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ASTRONOMICAL INSTRUMENTS

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Application Note
CCDOps Single Axis Mount Dynamics Command
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This application note describes the Singe Axis Mount Dynamics command in the Track menu of CCDOPS. This command exercises the mount in one axis by making a sequence of moves forward then backwards, recording the telescope position by measuring the centroid of a guide star. Our hope is that it will help users troubleshoot problems with Autoguiding

Setup

To use this command you first Establish a link to the camera, enable the cooling and then focus on a relatively bright, isolated star. Orient the camera such that RA is along the X (horizontal) axis of the CCD and Declination is along Y. It doesn't have to be exact, maybe within 10 degrees or so.

The star needs to be roughly centered in the field of view and not have any neighboring stars within 200 pixels. Don't use the brightest stars in the sky but instead point to a 4^{th} or 5^{th} magnitude star. You can use either CCD (Imaging or Tracking) just so long as that CCD is the active CCD in the Camera Setup command.

Also make sure the Autoguiding cable is connected between the camera and the telescope. Note that you **do not** have to be calibrated to the mount to use this command. Once the camera is focused and pointed use the Single Axis Mount Dynamics command in the Track menu.

Command Parameters

The Single Axis Mount Dynamics command takes the following parameters:

Exposure – Set this to the desired exposure as appropriate for the guide star brightness. Ensure there is sufficient exposure to bring the star well out of the noise but not too much such that the star saturates in the core. Exposure times of 0.12 to 1 second are recommended to minimize the effects of mount drift.

Each Move – Set this to the relay move you want to make at each step of the process. You can do a large number of short moves or a small number of large moves. *To start out we recommend you enter 0.1 second here*.

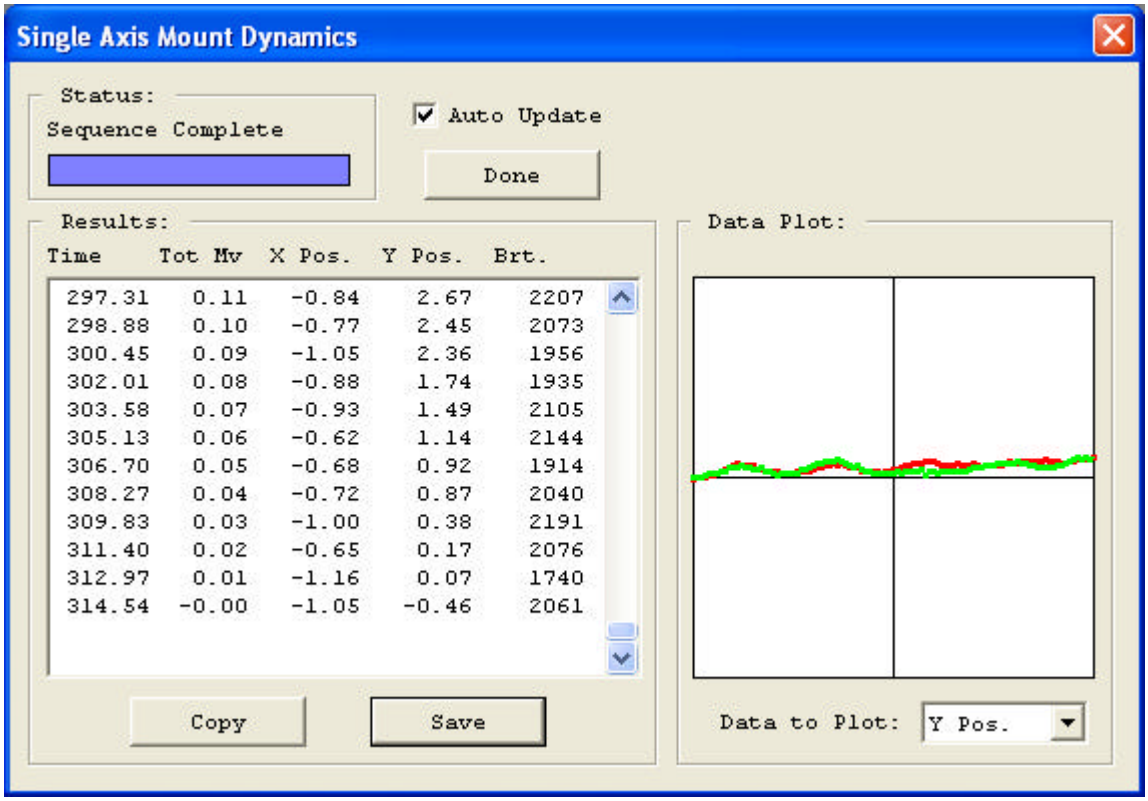
No. of Moves – Set this to the number of moves you want the command to take in each direction of the sequence. For example if you entered 0.1 seconds for Each Move and 10 for this parameter the command would take 10 steps of 0.1 seconds in one direction then reverse directions and take and additional 10 steps. *To start out we recommend you with enter 50 here*.

Relays – Here you can choose to use the X Relays, the Y Relays or None. With most mounts the X Relays correspond to RA and the Y to Declination. Typically you would select the X or Y Relays; the None selection allows you to just monitor the uncorrected performance of your telescope drive. *To start out we recommend you select the X Relays*.

When you've entered the options you want click the OK button to start the data acquisition process.

Data Acquisition Mode

One the command is started you are presented with the dialog similar to the one shown below:



The major items/sections of the Single Axis Mount Dynamics dialog are:

Status Box – This shows the progress of the command as each exposure is taken.

Results Table – This is a table showing the following data in columns:

Time – This shows the elapsed time since the first image.

Tot Mv – This shows the total move applied to the Relay axis you have chosen. This number will increment up by the amount entered in Each Move until the No. of Moves has been taken at which point the moves will reverse and this total will decrement down to zero.

X Pos – This shows the guide stars X centroid position relative to the center of the image.

Y Pos – This shows the guide stars Y centroid position relative to the center of the image.

Brt – This shows the total integrated brightness of the guide star in ADU.

Copy Button – Click this button to make a copy of the Results Table on the clipboard where you could then paste it into an email, etc.

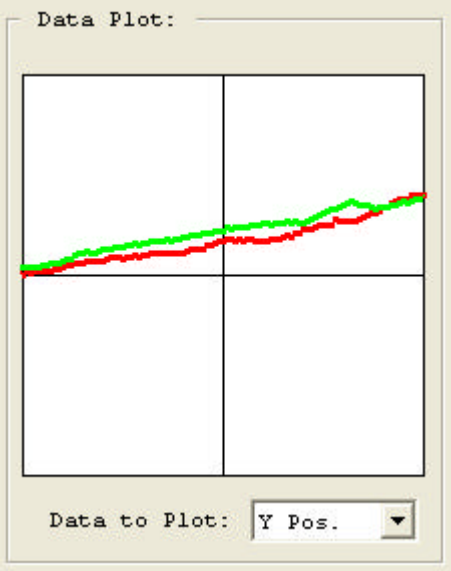
Save Button – Click this button to save the Results Table in a text file.

Data Plot – This plot shows the Guide Star's X or Y Centroid Position (selected in the pop-up below) on the vertical axis vs. the Total Move on the horizontal axis. The red data points show the moves for the first half of the command as the telescope is moved in one direction and then the green data points show the moves back.

Auto Update – If this checkbox is unchecked the command will pause after each step until you click the Resume button.

Pause/Resume/Done – This multipurpose button allows you to Pause or Resume the data acquisition while in progress or close the dialog after data acquisition is complete.

The command starts out by acquiring a full frame dark-subtracted image where you select the desired guide star. Position the guide star selection box over the desired guide star, then click the Resume button to start acquiring data. The command will then take a sequence of images, measuring the guide star position and moving the telescope. When it's all done the Results Table may be saved on disk an/or you may wish to use the **Alt - Print Screen** key combination to make a copy of the window showing the plot. After pressing **Alt - Print Screen** you can paste the results into the Paint application and save the bitmap.

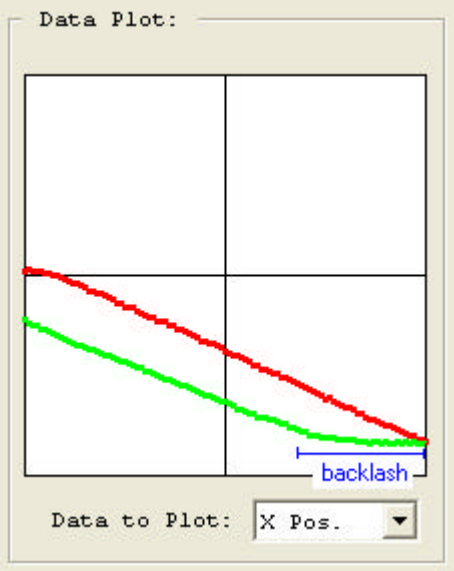


What Results Should you Expect?

The results you get will vary from RA to Declination and from mount to mount.

The data plot to the right shows the results of a typical telescope mount in RA. The red data points show the telescope moves out in RA and the green data points show the moves back. For the most part the telescope moves are uniform for each step as indicated by the slope of the lines. The mount also moves back to the same position at the end as indicated by the overlap of the left hand points in the red and green data plots. You can see a little drive or periodic error is indicated in the structure of the lines. An absolutely perfect mount would show all data point in a line with the red and green data points overlapped.

The data plot below and to the right shows the results of a typical telescope in Declination. There is a little take up of backlash at the start of the red plot as the telescope remains stationary and the data is flat but then it starts to move and the data plot trend downward. At the midpoint where the mount reverses (on the right where the data turns green) you can see further signs of backlash (shown in blue) as again the plot remains flat. You can actually determine the amount of backlash from the plot. Since about 30% of the green plot is flat the backlash is 30% of 100 Total Moves at 0.1 seconds per move or 3 seconds. That's quite a bit.



What you don't want to see is a sudden discontinuity in the data that would indicate the mount had taken a hop. I don't have any examples of that, but again, what you would see is a line sloping up or down with a sudden vertical jump followed by a flat period or further slope up or down.

If you Have Questions

If you have any questions on how to use this command or how to interpret the results please let us know. If you want us to help you analyze the results save the Results Table and then email it to us as an attachment. We're looking forward to seeing the results users get with the various mounts out there and are more than happy to help diagnose problems with your setup.