Getting the most from your Meade Scope:
Polar Alignment – Part II

Overview

In the Part 1 of these two articles on Polar alignment with your Meade Scope, we covered the basics of Polar alignment from the standpoint of a basic understanding of how Polar Alignment works, scope setup, and we also covered the first of three alignment procedures, my version of Dr. Clay's Kochab Clock Method. In this second article we will continue where we left off before and cover a second method of Polar Alignment, the Iterative Method.

Since the first of the these articles came out a year or so ago, Meade has continued to improve the alignment procedures in the AutoStar Hand Controller and users of the AutoStar 497 (ETX, LX90, and LXD55/75) now also have the ability to have the 497 tell them how far off the scope estimates the mount is from true north upon completion of an alignment when in Polar Mode. This article will not delve into those new methods too deeply but will cover them briefly at the end of the third article (still in work) taking the user thru a Polar Alignment exercise using only the inputs form the AutoStar 497.

In the previous method of Polar Alignment, the Kochab Clock Method, the scope was still in a static state, in other words, we had not even turned the power on to the mount yet. The following two methods will be conducted after the power has been turned on and the scope initialized for alignment. I will not be discussing the initialization procedures here as they are specific to each mount, you should refer to your user manual for your scope to complete the tasks to get ready for the alignment. Suffice to say though, these would of course include turning on the power, setting the date and time, making sure your location is correct, scope is correctly oriented, etc. Once these tasks are complete and the scope is ready to be aligned you will be set to move onto the next alignment procedures.

The Iterative Method of Polar Alignment

I first learned about the iterative Method of Polar Alignment before I had heard of Dr. Clay's Kochab Clock and used this method for some time before including the Kochab Clock in my procedure. Now, it is just a natural progression for me to start with the Kochab Clock and then move directly thru the iterative procedure.

Like the previous method, the Iterative Method is a very handy tool to have in your arsenal as it is a very simple yet precise method of ensuring your scope is accurately polar aligned. Also, like the Kochab Method, I am not the original inventor of this method either, in fact, I am not even sure any longer where I first heard of this procedure, but I have performed this so many times that like everything else, it has now become my own as these things often do.

The primary idea behind the iterative method is that by using a step by step approach, you may achieve a very close polar alignment. This is done essentially by slewing back and forth between two stars (or iterating, hence the term), Polaris and some other well known star, making small corrections each time until they both eventually are perfectly centered on each slew. While I will detail this process in its entirety, there are essentially 5 rules that if followed will ensure your success:

1. When centering the scope on Polaris, always use the wedge controls only, never the hand box.

2. When centering the scope on the other selected star, always use the hand box and always sync on that star once centered.

3. When attempting to recenter Polaris, only move HALF the distance from its current position to the center (I will explain this in detail later).

4. Never select a star that is within 3 hours of the RA of Polaris. (more on this later also)

5. Select a star that is either close to the Zenith as possible or further away from Polaris.

To better understand how this method works, you must first understand a bit of how the AutoStar determines where the scope is pointing and how the Sync function affects that calculation. After completing a basic alignment (Easy, 1 Star, or 2 Star) the AutoStar stores this information internally and uses that data to determine where the scope is pointing at any point in time and how far it has to slew the scope in order to move to another object in the sky. Initially, even with a poor polar alignment, the AutoStar will do a pretty good job of slewing between objects, but as the evening wears on, the effects of a poor alignment will evidence themselves in two ways. First, you will see drift in your images as oblong or streaking stars, but also you will find that the precision of your Goto's will degrade over time. This is because the scope is "drifting" with respect to the true rotation of the sky and has no way of knowing that the polar alignment is off and therefore will simply use its internal calculations to move or slew the scope the location it thinks the next target is.

Syncing is a method whereby we can correct the current location of the scope to a known star or object. When we sync the scope on a known object, the AutoStar updates its internal coordinates such that it now correctly knows its position in the sky. This is a very handy tool to use when imaging to ensure your objects are well centered on the chip of your camera and Meade has included High Precision Pointing in the AutoStar which essentially does the same thing as a manual Sync. But also, because of the way the Sync function works, we can use it as a tool to help us achieve a better polar alignment as well.

In the Iterative Method of Polar Alignment, we will use the Sync function to correct the AutoStar in a very precise manner for a given object's location. By doing so, we will also ensure that Polaris is not where the scope thought it was prior to the Sync. Why is this important? Because after each Sync, we will then use the fact that Polaris will not (at least initially) be centered when we slew back to it and we can then make a mount adjustment to get it closer to where it should be. By doing this several times, we will eventually get the star we are Syncing on and Polaris to both slew between each other and be perfectly centered each time. Once we are able to do that, the scope will be very well Polar Aligned. If this sounds a bit confusing right now, don't worry, it is actually very simple and after a few times of using this method you will be able to do it very quickly.

Getting Started

As stated above, the first thing we need to do is get the scope as accurately pointed towards true north as possible and perform an initial alignment as we would do any other time. In setting the scope up for the alignment, I would strongly recommend using the Kochab method described in Part 1 of this series as this should make the iterative method we will go thru here all the much easier and faster. The actual alignment method you select is totally up to you and has no bearing on the rest of this procedure and is purely a matter of personal preference.

After you have successfully completed your alignment, we can then begin the Iterative Procedure. To do so, we must first select a star that will be used as our reference Star for the remainder of the procedure. In the 5 rules mentioned previously, the 4th rule states that in selecting a reference star, we want to ensure that the star selected is not within 3 hours of the RA of Polaris. The RA of Polaris is about 02:30 (Epoch 2000 and by 2010 will be about 02:45). So, for this procedure we will want to select a star that has an RA of at least 05:30 or greater or 23:30 or less. The reason for this is simple, we are trying to get as much movement in both the RA and DEC as possible. If the star selected for our reference and Polaris are close in RA, then the scope will simply slew in DEC and we will never get much in the way of angular separation in which to make our corrections. In fact, if the RA of the Reference Star is less then 3 hours or so from Polaris, we may never be able to use this procedure as the angles will never close or worse yet, may close erroneously leaving us thinking our alignment is good when it isn't.

The other point made in rule number 5 is that we want to select a star that is a good distance away from Polaris in DEC as well. This is probably the easiest of the two as we simply select a star near our Zenith (straight overhead) or more towards the south in the Northern Hemisphere. This will ensure we have plenty of DEC movement. Using these two rules, you can select any reference star you wish though I would recommend selecting one that is bright enough to easily pick out and easily located on your hand controller as we will be switching between it and Polaris many times during this procedure. During the summer, I find that Vega is a good star to use and the one we will use for the remainder of this article.

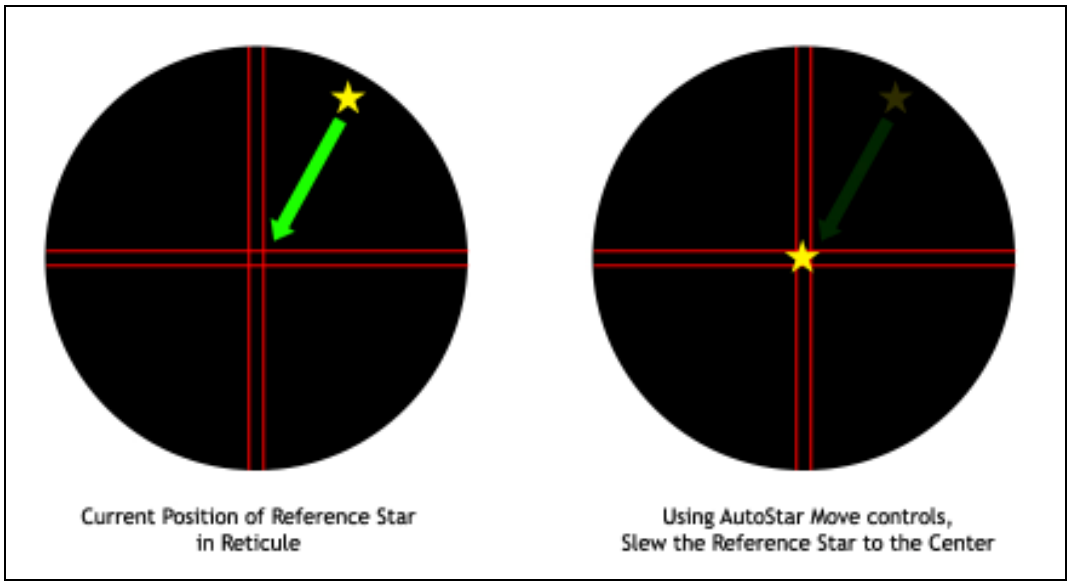
Finally, before we get started, there are a couple of other points I think are worth considering. First, depending on the time of year, your scope may end up in some fairly strange configurations, especially when pointing at Polaris. This can make things a bit difficult at times when trying to look thru your view finder or even a diagonal, especially when the scope has to roll completely upside down in order to center on Polaris. For this I would recommend, if you can, that you use a right angle finder. We will be using the finder itself quite a bit, especially at first, and a right angle finder can save you from a serious crick in your neck. Secondly, if possible, use a finder with an illuminated reticule. Though not impossible without the reticule being illuminated, it will certainly make things a lot easier when trying to ensure you are moving towards center. And finally, if possible, use a camera in the scope for the final portions of this method. This can sometimes be difficult due to the clearance you may have when pointing at Polaris but will definitely make this procedure far more precise in the final steps and once again, will certainly save you from getting that crick in your neck.

Starting the Iterative Method

Now that the scope is aligned as we have selected our reference star, we are ready to begin the Iterative Alignment Procedure. The following steps will take you thru the procedure start to finish.

1. Locate your Reference Star in your AutoStar Controller and slew the scope to the star.

2. Using your Finder Scope and the move buttons on the AutoStar (*NOT the wedge manual adjustments*), ensure that the Reference Star is as close to center as possible. Then, using a fairly high powered eyepiece (preferably with a cross hair reticule or even your camera), ensure the star is perfectly centered as seen below:



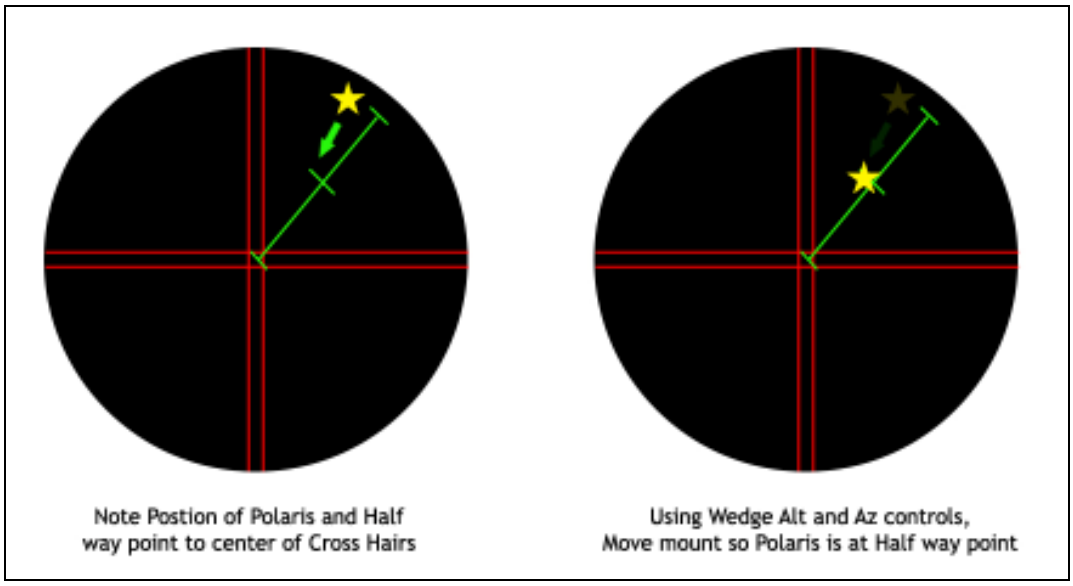
3. Making sure the star is still selected in your AutoStar, press and hold the <ENTER> button for 3 seconds until the scope beeps. Ensure that the star has not drifted in your eyepiece and press the <ENTER> button a second time. The scope will beep again telling you it has successfully Synced on the selected star.

4. In the AutoStar, locate Polaris and click the Goto button. The scope should now slew over to where it thinks Polaris is based on the last Sync we performed in step 3.

5. When the scope has stopped slewing, Polaris will most likely not be centered in the eyepiece or even the finder scope. This is fine and what we expected. We would expect though that Polaris should at least be in the finder scope if not in the eyepiece itself depending on how close to true north your initial setup is.

6. If Polaris is not even in the FOV of the finder, using the manual adjustments on the wedge (NOT the move buttons on the AutoStar), begin to move the scope such that Polaris ends up in the finder scope near the edge. DO NOT try to take it all the way towards the middle as this will only throw off your alignment.

7. If Polaris is in the FOV of the finder scope as we expect it should, we will now make the most important correction of this procedure to the wedge itself. Using the manual East / West and Altitude controls on your wedge, first note the current position of Polaris and then, making small movements, adjust the manual controls such that Polaris begins to move towards the center of the crosshairs, but, and this is VERY IMPORTANT, only move Polaris HALF WAY from it's current position towards the center as seen below:



(Note: The image above is to be used as an example only of moving Polaris half way to the center. Where Polaris is in your scope will differ, move it half way from that point towards the center)

8. As in Step 1, select your reference star in your AutoStar controller and slew the scope back to the star. Because we made a wedge adjustment, we should expect the star to no longer be centered and will probably be off about as far as Polaris is now from the point that we moved the scope.

From this point on, repeat steps 2 thru 8. With each iteration, the amount of distance moved in each step should grow progressively smaller until both the reference star and Polaris are perfectly centered as you slew back and forth between them. At some point, you should no longer need to use the finder scope at all and should be able to perform the remainder of the procedure using your high powered eyepiece. Once both stars are perfectly centered between slews, your scope should be very well Polar aligned.

Follow-up and Possible Issues

One thing that I have found is particularly useful when performing the Iterative alignment method, especially in the last few iterations, is to use the camera, preferably with cross hairs on the screen, to make my final adjustments. The camera will generally show the stars at a slightly higher power then what you can see visually and it is obviously easier to use then straining your neck to look thru the diagonal or finder scope. This will also be far more precise and will help to ensure you are getting as close to a prefect polar alignment as possible.

There are a couple of things that can come up when performing this procedure that can make it difficult. One of the most common I have seen is moving Polaris too close to center using the wedge manual controls. The result of this is that you may end up swinging to the other side on your next iteration because you have moved it too much. I have generally found that erring on the side of moving Polaris less then half way is far better then going too far. If you do encounter this, then just continue with the steps moving Polaris the opposite direction in the successive iterations.

Another issue you might run into is that the closure, at some point, begins to slow down or stop all together. In other words, you slew to Polaris having just completed the slew from your reference star and Polaris is no closer then it was before. The first thing to check here is to make sure you remembered to Sync on your reference star after you slewed to it prior to returning to Polaris. I have done this a few times and it will certainly make you think something is wrong. But, if you have been syncing correctly and Polaris is still not closing on the center of your reticule, your reference star may not be far enough from the Polaris RA. I find that during the winter it can be particularly tough to find a good reference star as opposed to the summer (for my location). If this continues to happen, you might consider selecting a different reference star and starting the process over again.

Finally, you might find that after you have done this entire procedure, your mount may be very well polar aligned and hold a star dead center for a long time, but your GOTO's are now way off. This is probably as a result of one of the down side's to SYNCing on a star during this process. Syncing on a star really only corrects the internal "mapping" of your AutoStar for the quadrant of the sky in which that star is found. In fact, it can actually throw off other portions of the sky. If this is a problem for you after this procedure, simply return the scope to its home position and do a normal Easy or 2 Star Alignment. Since the mount itself (generally a wedge) is now nearly perfectly aligned, be sure to not move it at all during a re-alignment but make corrections only with the AutoStar Controller.