



Observing Asteroids



Las Cumbres Observatory Global Telescope

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Astrometric Data Reduction with Astrometrica

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Introduction

Now that you know how to identify an asteroid in a set of images - we need to look into measuring its position using the astronomical co-ordinate system Right-Ascension and Declination. You can then send the "exact" position of the asteroid to the Minor Planet Center to include in their orbital calculations.

Astrometric Data Reduction is the process of determining the position of an object in the sky. The software analyses your images and identifies each star present; it then checks these stars against records in a star catalogue (more information later).

When it has labelled all the stars in the image, it is easy to pick out the asteroid (you also see the asteroid when you blink the images) - the software then consults a database of known asteroids and makes a match to the closest asteroid to that position.

This document will show you how to do this with Astrometrica.

Data Reduction

First, go to File>Load Images and load the images of your asteroid. Click Ok to confirm the Date/Time for each one.

Blink the images, and make a mental note of where the asteroid is.

Next, go to **Astrometry>Data Reduction**, and you will see a window appear with the following fields:

Object
Right Ascension
Declination

The object field should be blank; obviously if you are searching for a new asteroid then it won't have a name to be identified by.

The RA and Dec fields should be filled in - again this is read from the FITS header, so you can assume these are correct (unless you notice otherwise). Because the declination field cannot contain a + or - sign it has North and South buttons. North is + and South is -.

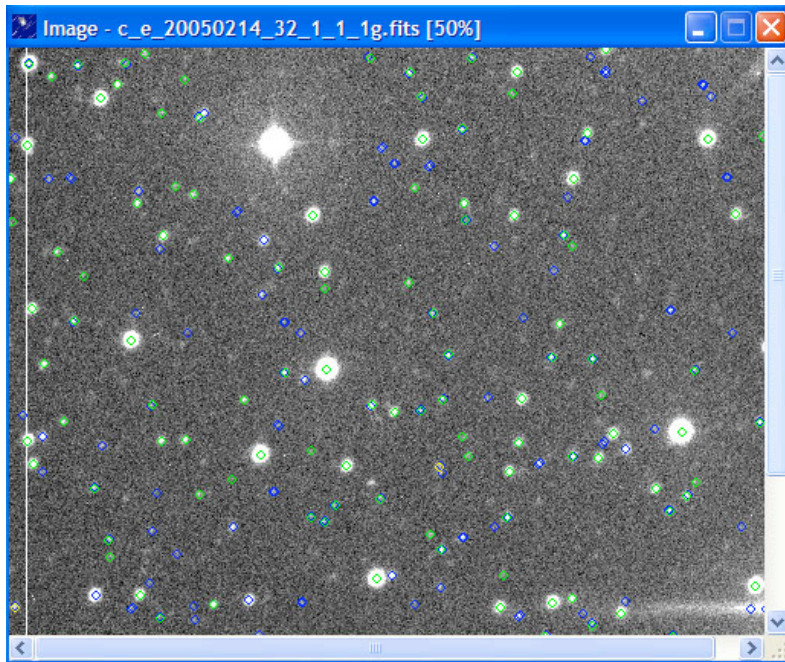
When you are happy with the information, click the Ok button.

The software will now extract all the object it thinks are stars.

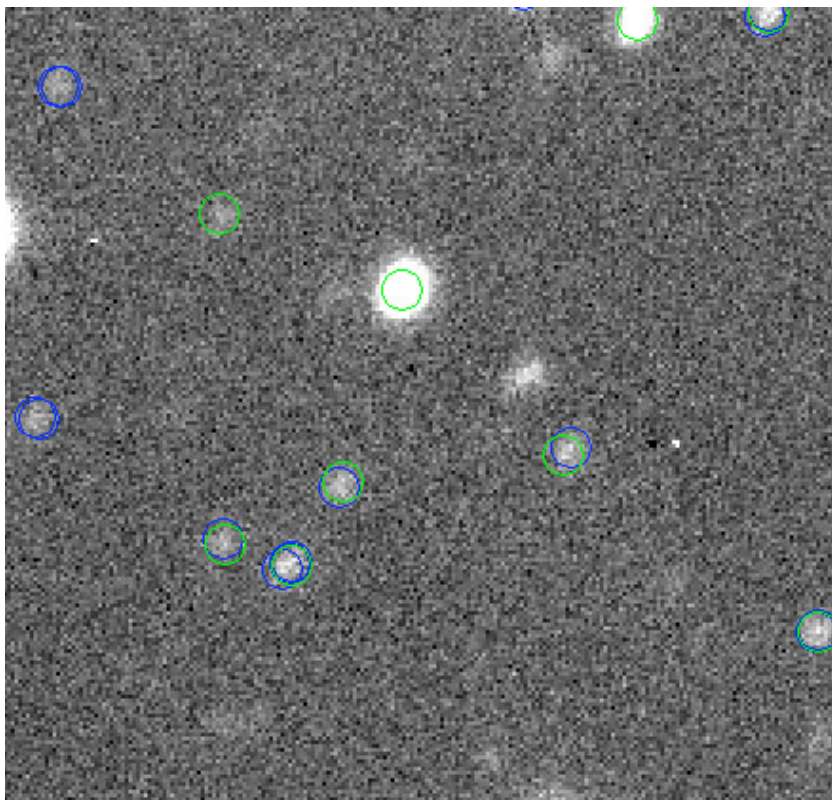
You will then see coloured circles around the stars in your image. The **green** circles are for stars that it has correctly identified in the star catalogue and **blue** circles are stars that it hasn't been able to confirm but still believes they are stars.

Please Note: If the majority of your stars are blue and very few green, see the section below called **Aperture Radius**.

If you look carefully at your asteroid, you should see that it has no circle around it. Obviously this is correct as it is not a star and will not be present in the catalogues.



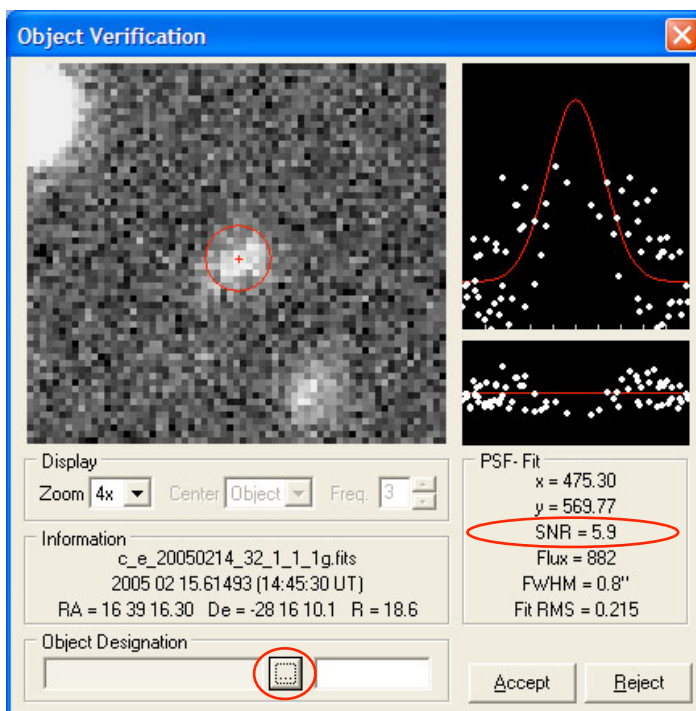
If you look carefully at your asteroid, you should see that it has no circle around it. Obviously this is correct as it is not a star and will not be present in the catalogues.



Object Verification

Carefully move your mouse over the asteroid and click on it as close to its centre as possible.

A new Object Verification window will appear - this shows a zoomed in view of the asteroid. You should check that the SNR (Signal-to-Noise Ratio) is 4 or higher - this helps determine the quality of the image. If the SNR is lower than 4 it means the image quality is not good enough for accurate measurement and you should consider not sending the results to the MPC.

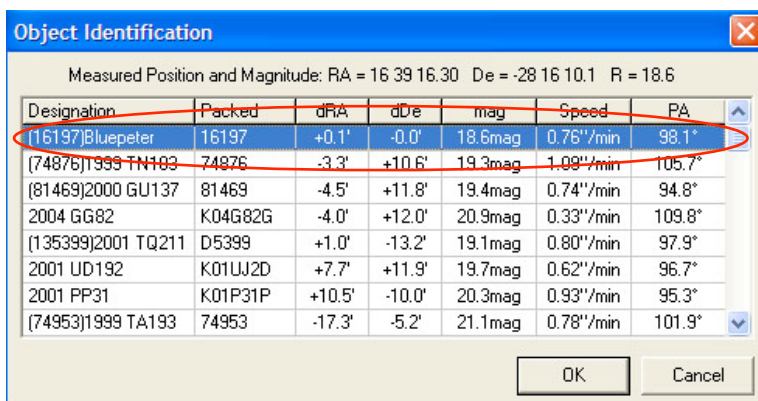


As you can see, the Object Designation box is empty, if this is a known asteroid, you can have Astrometria identify it. Click on the small button in-between the two lower text boxes.

Astrometria will then search the MPCOrb database that you downloaded (see Setting Up for details).

Astrometria will then present you with another window containing a list of asteroids in the MPCOrb database close to the position of the object you selected.

The **dRA** and **dDec** columns show the difference in position between the nearest object in the database and the object you selected. If all has gone well, the object at the top of the list should be the asteroid you intended to observe and the dRA and dDec should be zero or close to zero.



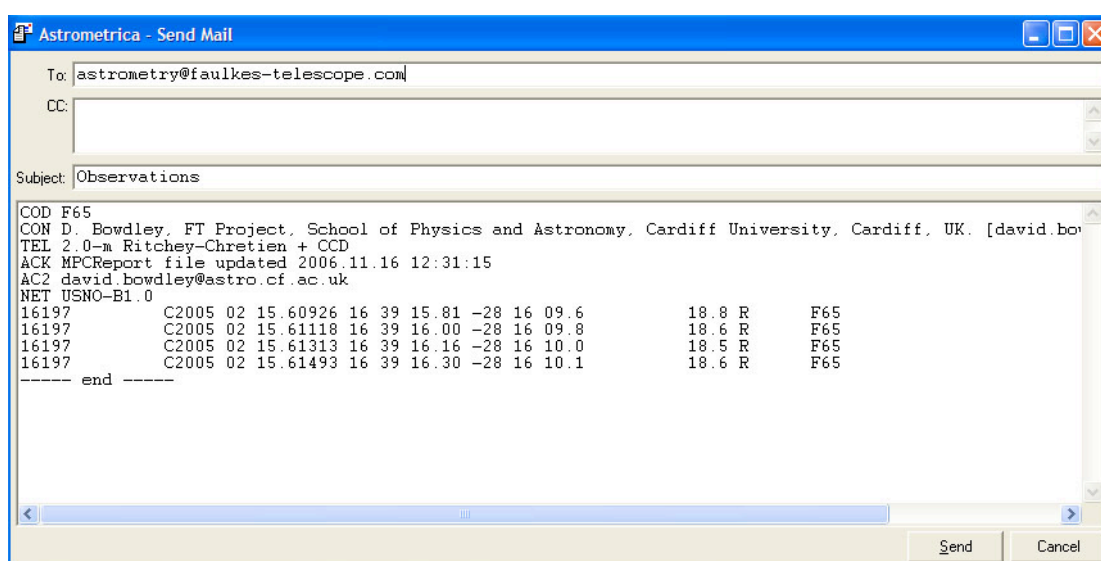
If this is the case, click on that asteroid entry to highlight it and click **Ok**. The Object Designation box will then be filled with those asteroid details, then click the **Accept** button.

Repeat this process for each of your images.

MPC Report

You are now in a position to have a look at the MPC Report that Astrometrica has been constructing whilst you have been measuring asteroids. We shall now submit this report into the Asteroid Portal (<http://portal.faulkes-telescope.com/asteroid/>).

Follow the instructions on the portal and submit the FITS Header (**Images>Display Header**) and the MPC Report (**Internet>Send MPC Report**).



Now, you can refer to the instruction document on using the Asteroid Portal to submit your results.

When Astrometric Reduction Goes Wrong

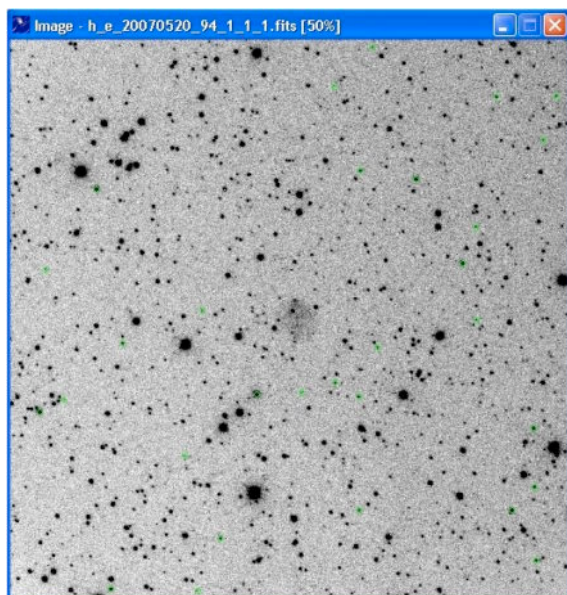
Now and again the process of identifying reference stars goes wrong and Astrometrica cannot identify the stars in the image with stars in its catalogue. This can be for a number of reasons such as poor image quality, very few stars in the image or possibly a setting in the configuration file that is not optimised for the particular images you have.

Aperture Radius

Astrometrica is programmed to search for stars in the images that are of a certain size i.e. radius in pixels.

Depending on the magnitude of the stars in the field and the exposure time used, stars can appear smaller or bigger. If they are sufficiently different in size compared to what Astrometrica is searching for then very few reference stars may be found.

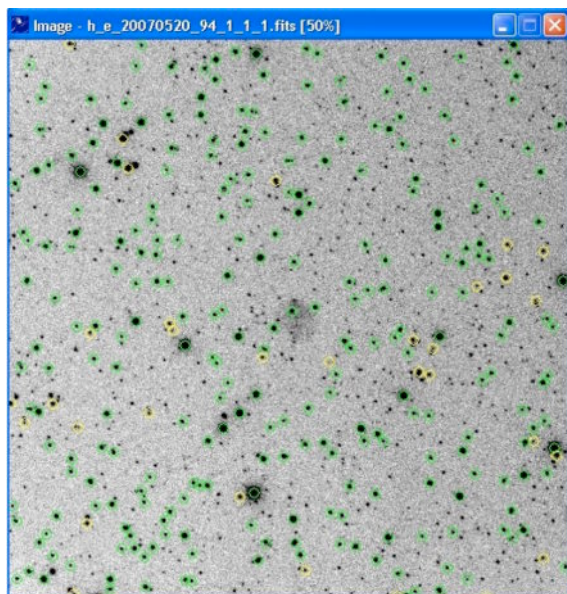
In this example, the default aperture radius of 4 pixels was used.



As you can see, there are very few reference stars (31 to be exact), even the brightest stars have not been identified. If you were to try and measure the position of an asteroid now, you will find that the coordinates you come up with will be wrong.

Because it has matched so few stars, it is possible that the software will match this image to the wrong patch of sky - an area which just happens to have a similar pattern to those 31 stars. This could be half a world away!

This is the same image again, with the Aperture Radius increased to 7.



This time, many more stars have been matched (302) including the brightest stars. This means that the software will successfully match this image to the correct patch of sky and the calculations carried out to work out the RA and Dec of your image will be correct.

So, if you have small stars, reduce the aperture radius and if you have large stars, increase the aperture radius.

Reference Star Match Error

If a box pops up saying **Reference Star Match Error** then you will usually be offered some options. If you choose Manual Reference Star Match then you will be presented with red circles on top of your image.

The idea is to move the red circles over the matching stars using the arrows in the separate window. When this is done you click **OK** and hope that Astrometrica can now identify enough stars.

There is a good chance that this will also fail. At this point, it is worth considering that there must be something more seriously wrong with the set up, rather than managing with a less than perfect situation that could compromise your data.

It might possibly be worth looking at the settings file to see if you can make a simple change there.

One of the most common changes to make in situations like this is to go to:

File>Settings and click on the **Program** tab and change the **FWHM** value. In the default configuration file it is set to 2, you could change this up or down a fraction and see if it makes any difference. Only a small change needs to be made at first, no more than 0.5 at a time.

If you cannot get a satisfactory result then we suggest that you get further help by going to Forum on the Asteroids Online Training page.
