

A case study on the accuracy of results from kinematic deformation models

Utkan Mustafa Durdag, Bahattin Erdogan, Taylan Ocalan, Serif Hekimoglu, and Ali Hasan Dogan
Yildiz Technical University, Civil Engineering Faculty, Geomatic Engineering, Istanbul, Turkey (umdurdag@yildiz.edu.tr)

The linear and quadratic kinematic models are frequently preferred to put forth the characteristic of deformations in geodetic applications such as the determination of the tectonic, landslide and engineering structure motions. However, if one uses the linear model, this may result in an incorrect estimation of the velocity or acceleration when the acceleration has a significant magnitude in reality. Nevertheless, in practice, it is impossible to obtain a prior knowledge about the location of displaced points, magnitudes of velocity and acceleration before analysis. The reliability of the results of both models is disputable.

For this purpose, Linear Motion Systems integrated with GPS were established at four object points (pillar monument) located at properly in Yildiz Technical University Davutpasa Campus. Moreover, five continuously operating GPS sites (off-campus) were predefined as reference points. Realistic displacements mostly called Minimum Detectable Displacement were loaded with the help of linear motion systems. The object points were displaced moving the Linear Motion System along three different planes: 1. Vertical platform (Up), 2. Horizontal platform (Northeast) and 3. Horizontal and vertical platforms (Northeast and Up) for intended scenarios as follows

1. Considering small velocity magnitude but neglecting acceleration
2. Considering both small velocity magnitude and small acceleration magnitude.

Each deformation scenario contains 4-period GPS observations with 8-hour session duration. The coordinates of the reference station selected from IGS Network, so-called ISTA, were kept fixed (not estimated). Observations were processed in Bernese v5.2 and baselines were defined by OBS-MAX with the SHORTEST bonus option strategy. Then 4-period GPS observations of each scenario were adjusted separately by linear and quadratic kinematic models that give the estimated displacement, velocity and acceleration parameters. Finally, parameters were tested whether they are significant or not and compared with the real magnitudes loaded.

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