

## The Classical 3D Transformation

Leica System 500 offers different kinds of transformations between measured WGS84 co-ordinates and Local Grid co-ordinates. This newsletter discusses the Classical 3D approach, which can be used both in SKI-Pro and on the Sensor.

### Remember the facts...

Please review Newsletters Vol. 00, No. 20 and Vol. 00, No. 21. They explained the conversions between different co-ordinate types.

- A **map projection** is needed to convert between **Grid** co-ordinates and **Geodetic** co-ordinates.
- An **ellipsoid** is needed to convert between **Geodetic** and **Cartesian** co-ordinates.
- The Classical 3D transformation provides the link between the **WGS84 Cartesian** and the **Local Cartesian** co-ordinates.

The different stages of the conversion process are best summarised below, using the buttons from the co-ordinate toolbar in SKI-Pro.

A Classical 3D transformation consists of up to 7 parameters: **3 shifts** (dX, dY, dZ), **3 rotations** (Rx, Ry, Rz) and a

**scale factor**. These parameters describe the different origin and the different orientation of the **Local Reference Frame** with respect to **WGS84**.

To calculate all 7 parameters at least 3 common points have to be known in both WGS84 and local co-ordinates and you must be able to compute the WGS84 and local Cartesian co-ordinates for these points.

Points surveyed in the field are stored on the Sensor as WGS84 Geodetic co-ordinates and it is trivial to compute the WGS84 Cartesian co-ordinates.

Local co-ordinates are typically entered as local grid and knowing the ellipsoid and the map projection, on which the Local Grid is based, the local Cartesian co-ordinates can be computed. Note, that they must be known in position and height to be able to get to local Cartesian co-ordinates.

On the sensor, the projection and ellipsoid are selected in the **COORDSYS\ Type Selection** screen.

```
COORDSYS\ Type Selection
Coord Sys : My Tranfo

Transform : MW Tranfo
Trans Type : Classical
Ellipsoid : Bessel
Projection : UTM 32
Geoid Model: -----
```

In SKI-Pro (Datum & Map), you do not have to select an ellipsoid and a projection - the co-ordinate system attached to the project of the local co-ordinates contains this information.

So now knowing the WGS84 Cartesian co-ordinates and the local Cartesian co-ordinates for at least 3 common points, it is now possible to compute the 7 unknown parameters of the Classical 3D transformation.

## Less than 7 parameters?

If there is only one common point, it is still possible to calculate a Classical transformation, if you fix the rotations and the scale parameters. Such a transformation will fit perfectly in the vicinity of the common point, but will get worse with the distance from that point, because neither the orientation of the local reference frame nor any scale factor within the local datum can be taken into account.

To fix parameters when determining a transformation on the sensor, press **SHIFT F5(PARAM)** in the **COORDSYS\ Determine Classical** panel, where you match the common points. In the next panel scroll to the parameters and press **F4 (FIX)**.

```
COORDSYS\
Name : My Tranfo
Trans model: Bursa-Wolff
Rotation X : 0.00000"
Rotation Y : 0.00000"
Rotation Z : -----"

CONT      FIX
```

In SKI-Pro you can do the same on the Classical 3D Parameters page from the Datum & Map Configuration.

## The Advantage...

The Classical 3D transformation does not distort your GPS measurements and fully maintains your GPS accuracy. Therefore this type of transformation can be used over virtually any area as long as the local co-ordinates are accurate.

## Remember...

- The **Ellipsoid** and the **Projection** have to be known to calculate a Classical 3D transformation from local grid co-ordinates.
- Common points have to be known in **position and height**.
- You can use this type of transformation over large areas.

