Configure the Plate Solver

Plate solving is necessary an order to determine image characteristics such as plate scale, orientation, and sky coordinates. Since plate solving is performed after alignment, it is only necessary to plate solve the first image in the sequence.

Tycho considers an image to be "plate solved" when two conditions are satisfied. The first is that the image must contain World Coordinate System (WCS) entries inside its FITS header. The second condition is that the entries must correspond to a 3rd-order SIP polynomial.

There are three ways to plate solve an image. The first of which is to use the Tycho online service which invokes the solve-field software developed by Dustin Lang et al. This is the easiest and preferred technique for most users, and is also very fast because it does not upload the image data – only the extracted sources. The second option is to download the solve-field software onto your own machine, along with the necessary index files. This option may be useful for those who do not have a reliable Internet connection. Finally, the third option is to use the astrometry.net online service, being sure to specify "tweak_order=3" for the 3rd-order polynomial. This option is the slowest as it requires uploading the full image data.

Plate Solve Option 1: Using the Tycho Online Service

Figure 1 - Settings for Tycho Online Solver

2021 04 11

As mentioned, the Tycho online service is recommended for most users as it is quick, easy, and reliable. Navigate to *Action->Plate Solve Images* and configure the solver as shown in Figure 1. Then click "Save Settings" to save the settings for future use. When you are ready to plate solve, click the "Start" button.

Note:
The default Downsample factor is 2, and usually works. However, if you have large images (3000x3000 or larger) then it may be useful to try a Downsample factor of 4. Conversely, if you have small images (700x700 or smaller) then it may be useful to try a Downsample factor of 1.

Plate Solve Option 2: Using the Offline Plate Solver

The offline solver may be desired by users who do not have a reliable Internet connection. For this option, the first step is to download the offline solver, a mirror of which is available from the Tycho website via the Download page from: https://www.tycho-tracker.com/download

Click on the "[ZIP]" link next to the offline solver entry, and you will start downloading the software for the offline solver. Once downloaded, extract the archive and run the setup executable. When the setup has completed, be sure to check the box "Run the Astrometric Index Downloader".
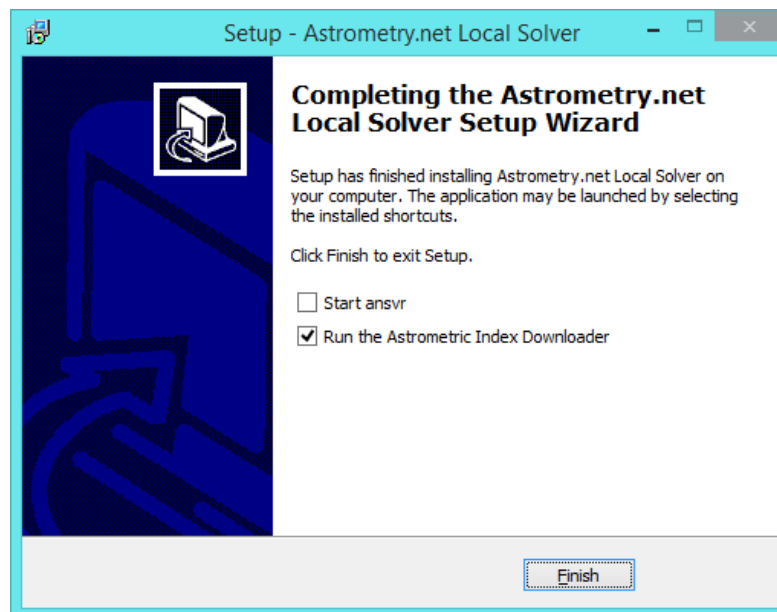

Figure 2 - Installing the Offline Plate Solver

It is not necessary to "Start ansvr" at this time, so you can uncheck that box.

The Index Downloader is important because it will automatically download the index files required for your field of view. Index files are used by the solver to perform the plate solve routine, and without them the solver will not function.
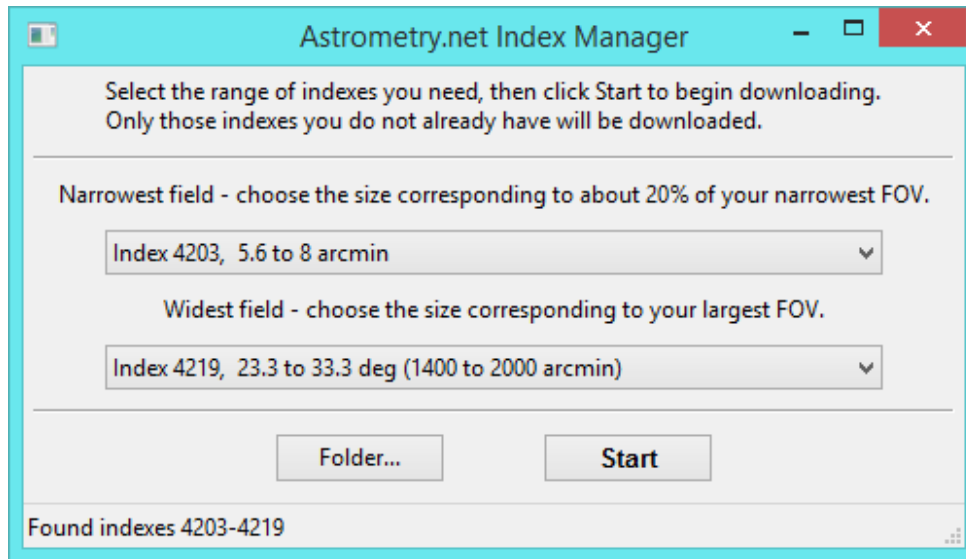
2

Figure 3 - Index Manager

Click "Start" once you are satisfied with the settings for "Narrowest field" and "Widest field". The Index Downloader will then proceed to download the relevant index files. When it is finished, you can close the window.

It is also recommended to install the 4100 series of index files. They are available here:
- http://broiler.astrometry.net/~dstn/4100/
- There are 13 .fits files totaling 340MB in size
- After downloading the files, place them into your index file directory (this will be similar to C:\Users\<user>\AppData\Local\cygwin_ansvr\usr\share\astrometry\data)

Once the plate solver has been installed, along with the index files, launch Tycho and choose "*Action->Plate Solve Images*". Provide the path to the `cygwin_ansvr` directory, this is usually going to reside in your local `AppData` directory.

If you know the plate scale of your imaging chip, you can provide a lower- and upper-bound on the pixel scale. For example, if your plate scale is 1.6, you may specify 1.4 as the lower bound and 1.8 as the upper bound. If you are unsure, it is perfectly fine to specify a wider range such as 0.5 to 3.0.

"Downsample=2" will usually produce the most accurate results. However, if you have a wide field or a large image then "Downsample=4" is probably better, and a lot faster. If you are experiencing plate solve failures, you might experiment with different values to see what works best for your images.

The option "Automatically perform second attempt with different source image" allows the plate solver to automatically perform a second attempt if the first attempt fails. It will also select the middle image in the sequence as the source image and, upon successful solve, copy its WCS information over to the first image in the sequence. This can be a useful fallback if the first image fails to solve.

The option "Narrow search to RA/Dec in FITS header" is useful to prevent false matches from occurring. It is very rare for the plate solver to produce a false match but it has happened on at least one occasion.
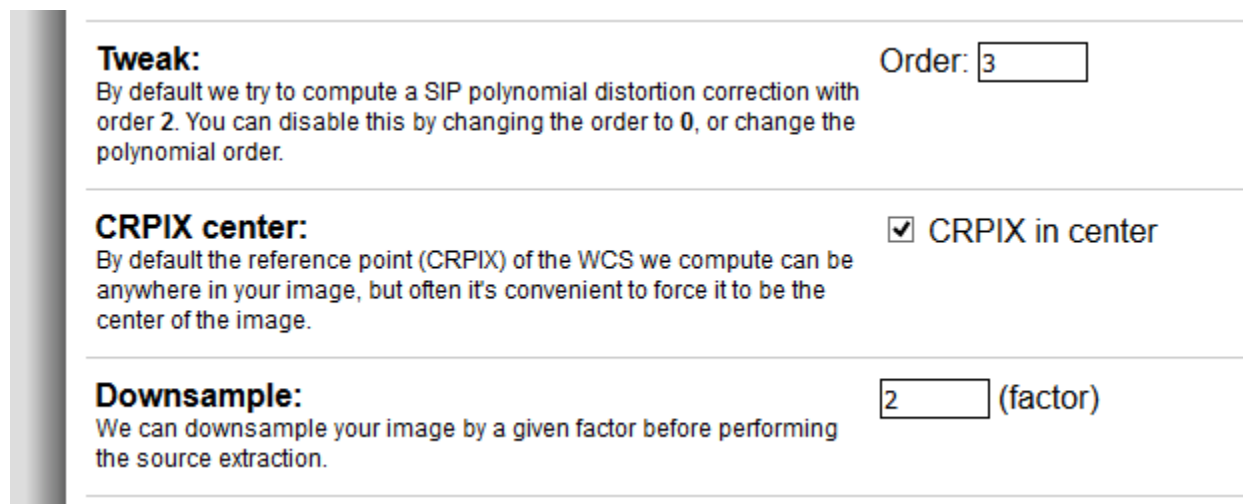
Therefore, this option can be enabled to instruct the plate solver to search within a given radius of the RA/Dec specified within the FITS header of the first image. If the RA/Dec is not found in the FITS header, the plate solver will revert to conducting a "blind search", which is the same behavior as if the option were disabled. The default search radius is 2.00 degrees, meaning that the RA/Dec in the FITS header can be off by that amount from the actual RA/Dec. Evaluation of numerous datasets has shown that while most FITS headers will have the RA/Dec correct to within 5 arcmin, some can be off by as much as 1 degree. Thus, to ensure that the plate solver is not overly constrained, it is advisable to have a radius of 2 degrees, which will still dramatically reduce the probability of an incorrect solution being returned.

Plate Solve Option 3: Using the Astrometry.net Service

Here are the steps to solve an image using the astrometry.net online service. Note again that you need only solve the first image in the dataset.

First, navigate to http://nova.astrometry.net and click on the "Upload" menu item.

Before uploading the file, click on the "Advanced Settings" text and scroll down to the following settings.
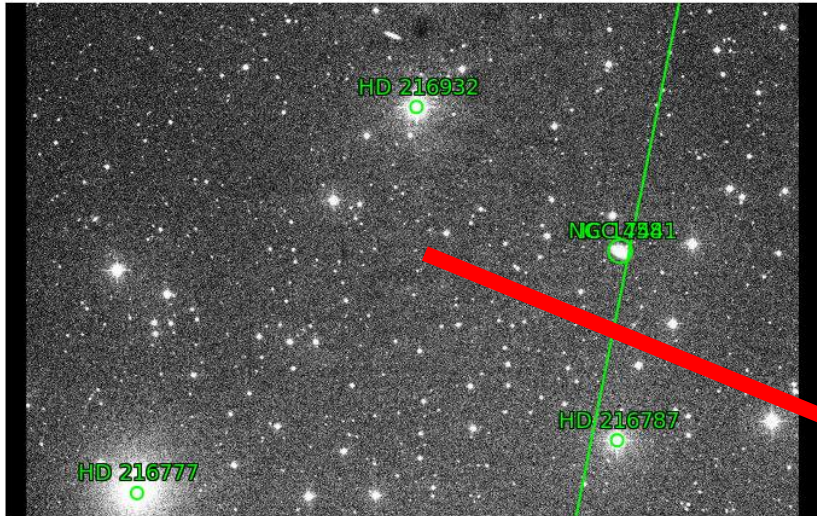

Figure 4 - Advanced Settings for Online Plate Solver

"Tweak" should be set to 3 in order to satisfy the 3rd-order polynomial requirement.
"CRPIX center" should ideally be checked, but it is not usually problematic if left unchecked.
"Downsample" is by default 2, but you may find that 4 works better for some images.

Once these Advanced Settings have been specified, proceed to upload the image and wait for the service to return with a result. When the service has finished, you can download the plate solved image by clicking on the "new-image.fits" link, as shown in Figure 5.

Figure 5 - Retrieving the Plate Solved Image

Once downloaded, you can replace the unsolved first image with "new-image.fits", which will take the place of the first image in the image sequence. As you can see, the astrometry.net service is a bit more tedious than using the integrated solvers, but is one more option available should it be desired.