

pySkyDarks Guide

What it does

This program provides a very specialized observatory automation process. It connects to an instance of *theSkyX* (Professional Edition) running as a server and controlling your CCD camera. *pySkyDarks* schedules and orchestrates the taking of a large number of flat or bias frames to help you create a calibration library.

How I use it

Here is how I use this program, and what led me to develop it, in case this might help you design convenient workflow of your own.

When using a temperature-regulated camera, dark and bias frames can be collected in advance. I keep a library of such frames at three different temperatures (-15°C, -20°C, and -30°C). Then, I ensure that I'm doing image acquisition with the camera regulated at one of those temperatures, so I can use the already-gathered dark and bias frames for calibration.

I like to do my dark frame acquisition at night. Since my camera has a shutter, this isn't strictly necessary; however, it makes me feel better to do it that way for two reasons:

1. in case there is any minor light leakage around the camera shutter, and
2. because it is generally cooler at night, so the camera cooler doesn't have to work as hard, and lower temperatures can be achieved.

However, I often found myself busy, or away from the house, or just distracted, in the early evening and would forget to get an acquisition session started.

I wrote this program so that I could set up and begin an acquisition session earlier in the day, and the program would wait until an appropriate time, then guide *theSkyX* to do the planned acquisitions. Image acquisition for a large dark and bias frame collection won't finish in one night, so the program keeps track of what it has accomplished, allowing me to run it again on second, third, and subsequent nights, until the complete planned collection has been acquired.

pySkyDarks can run on the same computer where *theSkyX* is running, or it can run on a different computer on your LAN and communicate with *theSkyX* over the network. I use it in this latter mode, running it on a computer in my office, and controlling the observatory computer over the LAN.

Setting up *theSkyX*

To use this program effectively, there are a few *theSkyX* settings that you will need to

prepare.

First, *pySkyDarks* does *not* control where the acquired images are saved. You must use the "autosave" button in the camera control tab in *theSkyX* to specify a path where your images will be saved. You should also ensure that *theSkyX* has a good image file naming convention in place so that your images will be easy to organize the following day. Make sure the filenames include the exposure time, the frame type, and the binning in use.

Finally, *pySkyDarks* can send a "wake on LAN" packet over your local network if desired. I use this by running the program on a separate computer, and having it send the "wake on LAN" packet to wake my observatory-control computer before beginning a session. If you want to use this feature, you have several things to do:

1. You will need to configure your observatory-control computer to respond to "wake on LAN" requests. Not all computers can do this, but most modern ones can. Google will locate appropriate configuration instructions for you.
2. Also, for "wake on LAN" to be useful, you will need to configure your computer so that *theSkyX* automatically launches when the computer starts up. Then configure *pySkyDarks* to wait a suitable amount of time after sending the Wake packet, to give your observatory control computer time to start up and stabilize.
3. Finally, you'll need to know the MAC address of your computer in order to send "wake on LAN" packets to it. Again, Google is your friend if you don't already know how to determine this information.

Using the program

When you launch *pySkyDarks*, you will be presented with a single window that is organized into five tabs, with the tabs across the top. Generally you visit these tabs in order from left to right to fully configure the program.

The first tab, labelled "Start/End", controls when the acquisition session starts and ends.

You can select "now" to have the session start immediately. More often, I select "today" and one of the sun-based times such as "sunset" to have the session start later in the day, as evening falls. If you want time for the air to cool as well as darkness to fall, use one of the "Dusk" settings, with Astronomical Dusk being the latest in the evening.

The screenshot shows the 'Session Start and End' window of the *pySkyDarks* application. The window has a title bar with '(Unsaved Document)' and a menu bar with 'Start/End', 'Temperature', 'SkyX Server', 'Frames Plan', and 'Run Session'. The main content area is divided into two columns for 'Session Start' and 'Session End'. Each column has 'Day' and 'Time' settings. The 'Session Start' column shows 'Day' set to 'Today' and 'Date' as '2020-01-13'. The 'Time' section has radio buttons for 'Sunset', 'Civil Dusk', 'Nautical Dusk', and 'Astronomical Dusk', with 'Civil Dusk' selected. Below this, 'C.Dusk: 17:34' is displayed, and a 'Time' field is set to '10:00 PM'. The 'Session End' column shows 'Day' set to 'When Done' and 'Date' as '2020-01-14'. The 'Time' section has radio buttons for 'Sunrise', 'Civil Dawn', 'Nautical Dawn', and 'Astronomical Dawn', with 'Civil Dawn' selected. Below this, 'C.Dawn: 06:55' is displayed, and a 'Time' field is set to '3:00 AM'. At the bottom, there is a 'Location (for Dusk/Dawn Calculation)' section with fields for 'Name' (EWHO), 'Time Zone' (-5), 'Latitude' (45.309645), and 'Longitude' (-75.886471). To the right of this is a 'When Done' section with checkboxes for 'Warm up CCD for 300 seconds' and 'Disconnect Camera (after warmup)', both of which are checked.

For the sunset calculations to work, you must specify your latitude and longitude, and the offset of your time zone from UTC. For example, I use "-5" since Eastern Standard Time is five hours behind UTC.

The second half of the screen controls when your session ends. "When done" means the session will run until all the frames in your plan are acquired, no matter how long that takes. More commonly, I select "Today / Tomorrow" and one of the sunrise times.

The second tab, labelled "temperature", is used to control and monitor the temperature of your temperature-regulated CCD. The most important field is the first one, where you specify the target cooling temperature for your CCD. In the second field you specify how close to that value you need to be before acquisition begins.

If you're trying to reach very low temperatures in a very hot climate, the camera may be unable to cool that far. So, you can specify a maximum amount of time to try to cool the camera. And, should cooling fail, you can have the program wait a while and then try again. The idea is that the ambient temperature is probably falling as night comes on, so after a while cooling may succeed where it failed the first time.

Finally, sometimes temperature rises through the night, or in the morning, and the ambient temperature might overwhelm your camera's ability to hold at the target temperature, so you can have the temperature monitored, and the acquisition session abandoned, if the temperature rises more than a given amount above your target.

The third tab is used to specify the network settings. Give the IP address or hostname of the computer where your *theSkyX* server is running. You can use "localhost" if *pySkyDarks* and *theSkyX* are running on the same computer. You also need to specify the port number where *theSkyX* is listening, which is 3040 by default. Even if you're running *pySkyDarks* and *theSkyX* on the same computer, you must have the "TCP server" option enabled in your instance of *theSkyX*. While *theSkyX* is running, you can use

The screenshot shows the "Camera Temperature Settings" window. It has a title bar with "(Unsaved Document)" and a menu bar with "Start/End", "Temperature", "SkyX Server", "Frames Plan", and "Run Session". The window contains several settings:

- ☒ CCD is temperature-regulated
- Target Temperature: -15.0 °C
- Within +/-: 0.1 °C
- Cooling Check Interval: 60 seconds
- Max Time to Try Cooling: 1800 seconds
- Cooling Retry Count: 5 times
- Cooling Retry Delay: 300 seconds
- ☒ Abort if temp rises: 1.0 °C

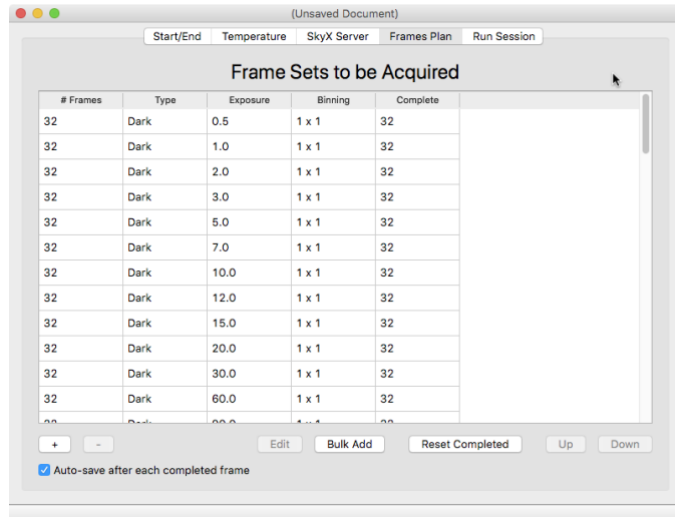
The screenshot shows the "Network Settings" window. It has a title bar with "(Unsaved Document)" and a menu bar with "Start/End", "Temperature", "SkyX Server", "Frames Plan", and "Run Session". The window contains several settings:

- Server Address
- IP Address or host name: 192.168.1.17
- Port number: 3040
- Test Connection button
- Wake on LAN
- ☒ Send Wake on LAN packet before starting.
- Seconds before start: 900
- MAC address: 74-27-ea-5a-7c-66
- Broadcast address: 255.255.255.255
- SendWOL Now button

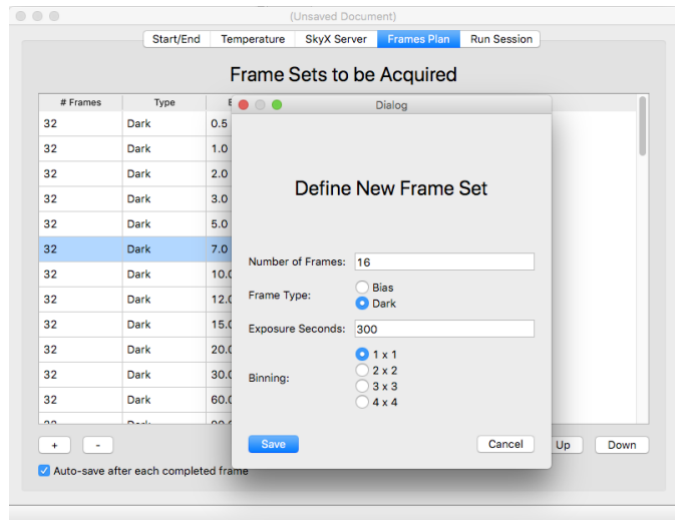
the "test connection" button to ensure that your connections work.

If you want this program to send a "wake on LAN" command at the start of the session, fill in the relevant fields on the right-hand side of this window.

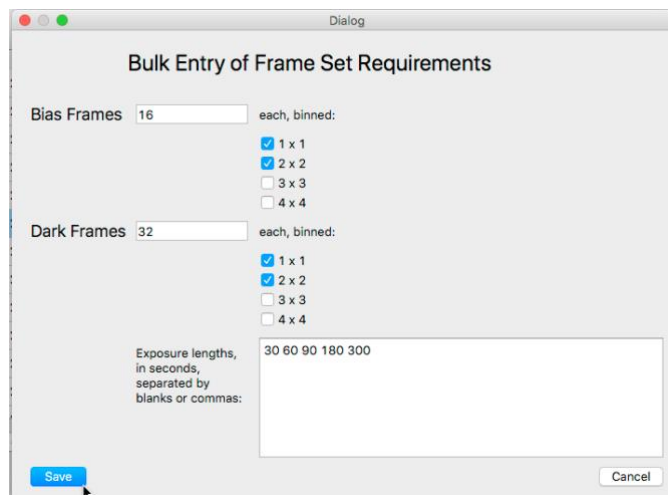
The fourth and most important tab is the "frames plan". This is where you specify what sets of frames you want the program to acquire. A "frame set" is a number of frames with identical specifications. For example, a frame set might be "32 dark frames exposed for 60 seconds and binned one by one" or "24 bias frames binned 2x2".



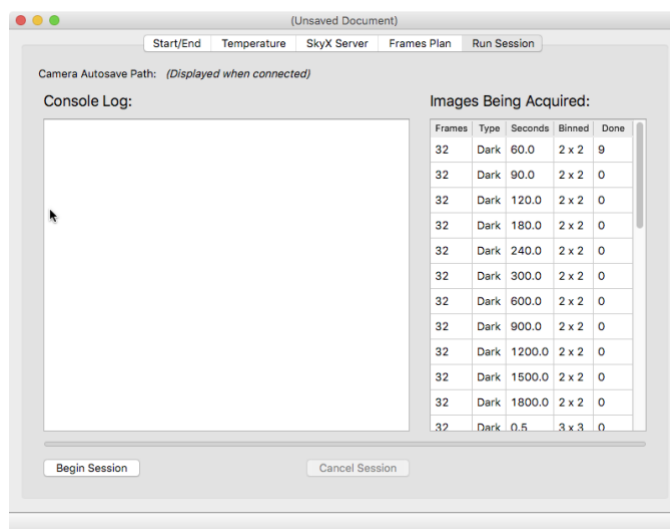
The buttons on this window are used to add, edit, and move frame sets in the plan. You can edit the specification for a single frame set by double-clicking on it or selecting it and clicking the "Edit" button.



To enter a large number of frame set specifications quickly, explore the "bulk add" button. This opens a window in which you can quickly specify how many frames of each type and, for dark frames, which exposures, you want and they then will all be added to the frame sets plan.



Finally, the "run session" tab is enabled only when the minimum necessary information has been filled in. That is, the server address, and at least one frame set. The "begin session" button will begin your acquisition session. Or, if you use the program with a delayed start, it will begin the process of waiting for the appropriate start time, following which the acquisition session will begin.



On the right-hand side of this window is the list of all the frame sets that will be acquired in this session. This list is read-only; the plan cannot be edited from here. The row currently being collected will be highlighted to let you see where you are in the plan. The left part of the window is a log where various informative messages will appear as the session proceeds.

Finally, you can click "cancel session" to stop the acquisition session while it is underway. You can't "Un-cancel", so be careful. However, usually you can resume a session just by changing the Start field to "Now" and then clicking "Begin Session" again.

Normally, when I wake up in the morning, I find that *pySkyDarks* has made some progress in acquiring the frame sets in my plan but is not finished. So, I simply save this file and then reopen and restart it that afternoon for another evening's acquisition. For a large collection of frames, it may take several evenings before everything is acquired.

Of course, if you trust your setup to acquire good dark frames even during daylight, and your cooling requirements are not too extreme, there is no reason you couldn't just leave the program running for as long as it takes.

