

Exercises - Integrating GPS With Terrestrial Data

1. The key to combining GPS and terrestrial survey data is using the rotation matrix at a particular latitude/longitude location. Form 1 of the rotation matrix is used to convert geocentric (GPS) differences to local differences and Form 2 (which is the transpose of Form 1) is used to convert local differences to geocentric differences.

The GPS vector on the Oregon Tech campus from Station K-785 ($\phi = 42^\circ 15' 17''$ N and $\lambda = 121^\circ 47' 09''$ W) to Station Trimble was observed to be $\Delta X = 122.547$ m, $\Delta Y = 56.946$ m, and $\Delta Z = 131.022$ m.

- Find the local $\Delta e/\Delta n/\Delta u$ components for the line.
- Find the azimuth and distance from K-785 to Trimble

2. Conventional "total station" observations (reduced to mark-to-mark) from Station Trimble ($\phi = 42^\circ 15' 23''$ N and $\lambda = 121^\circ 47' 06''$ W) to Station K-785 were observed as slope distance = 188.221 m, zenith direction = $91^\circ 22' 14''$, and azimuth of $203^\circ 12' 56''$.

- Find the geocentric coordinate differences for the line.
- Comment on how well data from this sections agrees with previous.

3. The data below were collected on the same EDM calibration base line; one set of data was obtained with an EDM, the other with GPS. Find the mean distance for each set of data, the standard deviation of the observations, and the standard deviation of the mean for each. Comment on the difference and speculate as to reason for the difference based upon technology, observing procedure, systematic errors and random errors.

EDM: 805.223 m, 805.231 m, 805.217 m, 805.226 m, 805.224 m, 805.227 m

GPS: 805.230 m, 805.232 m, 805.233 m, 805.230 m, 805.229 m, 805.231 m

4. The NAVD88 elevation of Station K-785 is 1,320.416 m. According to GEOID96, the geoid heights are: Station K-785, $N = -22.440$ m; Station Trimble, $N = -22.435$ m. What is the estimated NAVD88 elevation of Station Trimble using:

- Geoid height difference from GEOID96 with ellipsoid height difference.
- The c&r correction applied to the local up component?

5. According to the information on the OIT data sheet the azimuth from Median-2 to Pub is $53^\circ 14' 38''$. Using the P.O.B. northings and eastings (with respect to Station K-785) for Median-2 and Pub, what is the azimuth from Median-2 to Pub? Comment on the reason for the difference.

Note!

At no time did one need to work with grid scale factors or elevation factors. The GSDM does not distort distance as does use of state plane coordinates.