

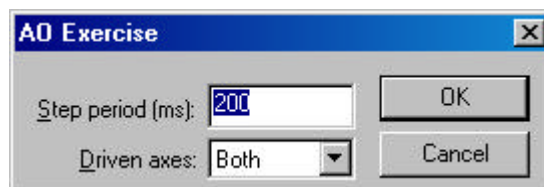
Application Note
Testing your AO-7
July 24, 2002

This application describes the common problems found with AO-7s and shows you how you can test your AO-7 for proper operation. AO-7s are somewhat delicate mechanisms and can require adjustment by the user.

A common complaint about AO-7s in the field is that they “won’t Calibrate”, meaning when you run them through the Calibrate routine, they fail with a message like “Invalid motion in X Axis”. We’ve added diagnostic functionality to CCDOPS for Windows to help you and us trouble shoot these problems.

The Exercise Command

The first test you should perform on your AO-7 is to have CCDOPS Exercise the unit while looking at the mirror or reflecting a laser (or other collimated point source) off the mirror onto a wall. Remove the AO-7 from the front of the camera so it’s easier to see the mirror motion, plug the AO-7 cable into the camera, Establish a Link to the camera then use the Exercise command in the AO menu where you’ll be presented with the following dialog:



Select a Step Period of 200ms and a Driven axes of “Both” as shown. This will move the AO through the four corners of its motion, pausing 200ms at each corner. If you’re looking with your eye you should see the AO move through the four positions as seen by looking at some object reflected in the mirror. While it’s hard to detect the exact pattern, you should be able to see that the AO moves in both axes. When using you eye you may find it easier to see the motion with a longer Step Period.

If you were able to project a laser off the AO-7 and on to a wall you would see a pattern something like the following:

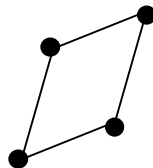


Figure 1 – Typical AO-7 Pattern

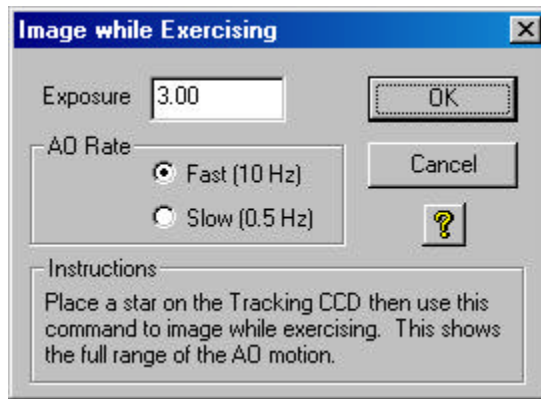
While you might expect the pattern to be a perfect square, the AO-7 produces a “flattened parallelogram”. The parallelogram is wider in one axis than the other by about 50% due to the fact that

one axis is tipped at 45 degrees relative to the camera. Also the two axes are not perpendicular but can be at angles of up to 60 degrees or so. All this is normal and the AO-7 Calibration routine measures the actual motion of your AO-7 and then uses the size and shape to make the proper corrections in response to guiding errors.

The Image While Exercising Command

Another test you can perform on your AO-7 is to have CCDOPS take an image while exercising the unit. Like using a laser reflected off the mirror, this uses a star to show the motion of the AO-7.

To do this test you need to mount the AO-7 onto the camera and then point and focus the telescope at a star field containing one or more bright stars on the Tracking CCD that aren't too close -focused image on the Tracking CCD as that's the CCD that's used to take the images. Once you have the AO-7, camera and telescope set up, use the Image while Exercising command in the AO menu where you'll be presented with the following dialog:



There are just a few options you need to select. First off you can choose to image the “Fast” response of the AO-7, whereby the AO-7 moves from corner to corner every 100ms, something typical of what you might expect while actually guiding. Alternatively you may choose to image the “Slow” response whereby the AO-7 moves from corner to corner every 2 seconds, something typical of what the AO-7 would see while calibrating. It's advised to take and inspect both images.

The final option you need to select is the Exposure time. Here the key is taking an exposure that is long enough to let the AO-7 hit all four corners (at least 0.4 seconds for the Fast option and 8 seconds for the Slow option), an exposure long enough to show get a decent exposure on the stars, but short enough such that drift in the mount doesn't smear the pattern or cause multiple patterns. We advise trying 1 to 3 second exposures in Fast mode and 20 to 60 second exposures in slow mode.

The Image while Exercising command takes a dark subtracted image, which should show star patterns like that shown in Figure 1 above or like Figure 2 below.



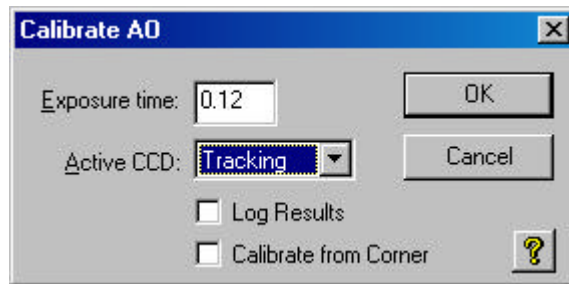
Figure 2 – Typical Image from Image while Exercising

The Calibrate Command

The final, and critical tool to using the AO-7 is the Calibrate command. To calibrate the AO-7 you must point the telescope at a relatively bright star field with one star much brighter than the rest. Roughly center that bright star in either the Imaging or Tracking CCD. Either can be used with the Calibrate command.

The Calibrate command takes a sequence of five images. The first is with the AO-7 at the “home position” and then the next four are after moving the AO-7 in one or the other direction along each axis. By measuring the difference in position of the calibration star in the first and subsequent images CCDOPS learns how to move the AO-7 in response to guiding errors.

Invoke the Calibrate command from the AO menu and you are presented with the following dialog:



The options and their implications are listed below:

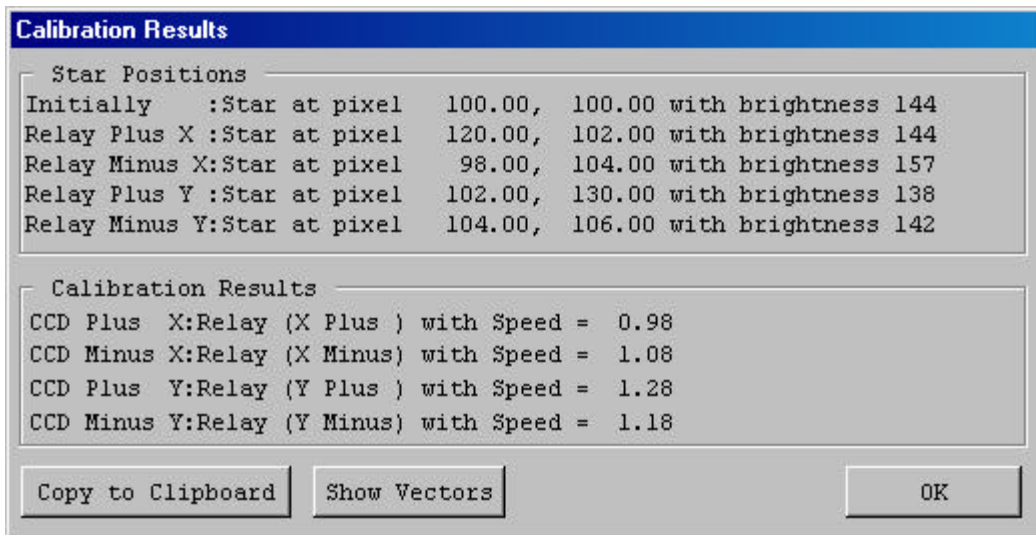
Exposure Time – Pick something long enough to clearly show the calibration star.

Active CCD – Select the CCD where you have centered the calibration star.

Log Results – Selecting this option makes CCDOPS save the calibration images on disk. They are saved in the CCDOPS directory with the names TrackCal0 through TrackCal4. Select this option if the calibration fails and then open and inspect the images to see why it failed. Perhaps the calibration star moved off the CCD or another brighter star came into the field of view. As a final option, you might email these images to SBIG tech support to help diagnose any problems you are having.

Calibrate from Corner – Typically the AO-7 calibrates from the center, moving to the right hand side and back then moving to the bottom and back. With this option selected the AO-7 calibrates starting in the upper-left hand corner then moving to the upper-right hand corner and back then to the lower-left hand corner and back. This gives is a bigger calibration move and should be tried if your AO-7 fails calibration.

While the calibration is being performed and after it has finished you are presented with the Calibration Results dialog shown below:



The top half shows the position and brightness of the calibration star at each of the five calibration positions. The bottom half of the dialog shows the calibration results.

When the calibration is successful you see the “calibration speeds” of the AO along the four directions. For a typical AO you should see that two of the speeds are roughly 50% higher than the other two, again because of the fact that the mirror is tilted at 45 degrees to the camera.

When the AO-7 fails calibration you must look a little further. The things that can cause the AO-7 calibration to fail are:

- The calibration star can move off the CCD or another brighter one can move on. Alternatively poor seeing could cause the brightness of the star to vary. You can tell this by looking at the brightness numbers in the positions. If they change by more than a factor of 2 suspect something like this is happening.
- The motion of the star is not great enough to get a valid calibration. You can tell this by looking at the star positions. The star needs to move at least 5 pixels. If not, try the “Calibrate from Corner” option.
- The two axes are too far from being perpendicular. CCDOPS expects the axes to be somewhat perpendicular and if they aren’t it will fail. Click on the Show Vectors button to inspect the calibration results graphically.

What to Do when All Else Fails

If you simply can’t get the AO-7 to calibrate then do the following and email the data to our Tech Support Staff. We’ll help you figure it out or in the worst-case ask you to return the AO-7 for repair.

1. Take Fast and Slow images using the Image while Exercising command. Save the images in SBIG format.
2. Try the Calibration with the “Log Results” option selected. Gather the five images that are created.
3. In the Calibration Results dialog after the calibration is complete and has failed click the Copy to Clipboard button then paste the results into your email.
4. Email the two “Image while Exercising” images, the five TrackCal images and the Calibration results to sbig@sbig.com.