Mapping Matters

Your Questions Answered

The layman's perspective on technical theory and practical applications of mapping and GIS

By Qassim A. Abdullah, Ph.D., PLS, CP**

Question 1: I am in charge of a project for the accuracy assessment of the generated 1m contours for a construction site. The terrain is of a highly undulating nature and the contractor proposed to establish a number of horizontal and vertical check points around the project area by the method of DGPS for the planimetric (horizontal) check points and leveling for the height accuracy check points. Project specifications call for horizontal and vertical accuracy to be equal to ½ the contour interval or 0.50 m as RMSE. I am new to this type of assignment and I don't have much idea about surveying and accuracy assessment of the contours. I need some guidance on the procedure of assessing the planimetric and height accuracy of the contours map in the field using the proposed check points.

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Dr. Abdullah: Here are my recommendations:

Vertical Accuracy Validation: You can use the surveyed ground control or check points to validate the vertical accuracy. There are two ways to achieve this:

A. The first is to manually insert the ground survey points into the contour data set — whether in hardcopy or in a digital CAD file(s) environment — and then estimate the accuracy by comparing the elevation of each check point and the elevation of the two contours surrounding the point. For example, if the check point elevation is 196.2 m you would expect that the point, once you insert it according to its easting and northing into the contours map, will fall somewhere between contours 196 and 197m and close to 196 by a ration of 0.2 of the spacing between the contours on the map.

B. The second, more automated approach, is to create a TIN (Triangulated Irregular Grid) from the provided contours using a CAD modeling software and then extract elevation from the generated TIN at the location of each of the check points in the map and compare it to the surveyed elevation of the check point. This process can be achieved either manually on a point by point basis or through an automated process that is included in most terrain modeling software.

In both methods, you need to record the discrepancies between the surveyed elevation and the one extracted from the map or the TIN. From these discrepancies, you must calculate the Root Mean Square Errors (RMSE) from all the differences in elevation, in order to compare it to the accuracy specifications required in your project. The RMSE can be computed using the following formula:

$$\text{RMSE} = \sqrt[2]{\frac{\sum v2}{n}}$$

where,

v is the difference in elevation at each check point or, $H_{surveyed} - H_{map}$

n is the number of check points

Horizontal Accuracy Validation

There is no practical way to verify the horizontal accuracy of contours other than collecting field surveyed profiles or cross sections and then compare the shape of the terrain along the profiles with the same profile from the contours map. For such verification, you need to survey accurate profiles and/or cross sections on the ground throughout the project area, especially where the ground is undulating and not flat. You need ridges and valleys in the profiles or cross sections to be able to estimate the horizontal shift (see Figure 1). To perform the analysis, you would need access to a terrain modeling software that is capable of simultaneously handling more than one surface. Figure 1 demonstrates how field surveyed profiles allow you to check the horizontal accuracy of your contours; in this case, the comparison reveals a 2.5 meter error in the horizontal accuracy of the contours.

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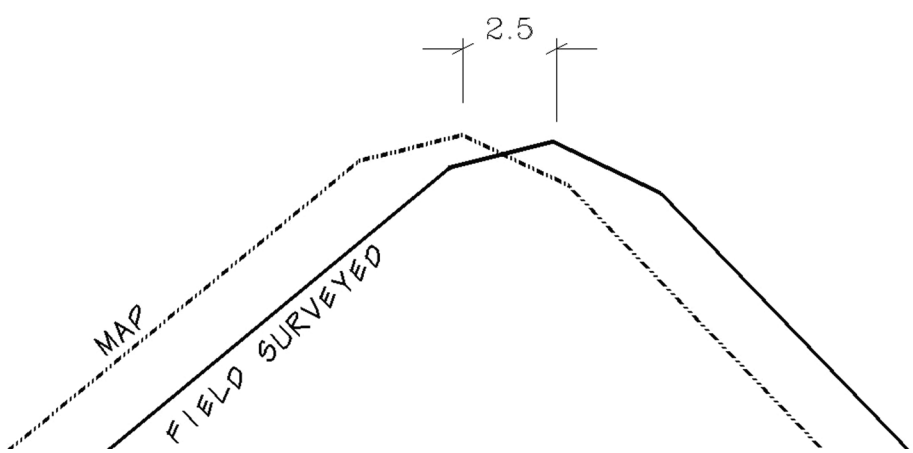

Figure 1. Profiles from field survey and map used to evaluate horizontal accuracy.