabled, and lens must be set for manual focus.
- For utmost timing accuracy, observing site latitude/longitude should be known to within ~200m, and computer clock should be set to within ~0.5s, which requires a GPS measurement on eclipse day.
- Optional connected GPS: Garmin USB such as 18x USB, or any brand serial port connected GPS with minimum required NMEA sentences: GPGGA and GPRMC. Optional sentences: GPGSV, PGRME, PGRMF, and PGRMT.

Accuracy

- With limb and refraction corrections enabled, and using precise GPS coordinates and GPS time at your actual observing site, the contact time predictions should be accurate to +/- 2 seconds or better. Predictions for previous eclipses were usually within 1 second. The dominant timing error is in fact the response time of the camera.
- Accuracy of programmed exposure times (relative to contact times) depends on camera responsiveness, camera file flush rate, and camera buffer size, and can be better than 1 second. Actual exposure times and the real-time timing error is logged.

Limitations

- Only 'M' or 'B' mode supported on USB/1394 camera: no automatic exposure modes allowed.
- Camera scripts are in CSV format and can be edited inside the application, or with plain text editor like Notepad. Opening a CSV script file in Microsoft Excel will corrupt times.
- Only one Canon camera may be shooting at any given time. Nikon allows truly simultaneous camera operation.
- Operation aboard aircraft is not recommended unless someone has computed the eclipse contact times for you and you have manually entered those event times. Operation aboard ship is only recommended when a GPS is connected and "Follow GPS Position" is enabled.

Acknowledgements

Camera interfaces courtesy Canon USA, Inc. and Nikon, Inc.

Eclipse circumstances are calculated using the Besselian elements from Fred Espenak's [NASA Solar Eclipse bulletin](#). Formulas are primarily from Jean Meeus' *Elements of Solar Eclipses* and *Astronomical Algorithms*, with additional algorithms by Fred Espenak, and USNO.

Blue Marble: Next Generation imagery courtesy NASA's Earth Observatory.

Camera interfaces courtesy Canon USA, Inc. and Nikon, Inc.

Kaguya lunar data provided by JAXA. Contact time correction algorithm by Dave Herald.

Lunar Reconnaissance Orbiter LOLA data courtesy NASA.

Stars from Yale Bright Star Catalog courtesy Yale/NASA.

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