Conversion to Local Coordinate System

There are many applications when surveyors need to have their own local coordinate system or make a conversion between the datum used in the project to their local system. This report will go over the procedure of doing so in GrafNav and is divided into two Sections: Section 1 explains how to create a grid profile that will define a local Cartesian plane coordinate system, which can be used as a grid in Export Wizard. It creates a coordinate system composed of a flat plane referenced to the earth (at an origin point). Section 2 uses a 4-parameter transformation so it is important that the user has 2 points with known coordinates in their GrafNav project. Information regarding these sections can also be found in the manual in Sections 2.5.1 and 2.7.3.

Section 1 Defining a Local Cartesian Grid

Figure 1 below shows a geographic interpretation of the local Cartesian grid.
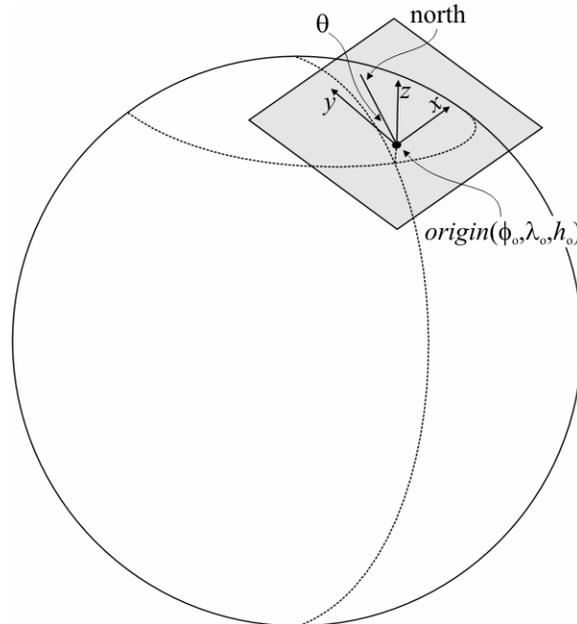
Figure 1 - Geographic Definition of a Local Plane

Essentially, the plane is tangent to the earth at the user-defined origin, with an orientation that is also defined by the user.

In GrafNav, open up a project and click on Tools > Grid/Map Projection > Define. The window in Figure 2 below should pop up
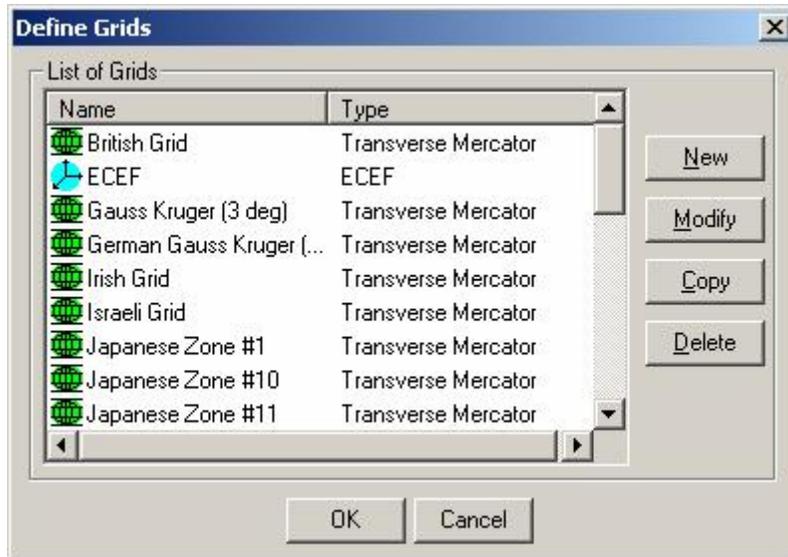
Figure 2 - Define a Grid Window

You will need to give a name for your local grid system. Be sure to select 'Local Cartesian' as the type. Click Next.
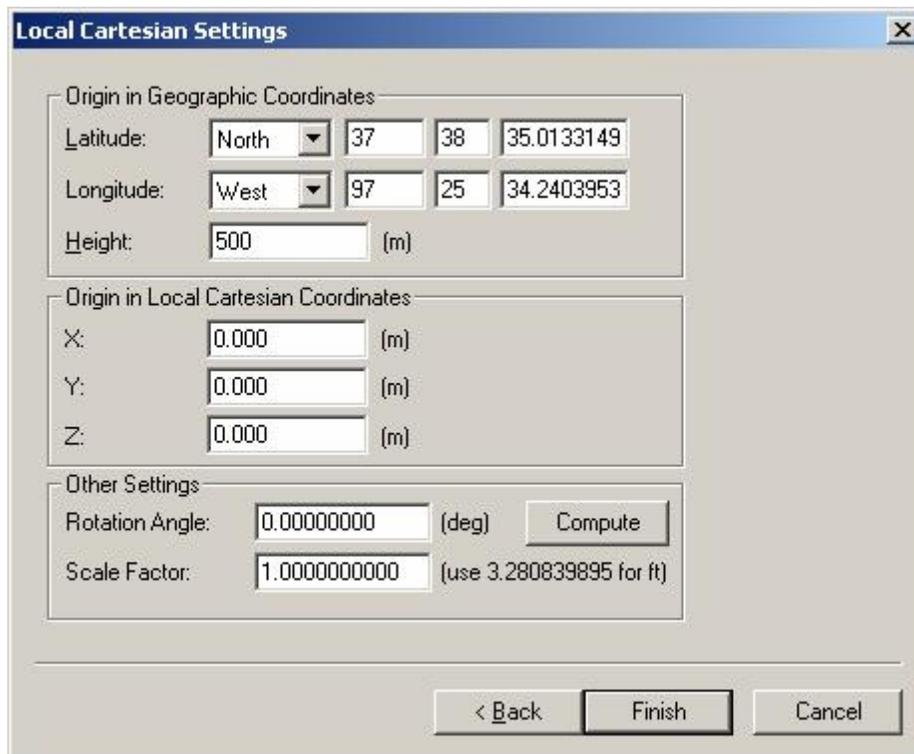
Figure 3 - Local Cartesian Settings

Now the origin of the system needs to be specified. Enter the latitude and longitude of one of the known points as the origin in geographic coordinates. If the height is unknown, enter the approximate height of the point. Entering a height will make this elevation zero in the output. For many applications, it is best left at zero. The origin in

local Cartesian coordinates also needs to be specified, however, this is generally kept at zero. See Figure 3.

Generally, if the Y-axis is to be parallel to north at the origin, leave the rotation angle at zero. Otherwise, determine the rotation angle by clicking 'Compute'. See Figure 4 below. The latitude and longitude of the second known point must be entered to determine the rotation angle. The orientation of the grid can be determined by selecting the location of the second point. It is up to the user to decide how they want to arrange their local coordinate system. Click OK.
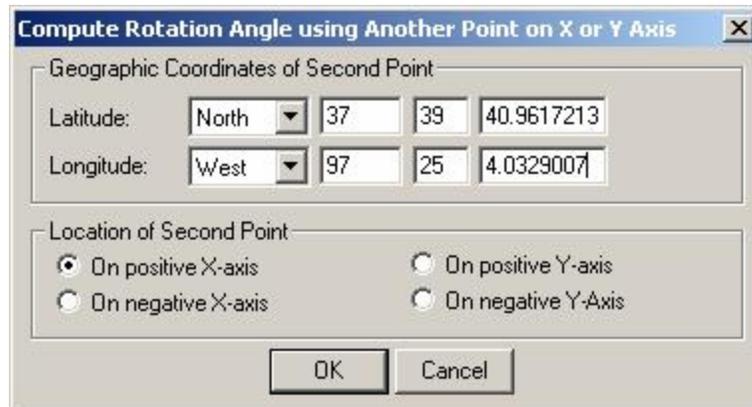
Figure 4 - Enter Second Point

A window should pop up, indicating results of the transformation, giving the rotation angle and distance between the two points. The scale factor can be left at 1, or it can be corrected for ellipsoidal curvature. Ellipsoidal curvature is a correction due to the ellipsoid. The ellipsoid is a model to represent the shape of the earth. An ellipsoid is a better geometric representation than a sphere, due to slight flattening at the poles. The correction is given by the following formula:

$$s = \frac{R}{R+h}$$

Where R is the radius of curvature of the earth (R = 6371 km) and h is the approximate height of the second point. Note that h is in km.

Click Finish. In the list of grids, you should see the name of your local grid with the icon next to it. As well, the user can now select this grid in their own Export Wizard profile or as the selectable grid profile already available.

Section 2 Using Local Coordinates Profile in Export Wizard

Before using the Local Coordinates profile in Export Wizard, at least 2 points with known coordinate must be loaded into the current project. These points can be:

- The master station, shown as a green triangle on the map.
- Other GPS stations, shown as yellow triangles.
- Loaded stations, shown as pink triangles.

To load stations with known latitude and longitude, an ASCII text file should be created with the following format (see Figure 5 as an example.)

Station_ID Lat_deg Lat_min Lat_sec Lon_deg Lon_min Lon_sec Ell_height (meters)

Spaces or commas can be used to separate the station ID, latitude, longitude, and height. Note that decimal degrees can be used as well.
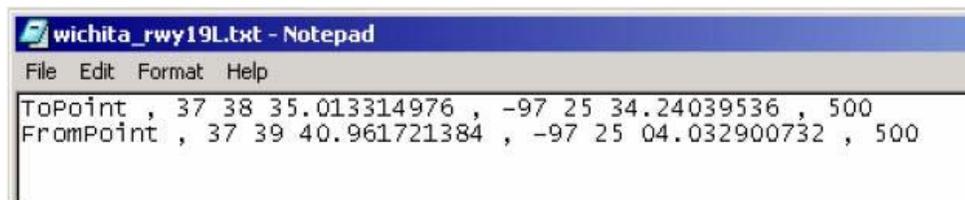

Figure 5 - Text file with geographic coordinates

In GrafNav, click File | Load | Stations with known lat/lon. A dialog blox pops up like the one shown in Figure 6. Locate the path of the text file with the lat/long coordinates and select the appropriate format and string handling. Click OK.
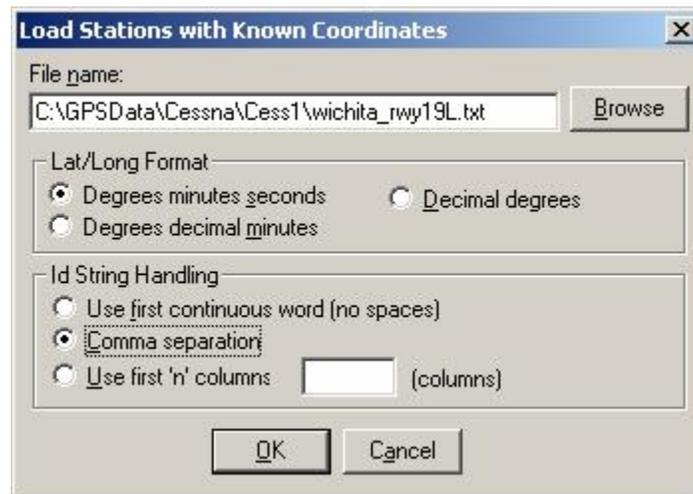
Figure 6 - Load Station with known coordinates

Pink triangles should show up on the map (like the one shown in
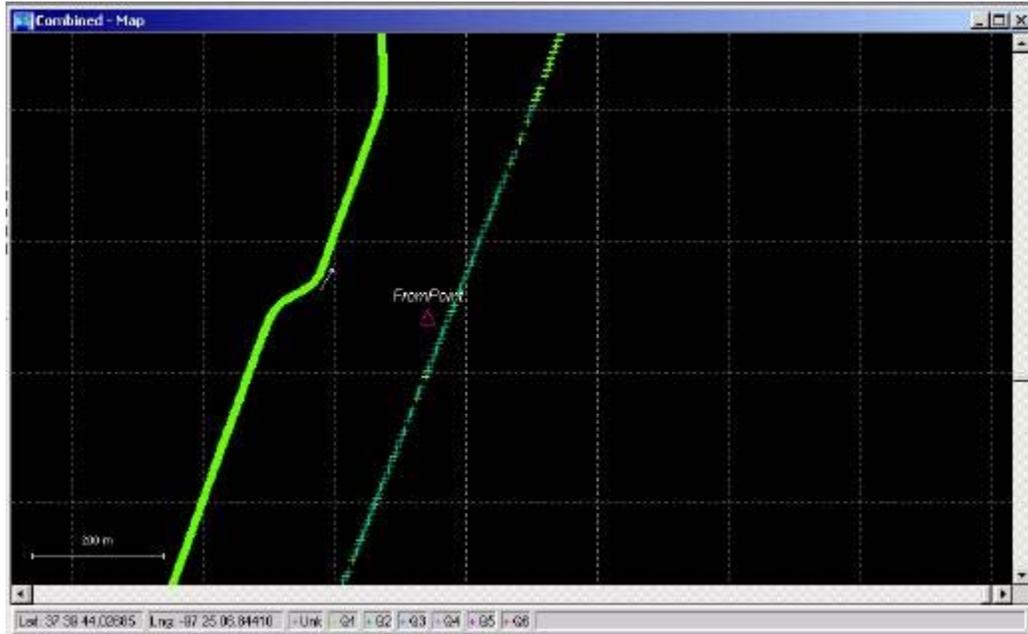
Figure 7 - Loaded station on the Map

Next, go to Export Wizard (Output | Export Wizard). Make sure that you have a forward, reverse, or combined solution loaded into your current project. Select the Local Coordinates profile (or your own profile that contains local plane coordinates). Click Next. Once you get to the Local Coordinate Transformation screen, you'll need to add your stations and reference then appropriately. Click Add. Under the name of the station, click search and locate the station as the master station, another GPS station, or a loaded station. See Figure 8. Click Select.
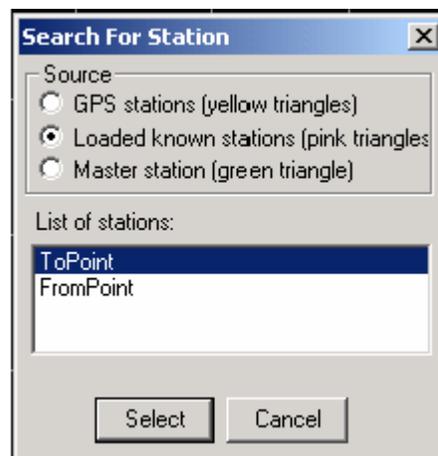
Figure 8 - Select Station

Now enter the local coordinates of this particular station in your local coordinate system in terms of easting and northing. The height coordinate can be optional. See Figure 9. Click OK.

Figure 9 - Local Station Info

The name of the station should now appear in the list of stations. Do the same procedure as above with the other station(s) to be added to the list. Once all the stations have been added, click compute to display the results of the desired transformation. Click next and finish to complete the Export Wizard. The coordinates will be written to a text file.