

CCD Autopilot (CCDap) and PHD2 Coordination

Overview

The PHD_Broker package provides a way to use PHD2 for guiding and dithering while letting CCDap manage all other aspects of the imaging session. It is a coordination project – not a full integration – in the sense that neither application “knows” about the other. The coordination is accomplished by a “broker” application and a set of batch files that together keep PHD2 and CCDap in-sync. The role of the broker package is to communicate with PHD2 to keep the guiding activity synchronized with what CCDap is doing during the imaging session. For example, guiding will be stopped and resumed whenever CCDap needs to move the telescope (for whatever reason). All of the telescope control features of CCDap that you rely on – slewing, centering, focusing, plate solving, fine-positioning, and meridian flips – will work correctly. In addition, you can initiate dithering at various points in the CCDap session, and the dithering will be performed by PHD2 synchronously – the next exposure in the session will not be started until the dithering is completed. To accomplish the coordination, CCDap will behave as if the session is being run without guiding – even though it is. This means that CCDap session logs will contain no information about guiding performance and will identify exposures as being unguided. You should ignore these messages and just use the PHD2 visualization and logging tools to evaluate your guiding performance. There is also an optional mechanism to let PHD2 and the broker application notify CCDap of things like lost guide star events and large guide star excursions. Depending on how you configure CCDap, you can get e-mail notifications for these events or even trigger an automated shutdown of the session.

Installation

The PHD_Broker package is comprised of several code files and a set of batch files. It does not include the CCD Autopilot program itself, which must be downloaded from the CCDWare web site. The minimum version level for CCDap is 5.09.8 – earlier versions will not work. CCDap should be installed in the normal way without any changes to its location on your hard drive.

The PHD_Broker package is downloaded as a zip file. You should extract all of the files and place them in the ‘Scripts’ folder for CCDWare, located in the CCDap sub-directory of the ‘Documents’ folder. On current Windows systems, the full path will look like:

```
\users\\My Documents\CCDWare\CCDAutoPilot5\Scripts.
```

This folder is created automatically by the CCDap installation, so you should be able to find it. When you are done with the installation, the ‘Scripts’ folder should hold all these files:

| Name | Date modified | Type | Size |
|----------------------------|--------------------|-----------------------|--------|
| broker_control.txt | 5/22/2016 5:11 PM | Text Document | 1 KB |
| IniFile.dll | 8/18/2015 1:35 PM | Application extens... | 8 KB |
| Newtonsoft.Json.dll | 3/20/2016 8:37 AM | Application extens... | 511 KB |
| phd_broker_begin_slew.bat | 3/20/2016 8:39 PM | Windows Batch File | 1 KB |
| phd_broker_dither.bat | 3/23/2016 8:04 AM | Windows Batch File | 1 KB |
| phd_broker_end_slew.bat | 3/20/2016 8:42 PM | Windows Batch File | 1 KB |
| phd_broker_guiding_off.bat | 3/20/2016 8:42 PM | Windows Batch File | 1 KB |
| phd_broker_guiding_on.bat | 3/20/2016 8:43 PM | Windows Batch File | 1 KB |
| phd_broker_pause.bat | 3/23/2016 12:04 PM | Windows Batch File | 1 KB |
| phd_broker_resume.bat | 3/23/2016 12:04 PM | Windows Batch File | 1 KB |
| PHDBroker_Client.exe | 5/21/2016 8:29 PM | Application | 7 KB |
| PHDBroker_Server.exe | 5/22/2016 4:58 PM | Application | 49 KB |

The timestamps on your files may be later than what's shown if updates are issued.

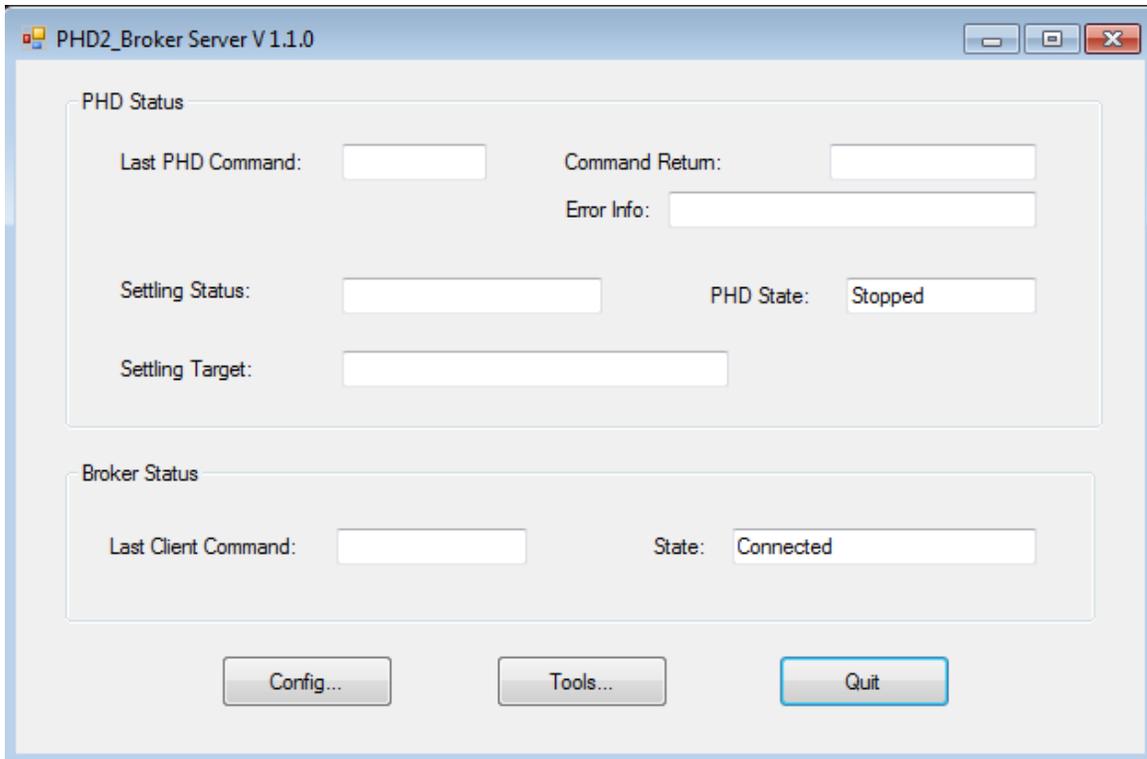
PHD2 and PHD_Broker Configuration

To get started, run PHD2 and load the profile you want to use. Look at the Global tab in the Brain dialog and make sure the dithering parameters are what you want:

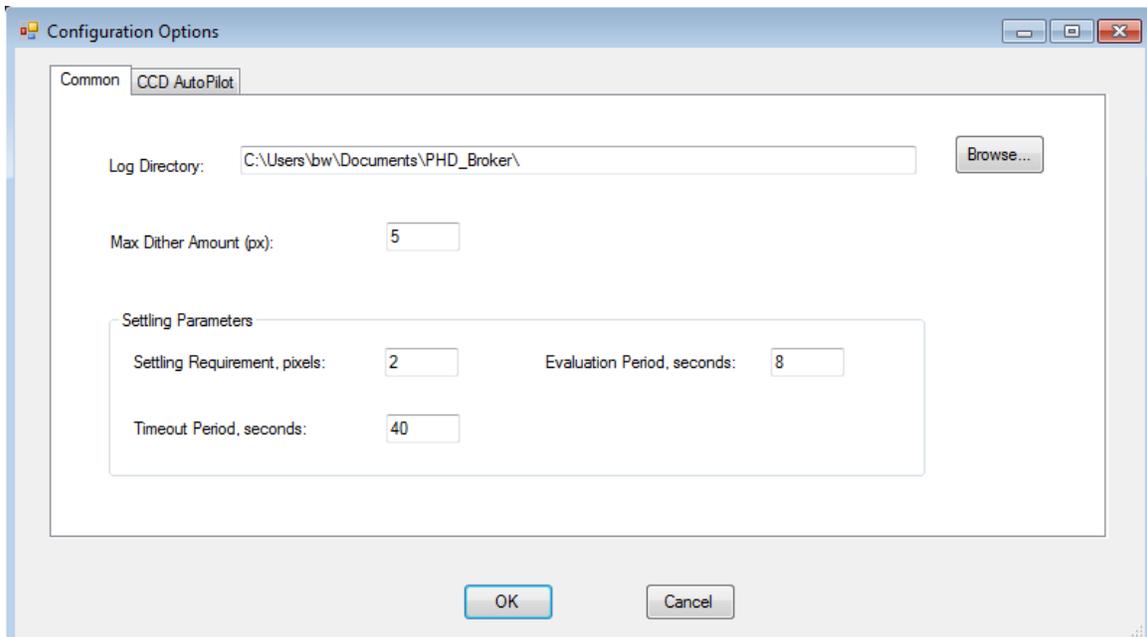


If you're not familiar with the PHD2 dither settings, you should read the help document. 'Spiral' is a new feature in the 2.6.1 development builds that lets you force a spiral (grid) pattern in the dithering. You can use the development build if you're interested in this feature or you can wait until it becomes generally available in 2.6.2. You can set these options any way you'd like.

Now run the PHD_Broker app (phd2_broker_server.exe) that you previously copied to the Scripts folder. Since PHD2 is already running, PHD_Broker will automatically connect and display this dialog:



When you run PHD_Broker for the first time, click on the 'Config...' button to set up your dithering and settling parameters:



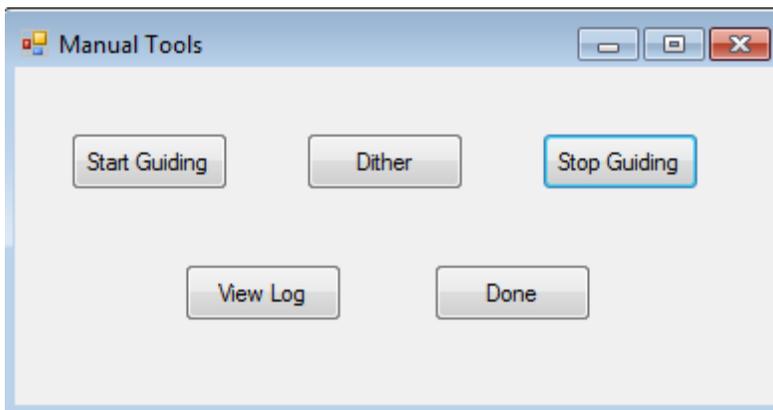
You can choose whatever settling parameters you want. CCDap will not start the next exposure until settling has completed – either because the criteria have been met or because the timeout period has expired. Having the timeout period expire doesn't result in errors or otherwise create any problems, so your only concern is that you don't want an exposure to start until guiding has

reached some level of stability. Remember that the details of the dithering operation, including scaling, RA-only mode, and spiral dithering, will be handled by PHD2.

All of these PHD_Broker settings are saved across program executions, so you won't need to repeat the configuration process unless you want to change something. Once you're done, click on 'Ok' to return to the main dialog.

Familiarization

If you want to experiment with PHD_Broker, you can do that without running CCDap. PHD2 will have to be connected to its gear, but you can use the simulators for that if you want. With both PHD2 and PHD_Broker running, click on the 'Tools' button in the Broker main window. That will launch a dialog that lets you try the basic operations:



If you also want to verify the installation of the package, you can manually run the various scripts in the CCDap Scripts folder: ...begin_slew.bat, ...dither.bat, end_slew.bat, etc. As you execute the various commands, the controls in the main window for PHD_Broker will be updated to show what's being done and what PHD2 is doing. This will also be done when the commands are coming from CCDap.

If a problem occurs with guiding, you can always use the PHD2 user interface to fix things. PHD2_Broker will notice state changes in PHD2, but these won't trigger any errors or interrupt what CCDap is doing. You might lose a light frame because of poor guiding, but you won't have to restart the CCDap session.

CCDAutoPilot Configuration

For initial testing, you may want to defer the error notification parameters, which will be described later. This section explains the necessary changes in the CCDap settings to get the basic operation running.

Setup and Guiding Pages

Since PHD2 will handle all the guiding, we want CCDap to treat the session as being un-guided. In the CCDap 'Setup' page, choose the 'unguided' option:

Software

Camera X=Y Bin

Telescope Change Driver

Plate Solving

Focuser

Rotator

Weather

Equipment

Imager

Focal Length (mm)

Pixel Size (micron)

Unbinned Image Scale

Use Sub-Frame

G2V Filters

R:

G:

B:

Guider

Focal Length (mm)

Pixel Size (micron)

Unbinned Guider Scale

A/D Bits/Pixel

AO Binning

Method

On the CCDap 'Guiding' page, again specify unguided operation:

Guided Operation Unguided Operation

Dithering

Method None

Suggest Max. Pixel Dither ± 2.0

Max. Guide Error ± 1.0

Max. Error Cycles 10

Auto Exposure

Enable Guider Auto Exposure

Min. Guide Exp. 3.00

Max. Guide Exp. 10.00

Target Guide ADU 3,000

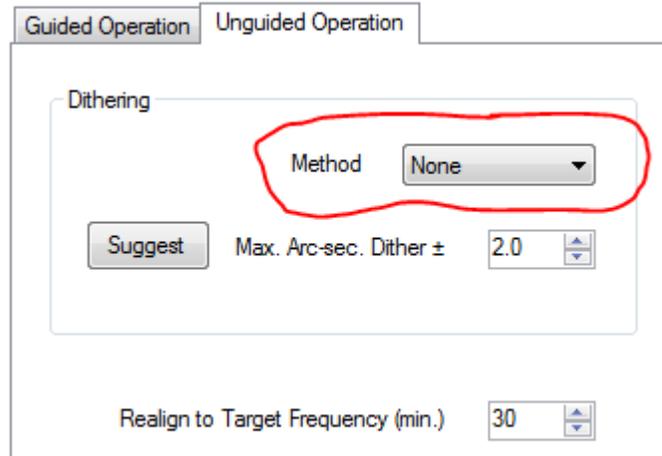
Use MaxIm Guide Star Detection

Tune Hot Pixel Filter 0.00

Audible Alarm Guide Through Series Changes

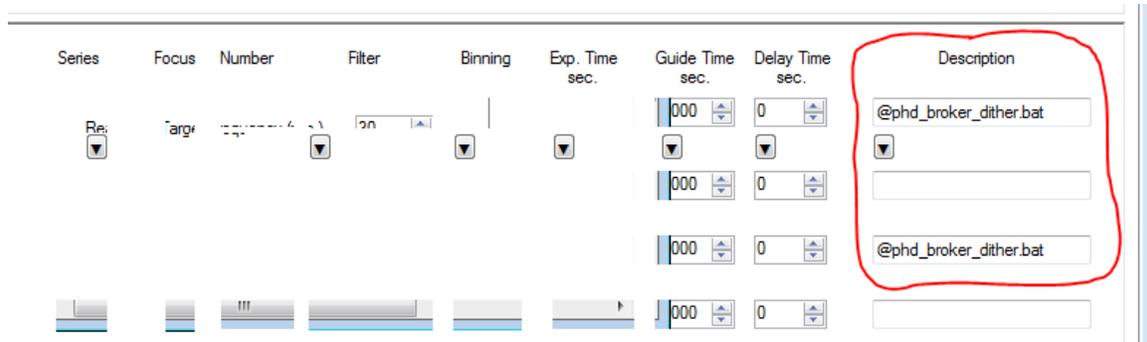
AO Centering None

We also want PHD2 to handle the dithering operations, so you should disable dithering in the 'Unguided Operation' tab of CCDap:



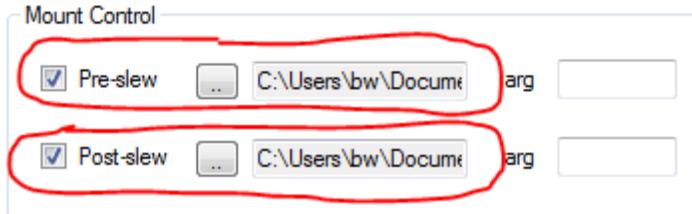
Session Page:

Your usual session parameters will be unaffected, and you should do what you normally would in terms of light frame sequences, focusing, dusk/dawn flats, dark frames, etc. In order to control dithering, you can force a dither operation whenever you want one:



Settings Page, Control Settings

The primary new element in CCDap is the ability to notify PHD2 whenever the scope is going to be moved - for whatever reason. You do that by specifying script parameters in the 'pre-slew' and 'post-slew' fields on the Control Settings tab of the Sessions page:



Since the two text controls are small, you can't see the full pathname for the scripts without moving the cursor in the field. The "pre-slew" script should reference:

MyDocuments\CCDWare\CCDAutoPilot5\Scripts\phd_broker_begin_slew.bat

The "post-slew" script should reference:

MyDocuments\CCDWare\CCDAutoPilot5\Scripts\phd_broker_end_slew.bat

Other than the settings shown so far, you can leave all your other CCDap settings in place to achieve basic operation.

Basic Operation

Once you've made the configuration changes in CCDap, you should be ready to run a live session. Just follow this sequence to get started:

1. Run PHD2 and connect to your gear
2. Run PHD_Broker and let it connect to PHD2 – that will happen automatically
3. Run CCDap and start the imaging session
4. Both the CCDap session log and PHD_Broker will show the command sequences. Don't worry about redundant 'start slew' or 'end slew' commands and don't fret about the timing.

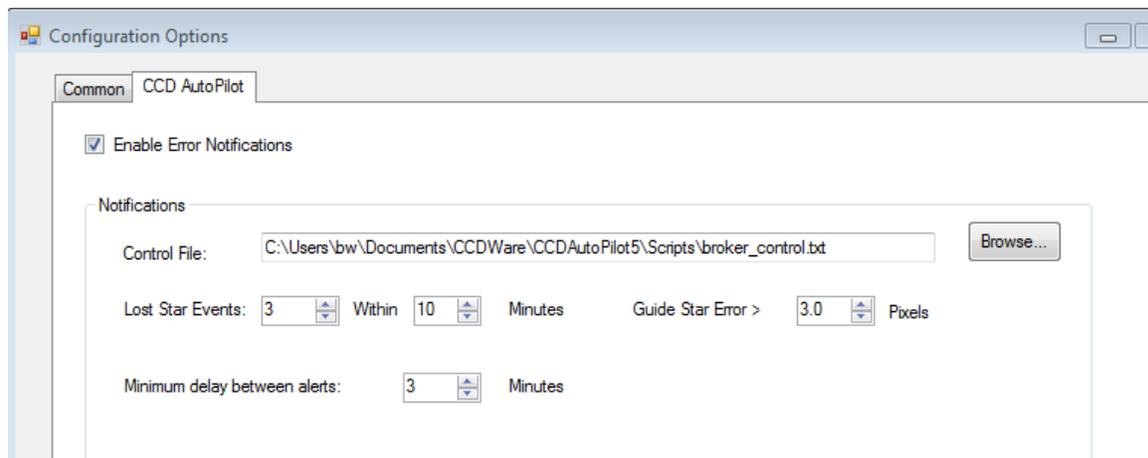
The main things to watch for are any places where the two apps get out-of-sync – either CCDap is taking an exposure without guiding or PHD2 is trying to guide while CCDap is focusing or moving the scope. Field testing has not shown any sign of these problems, but you will probably want to watch things the first few times. There are three log files that should cover the bases for debugging – the CCDap session log, the PHD_Broker log, and the PHD2 debug log. The first two are located in their respective folders in "My Documents", and the PHD2 debug log will be in its usual place (see PHD2 help docs for details).

Operation with Exception Reporting

PHD_Broker has an optional feature that will generate error notifications for events like lost guide stars and unusually large guide star deflections. The feature relies on the CCDap control file and e-mail mechanisms for actually sending the alert messages, so those must be configured correctly. CCDap still won't "know" that PHD2 is doing the guiding, so you'll continue to see messages from CCDap saying that an exposure is unguided; but those are irrelevant. Alert notifications from PHD_Broker may also trigger a "good night system" action in CCDap depending on how you've set things up.

Configuring PHD_Broker for CCDap Error Notifications

To configure alerts in the PHD_Broker app, use the 'Configuration Options' dialog:



If you don't want any error notifications, just leave the 'Enable Error Notifications' checkbox unchecked. If it is checked, the UI controls below it will be enabled and you'll be able to specify how you want the alert mechanism to behave. You should use the 'Browse' button to identify the CCDap control file – it should reside in the same folder as the other broker-related files.

One of the goals here is to avoid bombarding you with e-mail messages, so the UI controls will let you tune the mechanism to suit your needs. The lost-star events use a counting mechanism – the broker looks for a certain number of lost-star events within a specified time window. In the example above, an alert would be triggered only if there were more than 3 lost-star events in a 10-minute period. Once the threshold has been reached, the counting process starts over from zero. If you don't want notifications for lost-star events, set both spin-controls to zero. The 'Guide Star Error' control says to send an alert when an unusually large guide star deflection is seen, presumably because of a mechanical problem of some kind. If you don't want notifications for large guide star excursions, set the spin-control to zero.

Since guiding-related errors often occur in bursts, you can use the 'Minimum delay' setting to prevent barrages of e-mail messages. In the example above, e-mail messages will not be sent more often than once every three minutes. Setting this spin-control to zero means you'll see every alert condition that's triggered, included bursts that are associated with the same event.

This is an example of the e-mail message for a lost-star event:

Subject: CCDAutoPilot Notice

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15:48:06 : Guide star not recovered. Imaging unguided. PHD2 lost star
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The PHD2-specific text is restricted to 20 characters, so only limited information can be shown. Note that everything before the “PHD2” phrase is coming from CCDap and doesn’t reflect the actual state of the session. In reality, PHD2 will make every effort to recover the guide star and guiding is quite likely to be active. You’ll need to look at the PHD2 or PHD_Broker windows to know exactly what’s happening.

Support

If you have questions or experience problems with the PHD_Broker package, you should post to one of the PHD2-specific forums:

<https://groups.google.com/forum/#!forum/open-phd-guiding>

(preferred)

<https://groups.yahoo.com/neo/groups/stark-labs-astronomy-software>

Alternatively, you can e-mail me directly at bw underscore msg01 at earthlink dot net.

If you have questions about the CCDap configuration, problems unrelated to guiding, or CCDap licensing issues, you should post on the CCDWare forum:

<http://ccdware.infopop.cc/eve/forums/a/frm/f/9997083106?f=9997083106&a=frm&s=290100098>

If you don’t know where the problem lies, you should communicate with me and I will try to sort it out. Unless the problem is pretty obvious, I will probably need the three log files mentioned earlier.

Acknowledgements

I’d like to thank John Smith for his generous support of this project. Even though it doesn’t accomplish a full integration, the project could not have been completed without his help and without supporting changes in CCD Autopilot.

I hope the package serves your needs.

Bruce Waddington
May 2016