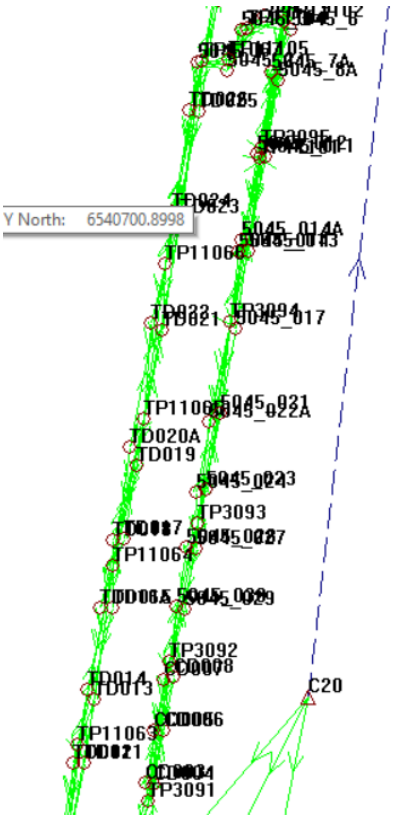
Grid Bearing Solution for Mine Surveying



ADDING Azimuth Grid Bearing in MOVE3

The grid bearing is mainly to exclude a possible rotation in the adjustment due to fix stations being close together and to get similar results for the coordinates with previous adjustments. This way you can fix the orientation of the network.

Measured gyro azimuths will do this also, but due to limited accuracy and the fact that in mines they can only be measured over short distances their effect on controlling the orientation will be limited.

We suggest to use the computed grid bearings only if there is no other solution to better fix the orientation. If a network is well braced then this method less applicable. For example: if there are control points at the 2 entrances of a mine, so the control points are further apart than what you would have with just one leg and an narrow entrance this is well braced.

For Mine Surveyors who run into the problem with limited fix stations, fix stations close together and in the same direction as the network one narrow leg then adding the **Grid Bearing** is the solution for you!

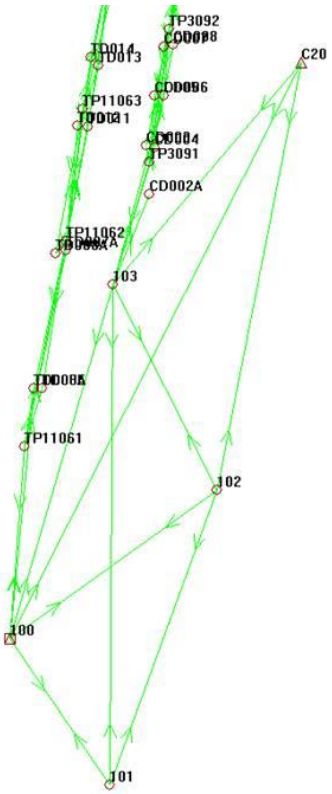
Would Gyro shot solve this problem?
The gyro's fix the orientation of the network. This is also fixed by the known points, so there may be a conflict there (azimuths versus known coordinates).

By measuring azimuths in a mine, it is usually not possible to take long lines so to some extent before and certainly after the measurement you will again be building up uncertainty with each leg of the network. So adding a few azimuths in a large network does not bring a lot of improvement.

Problem

If the fixed stations are at one end of the leg there is a risk that in a remeasurement you will get coordinates that are rotated.

For example if there is a short basis that is fixing the orientation of a 1 km mine network leg the solution is depending on the final solution of the orientation. So your largely dependent on the measurements at the beginning, any small difference in the orientation on this 100 m difference in East between fix station 100 and fix station C20 will lead to al 10 times as big difference in the East of the points at the at the end. This is a leverage of 10 times. This is also expressed in the standard deviations of the East of these points that is up to 10 cm.

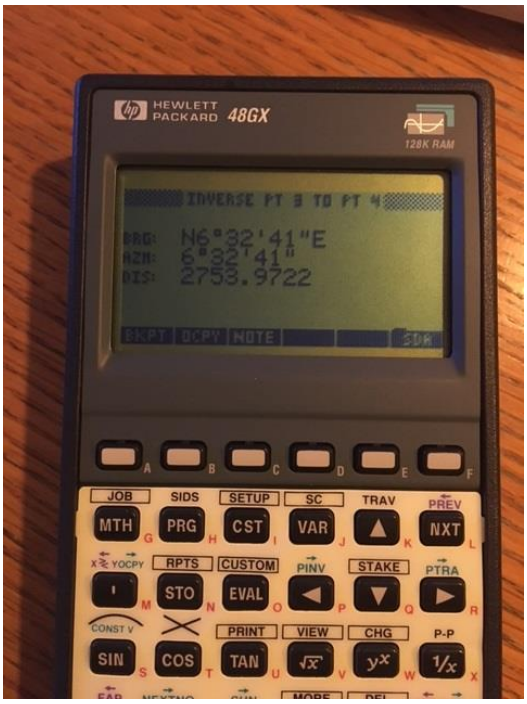


It is like a leverage, one mm difference at the one end of stations being 10 m apart can easily multiply by 100. If the leg is 1000 m long, so the 1 mm will become 10 cm. To avoid this rotation the grid azimuth can be entered to force both networks in the same orientation. To do this it would be best to take the grid azimuth between an **arbitrary fixed station** and an **arbitrary station** at the other end. Of course you should always be aware of what you are doing, and that using the grid bearing orientation will affect the final solution. From a perspective of trying to match the results of 2 separate check surveys. It seems a good option to resolve the weak orientation caused by the location of the fixed stations close together.

How to calculate Grid Bearing for MOVE3

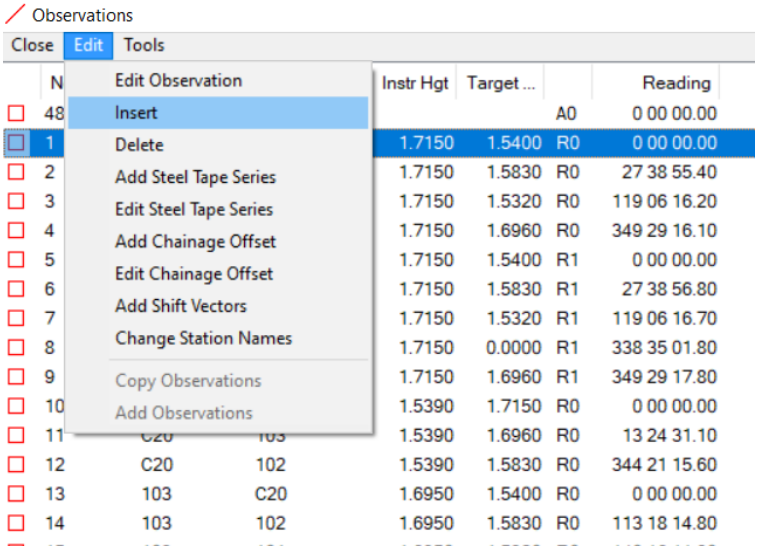
After successful adjustment in MOVE3

This needs to be done by hand, or in excel using an arctan of the coordinate differences in North and East of the points. Easily you can use your cogo software in your Leica or Trimble field controller also to calculate the azimuth bearing. Or pull out your old HP calculator with survey solutions.



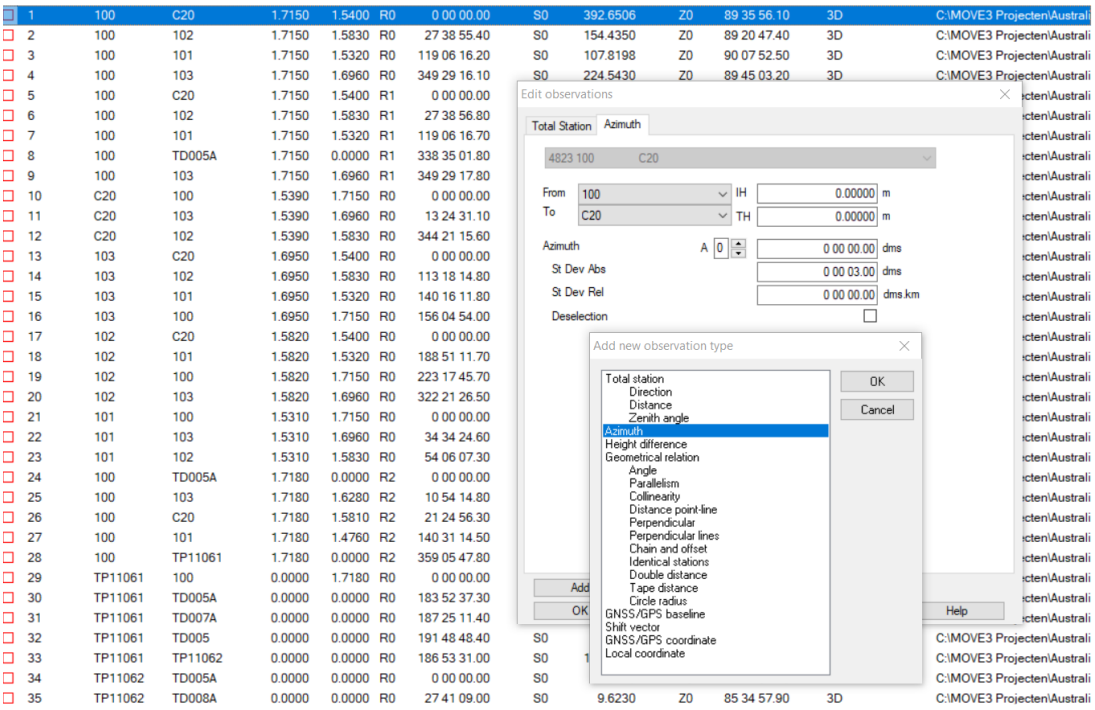
Adding the Grid Bearing in MOVE3

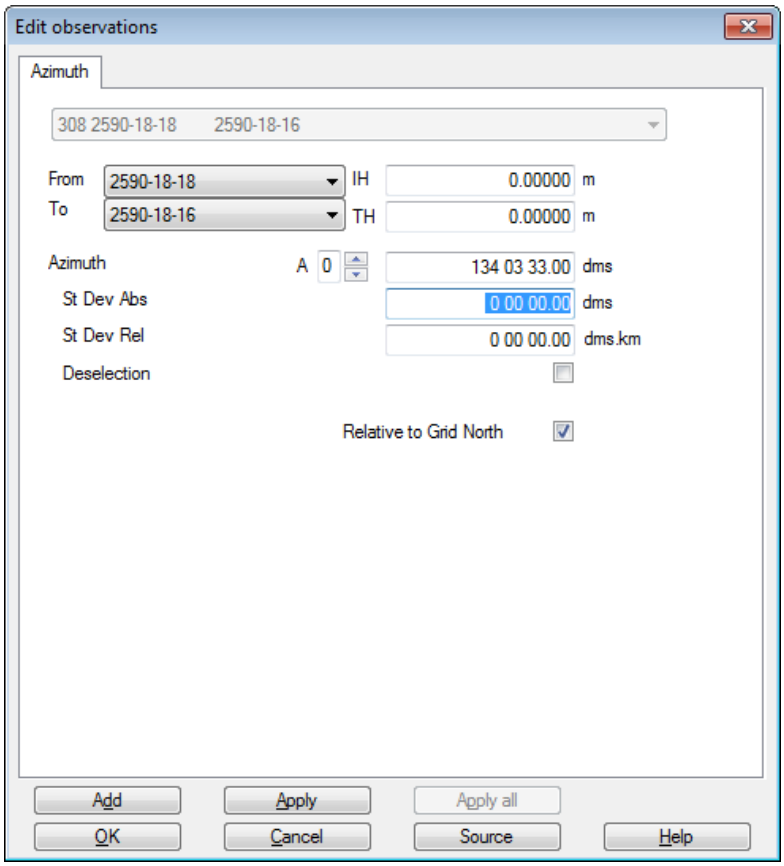
Observations – Edit – Insert - Azimuth



Or

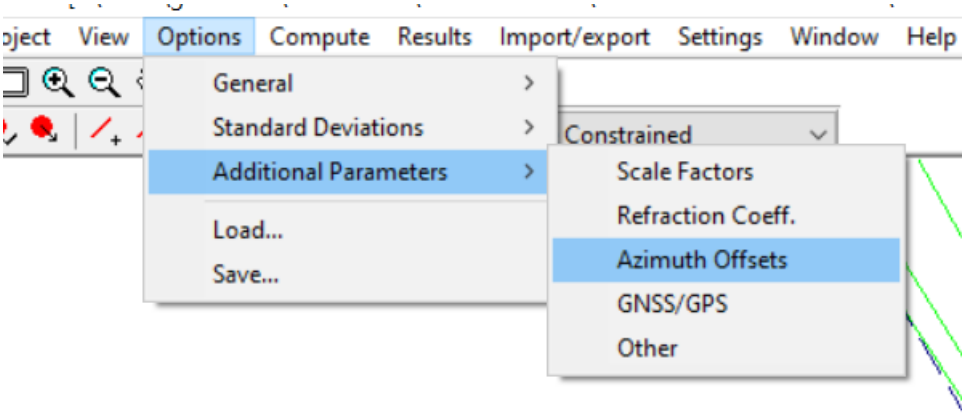
Double click on observation **ADD - Azimuth**

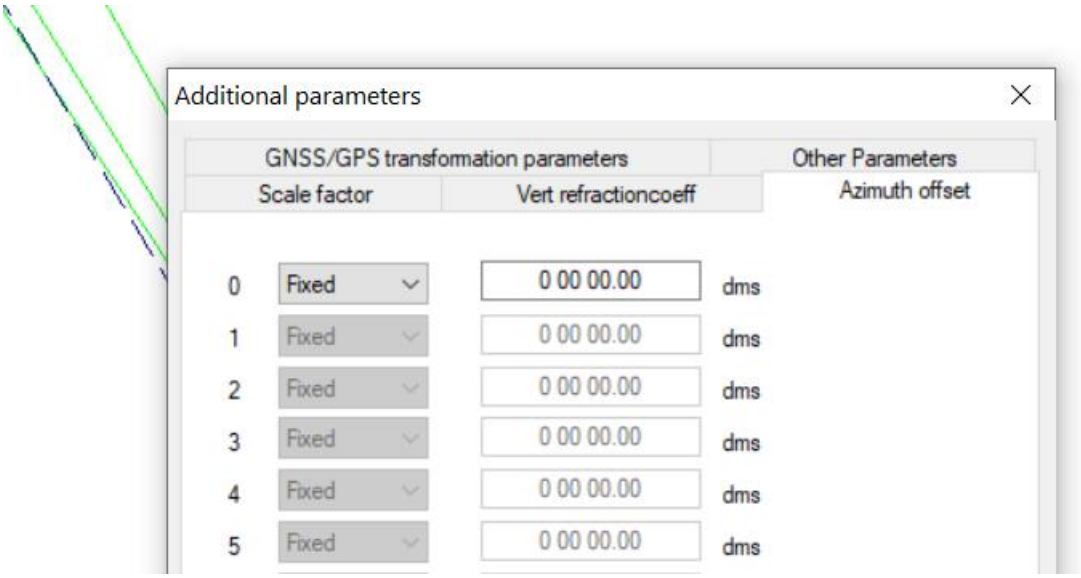




Since you are adding this as a constraint, and not as an observation it would be best to use 0 St Div.

If it is a grid azimuth also check Relative to Grid North. Be sure to have the Azimuth offset fixed.



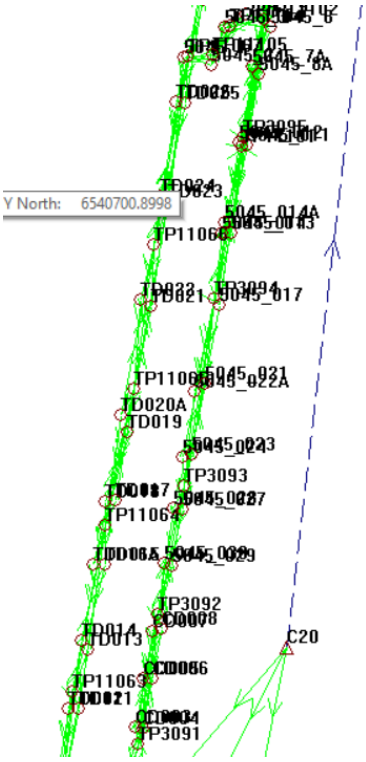


By adding the theoretical bearing of a long line as a azimuth measurement you will be able to fix the orientation of the network and get better standard deviations at the end. The largest ones will now be probably somewhere in the middle, but smaller than before.

Question

Would adding one grid bearing observation be enough could you add more?

Usually one would be enough, especially if it is a straight leg. Maybe if you include more separate legs in the network you would like to include one for each leg.
If there is a large bend in the leg then the azimuth from the beginning to the end may not be able to avoid that there are differences at a bend.



Wayne Pappas

MOVE3 Australia July 2021