Paramount MyT – Part 5 – TPoint
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If you would hit the mark, you must aim a little above it.
-Henry Wadsworth Longfellow

The map is not the territory.
-Alfred Korzybski

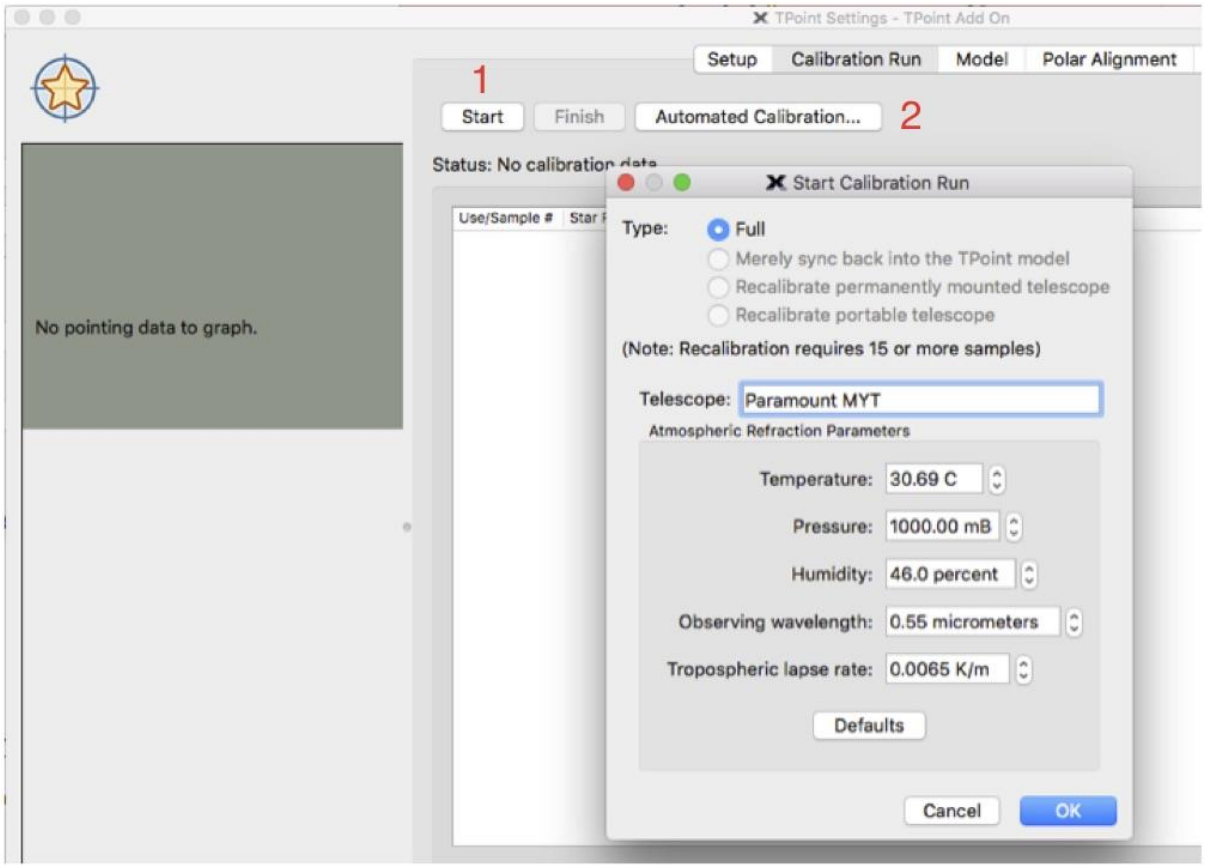
As discussed earlier, no mount nor payload is perfect. Payloads can cause the mount to point differently. The atmosphere behaves differently at different altitudes. TPoint is the set of mathematical wizardry that compensates for these issues and allows the mount to achieve, essentially, perfect pointing. The intricacies of how TPoint operates are all covered in the TPoint manual, available in the Bisque WWW site's downloads section.

You can think of TPoint as an intermediary between SkyX and the mount. SkyX will say "Please move to this object at this location." TPoint will intercept this message to the mount and replace it with a different, but more accurate, location for that object.

For the purposes of this article, we'll simply walk through the TPoint process. If you'd rather watch a video, there are several available by Charles Walker (here), Tolga Gumusayak (here) and Richard Wright (here).

In order for TPoint to work most effectively, the camera should be focused and you need to have Image Link working with your camera. You should, at least at first, go ahead and run TPoint's automated acquisition routine with All Sky Image Link (preferably in Blind mode). Using traditional Image Link (instead of All Sky) would probably allow faster plate solves, but I feel that the reliability of Blind All-Sky Image Link makes it the better option, especially for the smaller TPoint model that we're going to build right now.

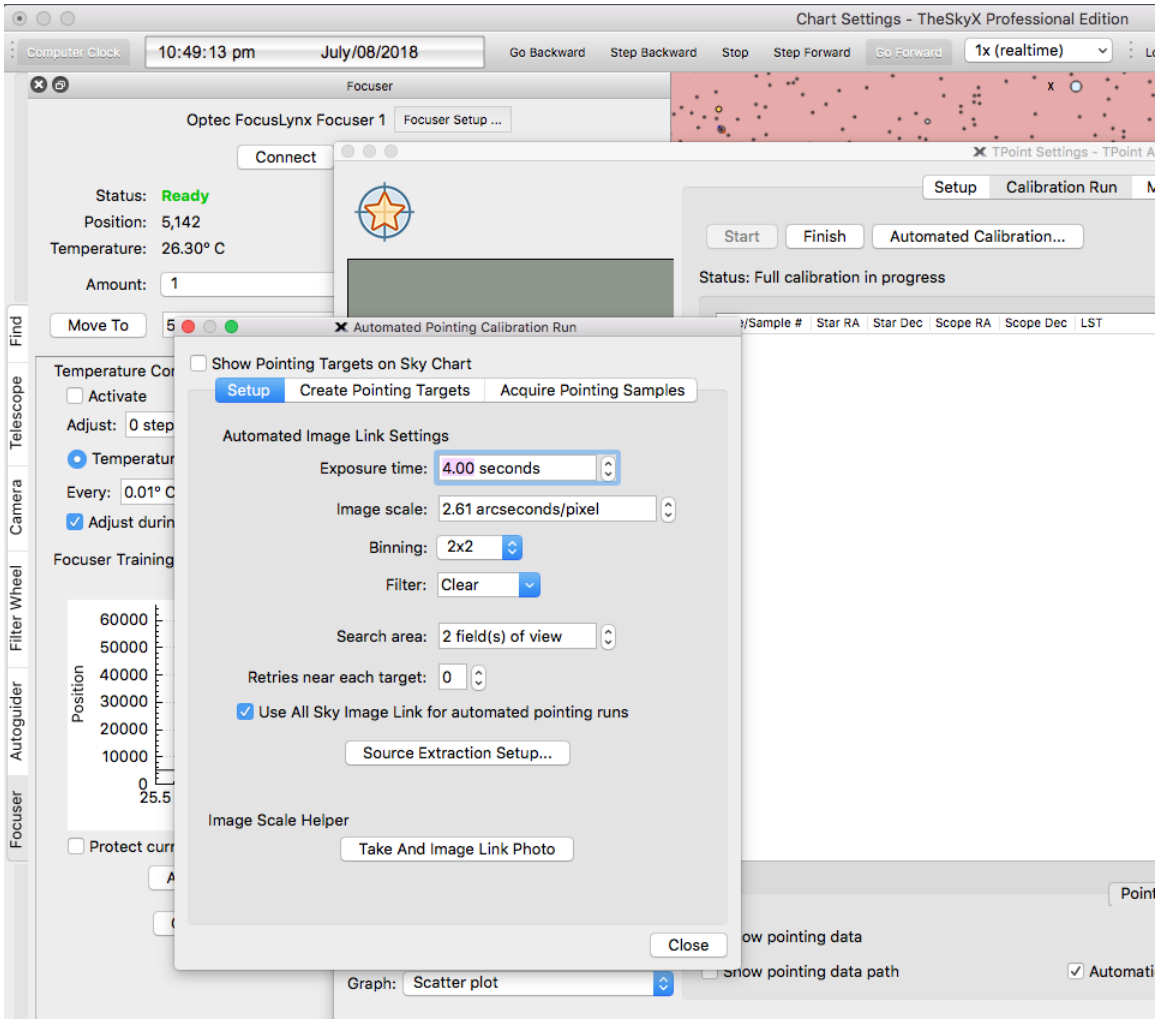
After homing the mount and ensuring focus, you will start the TPoint process by running "Telescope Menu" -> "TPoint add on". Once the control window has opened, you will create a new model by changing to the "Calibration" tab and then pressing the "Start" button:



Look up the temperature by referring to the focuser's temperature reading, using a thermometer or a weather forecast. Do the same with the humidity and pressure. I generally leave the rest alone.

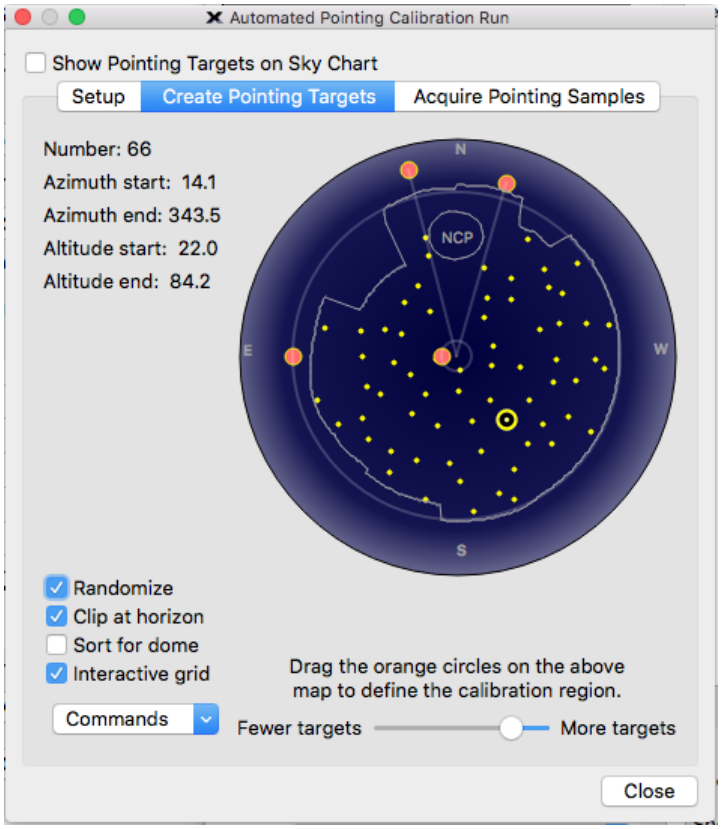
After you press "OK", you'll have the opportunity to insert sample points. While you could take the pictures and Image Link them yourself, or even use an eyepiece, we are going to use the "Automated Calibration Routine". So, press that button.

You will now work your way through three tabs. The first tab will allow you to setup the camera parameters. You should enter values that you have found to work for Image Link with your hardware. I generally use a four second exposure, binned 2x2. If you cannot remember your camera's image scale, then take a photo & Image Link it using the "helper" button.



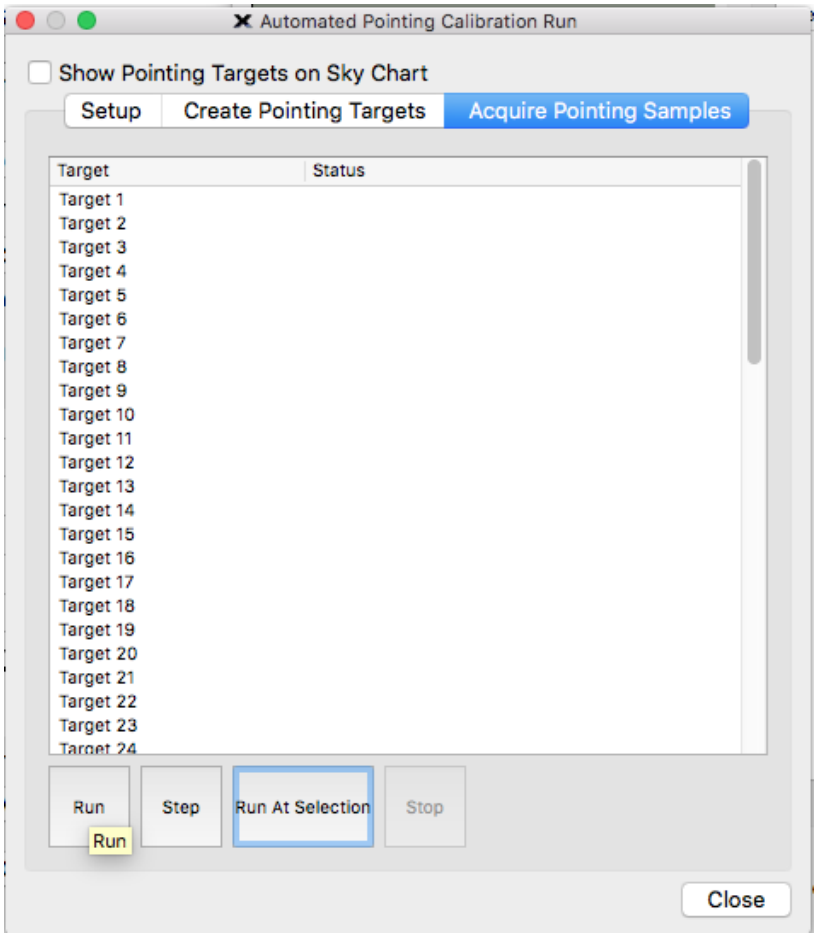
In addition to the camera parameters, I uncheck the “Show Pointing Targets on Sky Chart” because I don’t really care and have no need to see them after the run is complete. I also ensure that “Use All Sky Image Link” is on (and also have the Blind option selected under Image Link settings as described in the third article).

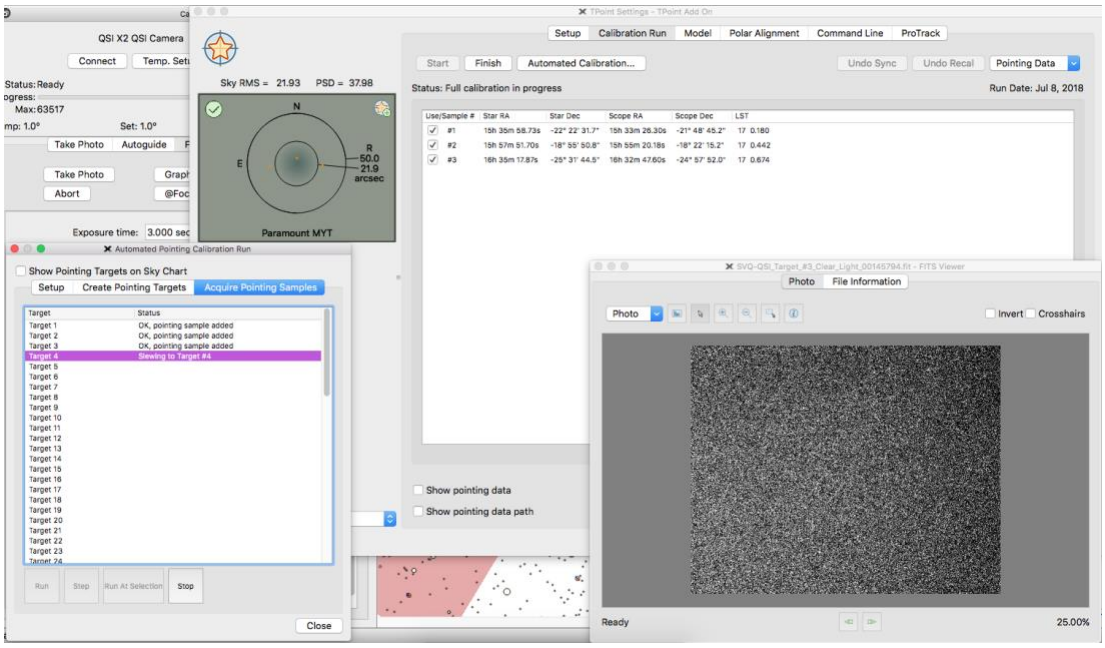
The second tab allows you to tell the routine how many points you want to take, and where to take them. While there are many options on this tab, the key one is to choose the number of points. In general, more points will create a better model but will take more time. Moreover, there is also a point of diminishing returns. So long as the points are well scattered across the sky, you will probably need about 55 to 60 points to perform an accurate polar alignment and dramatically increase your mount’s pointing accuracy.



While you can adjust your point placement to avoid obstacles around your site, the easiest way to do this is to draw a custom horizon that will be automatically used to adjust point placement. The tried-and-true approach, however, is to include a few extra points to compensate for some of the ones that may fail to link. In the example above, which was going to be used for a polar alignment check, I moved the slider until I had 60, plus a few spares.

After telling it how many points that you want, you move to the next tab. Despite the highlight around the “Run at Selection” button, you’ll actually want to press the “Run” button and the mount will begin slewing, imaging & linking each of the points. On my system, this process will take about 25 seconds per point.

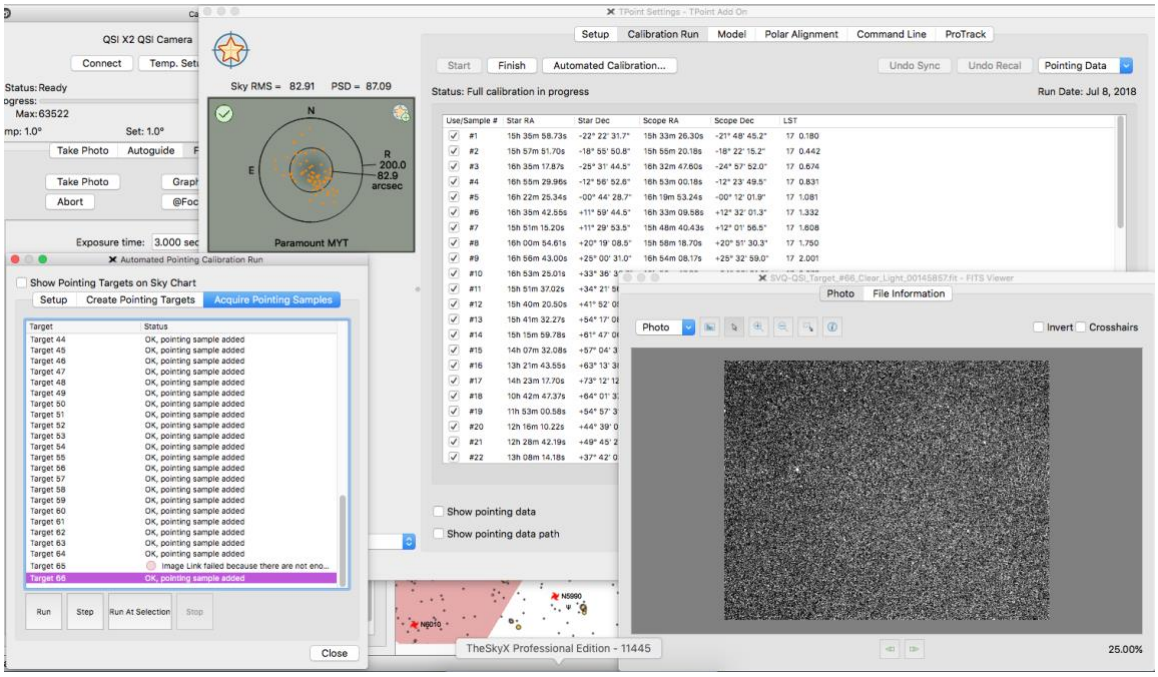

Automated Pointing Calibration Run
Show Pointing Targets on Sky Chart
Setup
Create Pointing Targets
Acquire Pointing Samples
Target
Status
Target 1
Target 2
Target 3
Target 4
Target 5
Target 6
Target 7
Target 8
Target 9
Target 10
Target 11
Target 12
Target 13
Target 14
Target 15
Target 16
Target 17
Target 18
Target 19
Target 20
Target 21
Target 22
Target 23
Target 24
Run
Step
Run At Selection
Stop
Run
Close


QSI X2 QSI Camera
Connect
Status: Ready
Take Photo
Autoguide
Abort
Exposure time:
Sky RMS = 21.93 PSD = 37.98
Paramount MYT
Automated Pointing Calibration Run
Show Pointing Targets on Sky Chart
Setup
Create Pointing Targets
Acquire Pointing Samples
Close
Setup
Calibration Run
Model
Polar Alignment
Command Line
ProTrack
Start
Finish
Automated Calibration...
Undo Sync
Undo Recal
Pointing Data
Status: Full calibration in progress
Run Date: Jul 8, 2018
Show pointing data
Show pointing data path
Photo
File Information
Invert
Crosshairs
Ready
25.00%

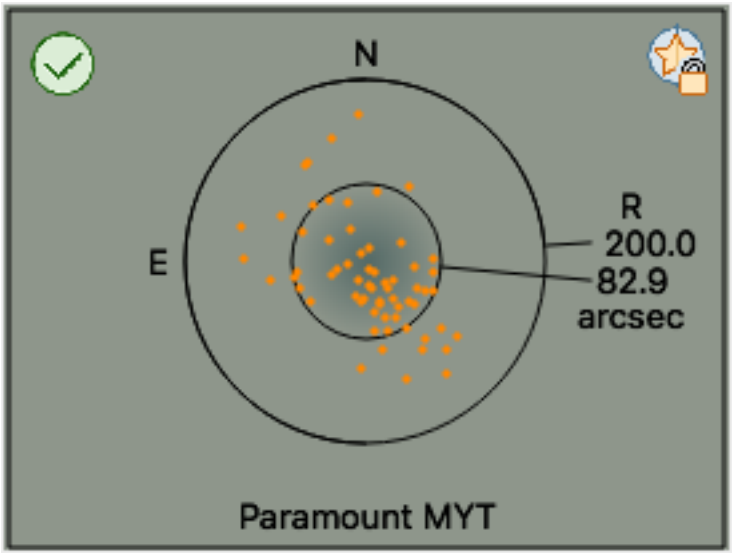
While the Automated Calibration Run is executing, you can rearrange your windows to better see the progress. You can also amuse yourself by watching the mount move around. If you walk up to the mount, be careful as it does move quickly and there are pinch points, so don't touch the hardware.

As the mount moves, examine the scatter chart. You will notice that the numbers labeling each ring will change. This is because the mount is exploring the sky and discovering pointing irregularities. At the same time, however, as the mount collects points, it actually updates the mount's pointing so the GoTo accuracy will get better.

You will have to watch the "Automated Calibration Run" window to see when the mount has finished. There is no grand announcement.



When the automated calibration run is complete, press the "Close" button in the "Automated Calibration Run" control panel (Not the close" button in the TPoint add-on).

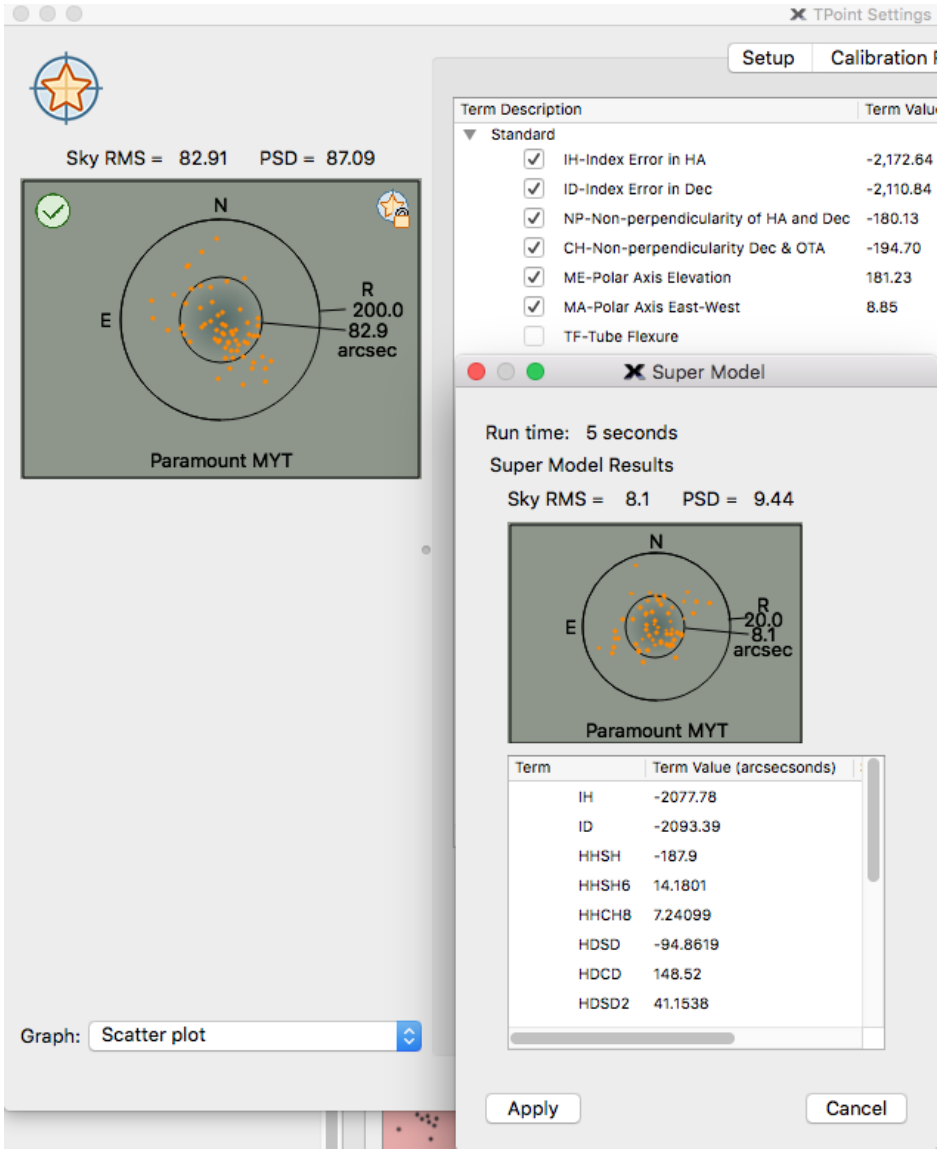


Now, take a look at the pointing accuracy. For the run above, the inner ring, where most points fell, is 82 AS. This means that TPoint should be able to get pointing within that distance from the desired location across the sky.

We can do better, however. The reason is because TPoint takes the points collected and models the mount's behavior according to a handful of basic "terms" or characteristics. By digging deeper, a more sophisticated analysis can incorporate more terms and improve pointing further. Traditionally, the user had to look over the terms, choose them and perhaps experiment. Today, the "super model" process has now automated much of this labor.

The first step is to finish the model by pressing the "Finish" button. Now, click on the tab that says "Model" and press the button towards the bottom that says "Super Model". After the calculation concludes, compare the two scatter graphs. If the new results are better, press the "Accept" button.

On my mount, the supermodel has created an order of magnitude improvement. My mount will now generally place a requested target within an area smaller than Messier 27. You could add more points and probably improve the mount's pointing even more. In my case though, if I need even more extreme precision, then I'll probably use Closed-Loop-Slew.



I am certainly satisfied with the pointing accuracy. For the moment, I will skip over the Polar Alignment tab, but I will discuss it in the next article. For now, switch over to the "Pro Track" tab and make sure that both the "Activate" and "Enable" checkboxes are ticked.

Pro Track is a system that subtly changes the mount's tracking rate in different parts of the sky based on information provided by TPoint. Think of it this way: Imperfections in the mount as well as refractions of the atmosphere may make objects appear to be located in a slightly different location than they should. TPoint compensates for this distortion when pointing, but Pro Track compensates for this distortion while tracking those objects through a "distorted area".

If you have a permanently installed system, you are pretty much done with TPoint. If you change your permanently mounted equipment, particularly the OTAs, then you'll want to create a **new** model. If you have a permanent system and take the system down for maintenance, but then put the same equipment up in the same configuration then you can do a "permanent mounted telescope" **recalibration** (so long as you don't change the polar alignment). If you are a portable user, but are simply setting up & tearing down the same gear then you will need to perform a "portable" **recalibration** (which assumes that the polar alignment has changed). The recalibrations use far fewer samples because they simply adjust the existing model and do not need to model every nuance of the system across the sky.

There are many additional functions within TPoint as well as cool tricks to help you optimize your use of TPoint. I encourage you to view the videos linked above and, most importantly, read the manual. I also encourage you to read the numerous posts by TPoint's author, Patrick Wallace, on the Software Bisque support site.

Once again: precision hardware combined with specialized software creates an amazing experience. You should now spend a few minutes slewing around to see the improved accuracy of your mound. Please don't obsess over TPoint, however. Use it to get Polar aligned and then take some real pictures!