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How minimum detectable displacement in a GNSS Monitoring Network change?

Muharrem Hilmi Erkoç, Uğur Doğan, and Cüneyt Aydın
Department of Geomatic Engineering, Yıldız Technical University,Istanbul, Turkey (mherkoc@yildiz.edu.tr)

The minimum detectable displacement in a geodetic monitoring network shows the displacement magnitude which may be just discriminated with known error probabilities. This displacement, which is originally deduced from sensitivity analysis, depends on network design, observation accuracy, datum of the network, direction of the displacement and power of the statistical test used for detecting the displacements. One may investigate how different scenarios on network design and observation accuracies influence the minimum detectable displacements for the specified datum, a-priorly forecasted directions and assumed power of the test and decide which scenario is the best or most optimum. It is sometimes difficult to forecast directions of the displacements. In that case, the minimum detectable displacements in a geodetic monitoring network are derived on the eigen-directions associated with the maximum eigen-values of the network stations.

This study investigates how minimum detectable displacements in a GNSS monitoring network change depending on the accuracies of the network stations. For this, CORS-TR network in Turkey with 15 stations (a station fixed) is used. The data with 4h, 6h, 12 h and 24 h observing session duration in three sequential days of 2011, 2012 and 2013 were analyzed with Bernese 5.2 GNSS software. The repeatabilities of the daily solutions belonging to each year were analyzed carefully to scale the Bernese cofactor matrices properly. The root mean square (RMS) values for daily repeatability with respect to the combined 3-day solution are computed (the RMS values are generally less than 2 mm in the horizontal directions (north and east) and < 5 mm in the vertical direction for 24 h observing session duration).

With the obtained cofactor matrices for these observing sessions, the minimum detectable displacements along the (maximum) eigen directions are compared each other. According to these comparisons, more session duration less minimum detectable displacement. Moreover, a linear relationship between the observing session duration and the minimum detectable displacement is observed and the minimum detectable displacement for a station decrease when the distance to the fixed station increases.

Keywords: Sensitiviy, GNSS, Session duration, Displacement