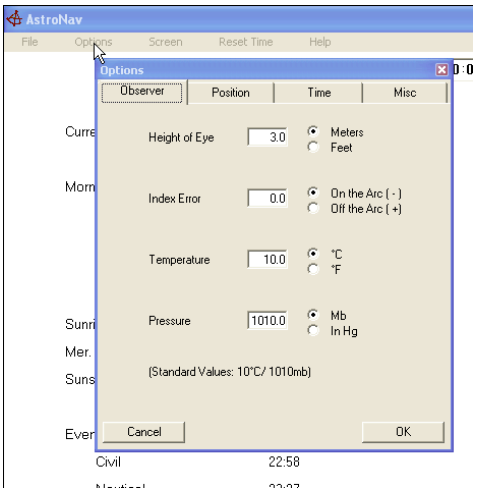
Using AstroNav to Calculate a Position

Initial Settings

There are three items that should be set immediately. These are:-

- Height of Eye.
- Index (Instrument) Error
- Position

These are set using the Option Menu and selecting the "Observer" tab. Note that these settings are used throughout AstroNav and are stored between sessions.

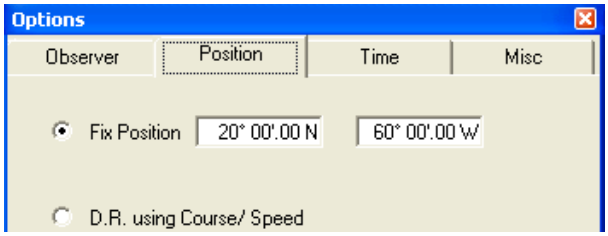


When Index Error is introduced, screens will display Sextant Altitude instead of Observed Altitude.

Temperature and Pressure corrections (to Refraction) are small. These can be left at the default values of 10° C and 1010 mb. These are usually ignored in manual calculations.

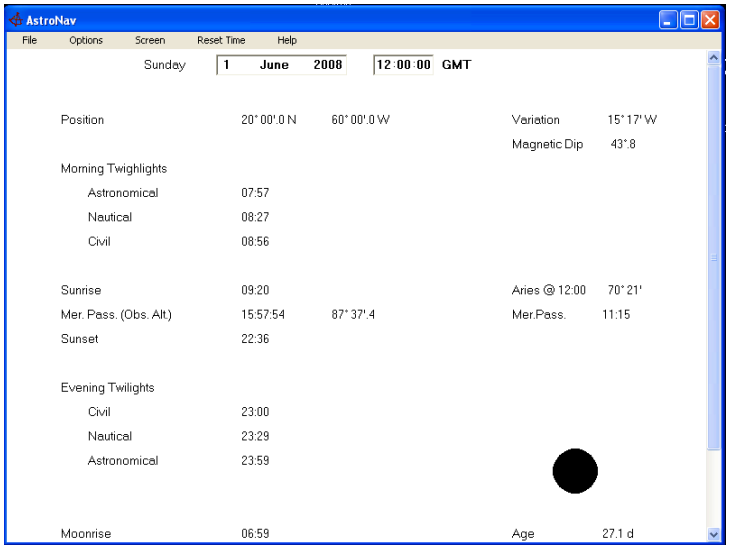
The Time Zone should be left at 0h or GMT (UTC) until familiar with the program.

The “Position” tab allows an initial position to be set. (Course and Speed will be addressed later.)

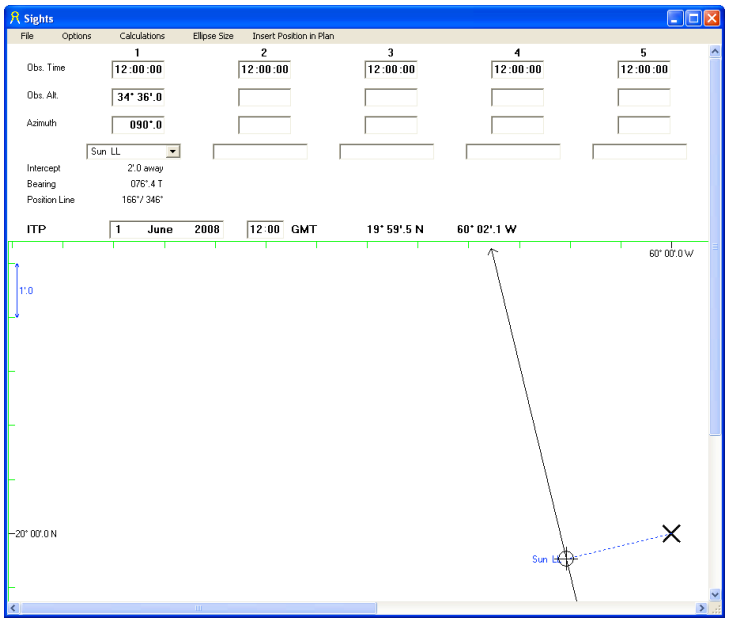


North/ South and East /West are changed using the + and – keys or n/s and e/w.

Clicking on “OK” causes all information to be recalculated based on the new values

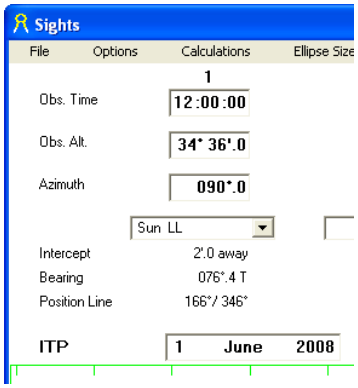


For a first sight, “Screen”/ “Sights” should be selected. This opens in a separate window



The information needed is time, altitude and approximate bearing.

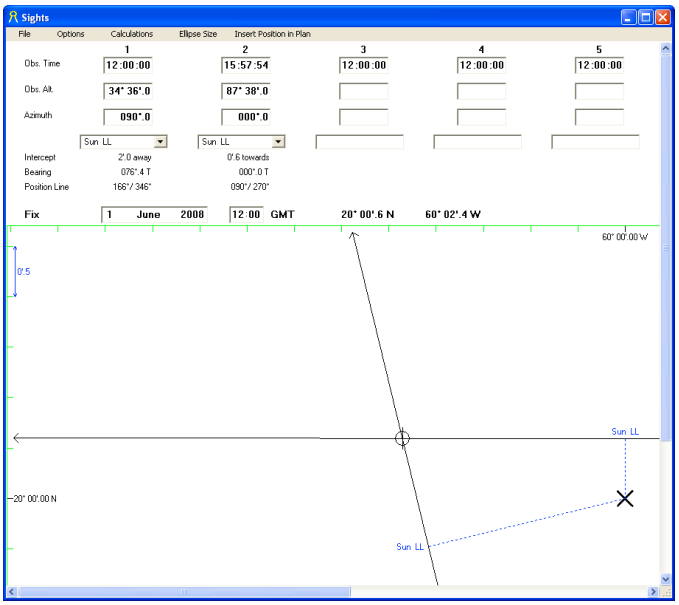
After an altitude and approximate azimuth are entered, the drop down box may (rarely) offer alternatives. These are filtered according to settings in the Sights' Options and dealt with later.



The information below the drop down box is the solution for this sight. The Intercept is the difference in distance between a calculation based on the initial position in use (Calculated Zenith Distance) and the distance measured by sextant. (True Zenith Distance.)

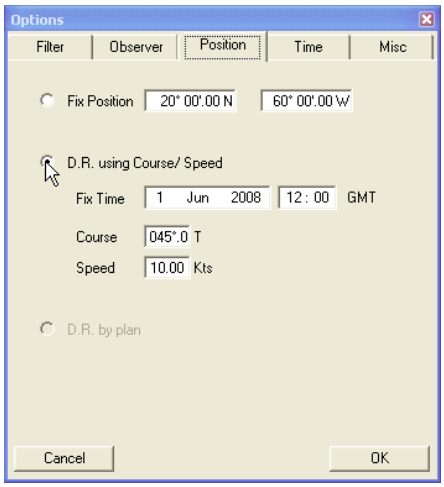
A single sight provides a position line therefore only an Intercept Terminal Position (ITP) is available at this stage.

Adding a second sight for the Sun crossing the Meridian provides a Fix.



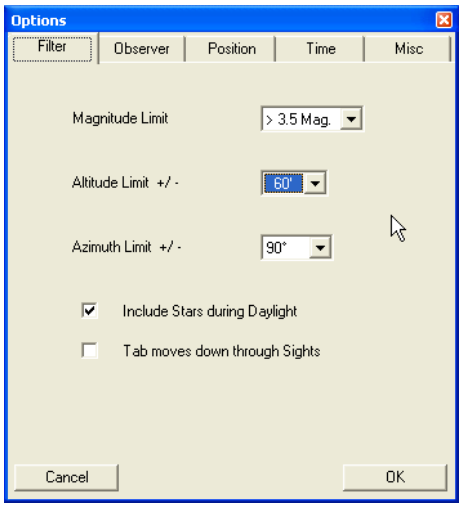
Allowing for Course and Speed.

The Options tabs vary according to which screen they are accessed from. In this case the Options accessed from Sights includes a "Filter" tab.



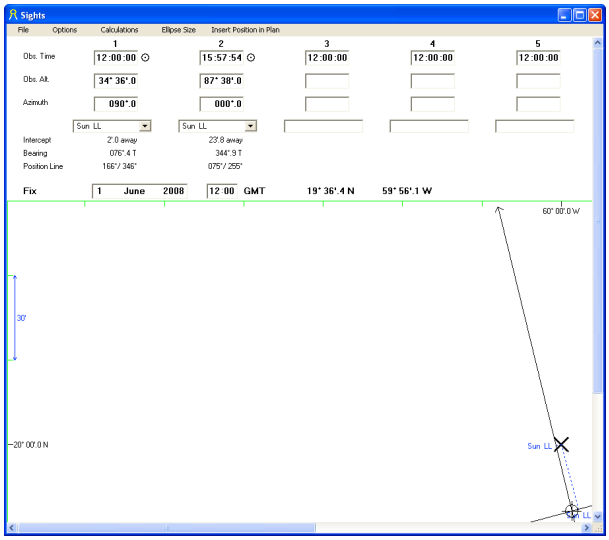
Clicking on the "D.R. using Course/ Speed" will cause all information in AstroNav to be calculated based on the expected position at that time. (D.R. stands for Dead Reckoning in other words an estimated position based on course and speed alone.)

Returning to the Sights Screen will cause the second sight to have lost alternatives for this sight. There are no bodies within the filter limits which therefore need expanding.



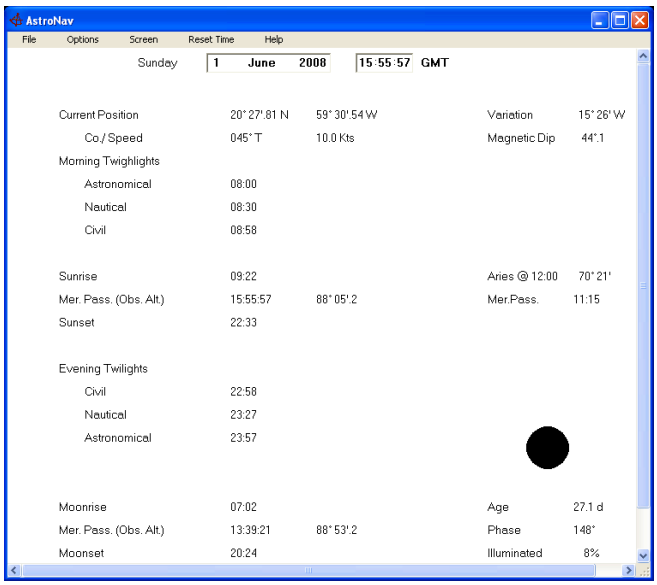
Increasing the Altitude Limit to +/- 60' will provide alternatives.

On returning to the Sights screen, Venus is offered as the selected body initially because it has a smaller intercept than the Sun's Lower Limb. After "Sun LL" is selected from the drop down list, its intercept is now 23'.8 and the bearing is 344°.9T.

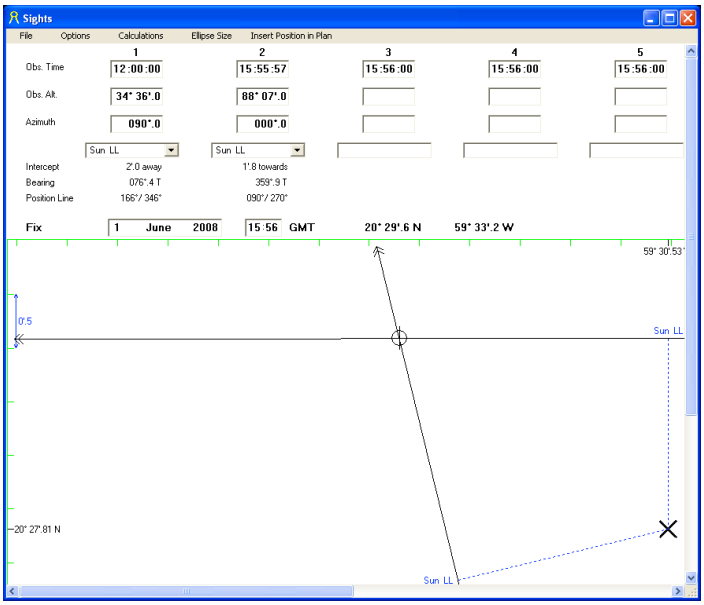


The second Position Line was brought onto the plot in the above screen shot by right-clicking on the plot to zoom out. (A left-click will zoom in.)

If the Sights' screen is closed and we return to the main screen, Course and Speed are now visible under the position. This now shows that the Sun's Meridian Passage will take place at 15:55:57. If the time is adjusted to that, then the position shown will be for that time.

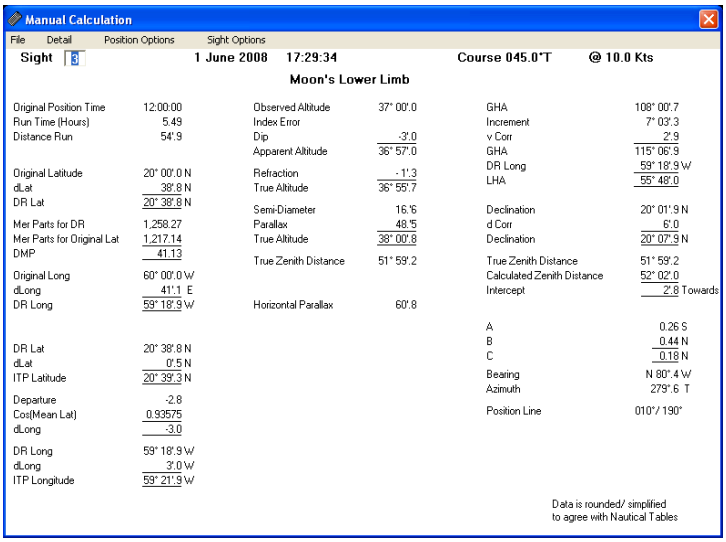


If the Sights' screen is reopened and the time of the second sight is amended to 15:55:57 and the altitude to 88° 07'.0, the Intercept changes to 1'.8.



In practice, the time of the fix sought will be the time of Meridian Passage. In the example above, the time of the fix has been changed to 15:56.

Many people will want to calculate a sight manually. The results using tables can be found using the "Calculation" screen available from the Sights' menu bar.



This gives the values expected using Nautical Tables to perform a manual calculation. There are various alternatives to align this with personal preferences. For instance Mercator/ Plane Sailing for positions and/ or additional corrections such as for Augmentation of the Moon's semi-diameter can be included.

An explanation of the terms and methods will be found in the Celestial Navigation Tutorial.

Star Sights

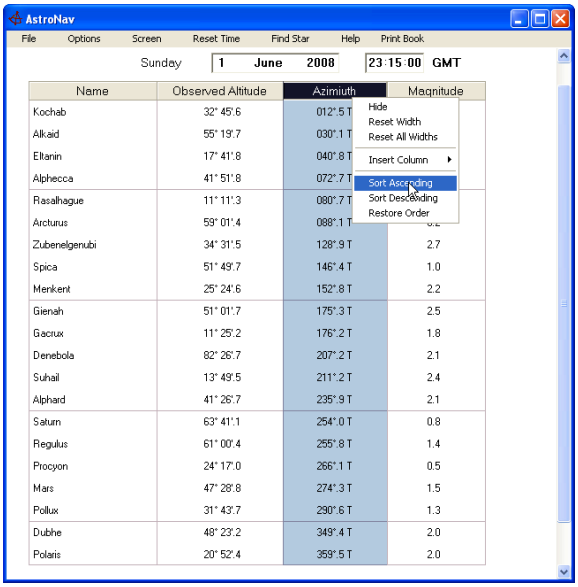
Sun sights are convenient however the position lines are being transferred over a period of several hours. Any inaccuracy in the assumed course and speed will degrade the accuracy of the final fix. Minimising the interval between sights is highly desirable.

If the Moon is visible during the day then it offers a second position line to compliment one from the Sun. However the most common means of obtaining an accurate position is during Nautical twilight when both stars and the horizon are visible. This allows several sights to be taken over a relatively short period which minimises the effect of any error in course or speed.

The first step is to find the time of Nautical Twilight. This is when both the horizon and stars are normally visible. It is found on the main screen. From the screen shot above, this is shown to be between 22:58 and 23:27. In other words, between the end of Civil Twilight and the end of Nautical Twilight.

Many people will list the expected altitudes and azimuths of the stars that they intend to use. This can be performed using the AltAz screen.

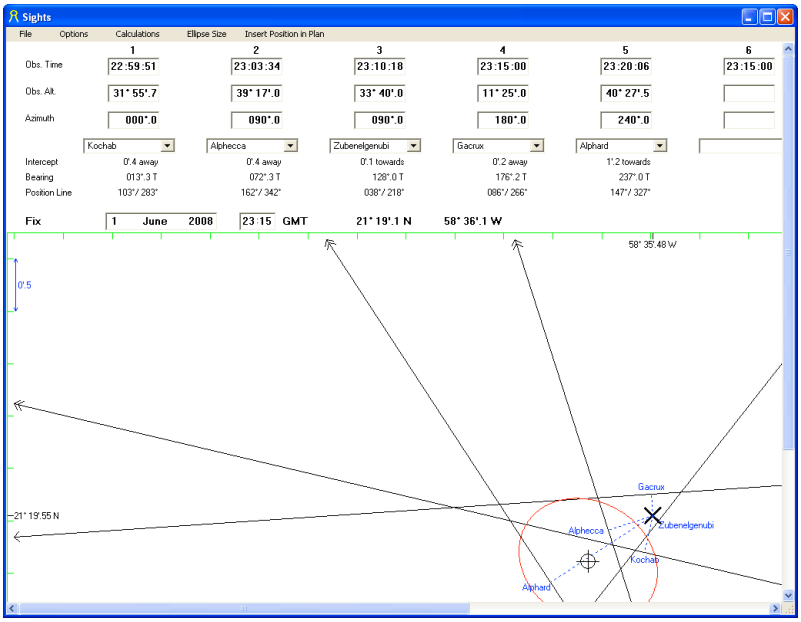
Using a time during Nautical Twilight, information for the bodies available are displayed. By default the list is limited to bodies above 10° and the main stars. This can be changed from the Options screen.



This list has been sorted by Azimuth. This can be used to prepare a selection to offer complimentary position lines. Alternatively, it can be used to fill gaps while taking star sights.

Columns can be added, remove or rearranged using the AltAz options.

Once three sights have been entered a red confidence ellipse is drawn around the position. This position is the mean of the intersections. (If there were enough sights to be statistically significant then the three ellipses would be 98%, 90% and 67% confidence limits.)

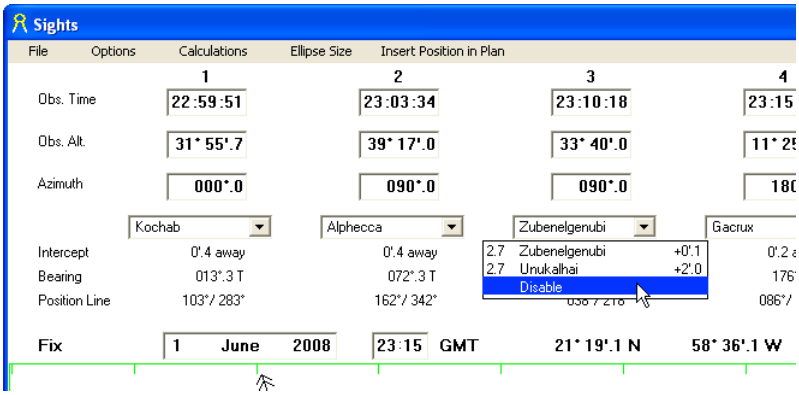


The quality of the fix is immediately apparent. This may suggest taking additional sights, perhaps in a particular direction.

Filtering Sights

There are 68 main stars used for navigation but nearly 270 of equivalent brightness. (The dimmest main star is Acamar at 3.2 Magnitude.) On average they are separated in altitude and azimuth by 12°. These two "average" stars may be at the same altitude separated by 17° in azimuth or vice versa depending on their altitude and direction from the observer. In reality they are of varying distances apart.

Setting the Filter to 3.5 magnitude ensures that these alternative stars are included.



The only potentially ambiguous star is Zubenelgenubi. Both stars are the same brightness and only 30° apart in bearing. (Unakalhai bears 097°.) This may prompt another sight or this observation can be disabled due to possible ambiguity. Whatever, you have been warned about this observation.

The additional benefit of setting the filter to a magnitude is that it removes the need to identify the star. AstroNav does this by providing a list satisfying the filter settings.