Examining quality of DGNSS derived positioning in data in urban city: a case study of an urban city in India

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Global navigation satellite system (GNSS) observations are carried out in static mode/differential global navigation satellite system (DGNSS) and dynamic mode/real-time kinematics (RTK) mainly. RTK mode of observation is useful in case of navigation, whereas in order to determine very precise positioning, static/DGNSS/differential global positioning system mode is recommended. In the present study, we have examined the quality of the DGNSS survey of an urban city in India over ~300 ground control points (GCP). A survey is carried out in DGNSS mode with dual frequency mode. All observations were recorded using the global positioning systems GLONASS, Galileo, and BeiDou, with geometry dilution of precision values ranging from 1.4 to 2.5. Beidu was used in broadcast ephemeris mode, whereas for other constellations, precise orbit ephemeris were obtained from the international GNSS service site as per the observation day and month. Further, all the data were post-processed in the software suite, and positional and vertical accuracies of millimeter to a few centimeter level were obtained. The present study describes the approach of GCP identification, surveying, methodology, use of CORS network, and data post-processing in order to achieve such a precise accuracy in the urban city.

Keywords: CORS, DGNSS, DGPS, urban canopy.

system (DGNSS)/differential global positioning system (DGPS) mode, reference and rover modules are kept stationary. The reference station is equipped with a stationary receiver that continuously receives satellite signals and calculates the position of the reference. Whereas, in order to obtain the precise location of the rover receivers, static observations for a minimum of 45 min are recorded at the rover end in order to cancel user equivalent range errors (UERE). In the case of RTK, the reference receiver is fixed at one location, and the rover is continuously moving from one place to another.

As the receiver on the ground is recording observations, there are many sources of errors, such as clock, orbit ephemeris, ionosphere, troposphere, and multipath. UERE is the square root of the sum of squares of individual biases from ephemeris, clock, ionosphere, troposphere, and multipath. All these biases can be minimised by better dilution of precision (DOP) values and longer observation times through dual-frequency observations. Currently, RTK positioning is being used as one of the most popular techniques for real-time precise positioning using GNSS carrier phase observations. RTK can be used in many fields, such as surveying and navigation. However, obtaining precise positioning with RTK is challenging in dense urban areas. Due to tall, dense buildings in urban areas, satellite signals are blocked, leading to multipath errors. Therefore, to obtain precise centimeter to millimeter level accuracies in urban areas, DGNSS/DGPS/static surveying is recommended.

In India, the Survey of India (SOI) has established the continuously operating reference stations system (CORS)