Ground Coordinates

Before beginning any discussion about creating or using "ground coordinates" it is important to understand that there is not a direct connection between GPS coordinates and a tangent plane survey. The ground coordinate system that most people refer to when they use that term is one that ignores the grid convergence angle and the grid and elevation scale factor. Because surveys on planet earth are not really on a plane there is a point where any tangent plane survey begins to fall apart at some distance from the origin point.

What we need, more than a ground coordinate system, is COGO, CAD, and GIS software that permits working with legitimate grid coordinates while at the same time allowing the use of distances, areas, and volumes that match the topographic surface. This would better enable us to maintain the connection to the GPS constellation. This would provide improved repeatability and more consistent results when connecting survey projects together.

One of the problems with the ground coordinate system tool in Ashtech Solutions is that it is project specific and changes the results if modifications are made to the size and shape of the GPS project. This should be the expected result of trying to hammer fit GPS measurements to a tangent plane.

Is there a more consistent method of connecting grid coordinates to the ground surface?

One concept of doing this was born from two NGS publications. Fundamentals of State Plane Coordinates was written long before there was such a thing as GPS. Because it is based on NAD27 it does not include a discussion of the Geoid model as we understand it today. But the fundamentals are there in that little book and they remain valid today.

Get your copy of fundamentals from the NGS at

http://www.ngs.noaa.gov/PUBS_LIB/FundSPCSys.pdf

The fundamentals need to be updated for our modern NAD83 datum. Take what you learn from the first book and modify it to take advantage of modern technology. The NGS5 manual is available from the NGS at

http://www.ngs.noaa.gov/PUBS_LIB/ManualNOSNGS5.pdf

Let's look at some basic concepts:

Any grid coordinate represents the grid distance from the point of origin. To convert a grid coordinate to a ground coordinate at that point all that is required is to apply the grid and elevation scale factors to the Northing and Easting coordinates. This method could be applied to every point in the project to obtain a precise ground coordinate for each point.

An alternative solution would be to compute an average grid and elevation scale factor for the project and apply it to every point in the project.

A third option would be to choose some control points around the GPS project and apply the grid and elevation scale factor to those selected points. The next step would be to create a "local grid" that would adjust the survey project to these ground coordinates.

Some people will object that the magnitude of the coordinates is too high and they want coordinates that are not millions of units. This can be done by application of the scale factor first and then with a simple subtraction of a constant from each coordinate. By doing the scale first and then the move it provides for a simple method of taking any point on the project back to something very close to a grid coordinate and a legitimate latitude and longitude.

The scale and move terminology used in the preceding paragraph should tell you that this is something easily done in your COGO and CAD software as well as in Ashtech Solutions or GNSS Studio. The procedure worked equally well when we used tablets and log tables for the calculations.

The concepts come from those NGS manuals and will work for the variety of grid coordinate systems that I have used in Southeast Asia, Europe, and the USA. I believe the concept will work anywhere in the world with excellent results with the understanding that it is still a tangent plane survey. Projecting lines beyond the confines of the project area are going to yield uncertain results. Minimizing the size of the project area is essential. Large variations in elevation also make a tangent plane survey something less than perfect. You will know the limits of how far you can take this method by doing some experimentation with computations using legitimate grid coordinates and using the method to compute and compare coordinates in the project area.

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