Dynamic RTK Performance of Low-Cost GNSS Modules in Mixed Urban Environment

Somnath Mahato(1), Ananya Ghosh(2), Prity Mishra(2), Sukabya Dan(1), P Banerjee(1) and Anindya Bose(1)
(1) Department of Physics, The University of Burdwan, Burdwan 713 104, India
(2) Department of Geospatial Science, The University of Burdwan, Burdwan 713 104, India

Global Navigation Satellite System (GNSS) has now become the principal method for precise geolocation. For achieving higher solution quality levels, various positioning techniques have evolved that include Real Time Kinematic (RTK). RTK is a carrier phase-based differential technique that provides real-time, accurate position solution using the composite infrastructure of a fixed Base operating at a precise location, one or more distant user (Rover) units located within a finite distance from the Base, and correction data streamed over wireless communication channel from the Base to the Rover. The Rover concurrently processes the local and correction data to provide cm-level real-time position solution. In this work, an effort has been made to explore the applicability of single and dual frequency compact, low-cost GNSS modules as moving Rovers for dynamic RTK operation within a typical urban mixed environment of India. The objective of this research is to investigate the performance of the low-cost Rover systems in dynamic RTK operation in the Indian context.

For the dynamic RTK operation, data from a permanent Base is used with two car mounted low cost, compact, multi constellation GNSS modules (uBlox NEO M8T (~USD 75) and uBlox ZED F9P (USD ~210)) as moving Rovers sequentially with two antennas (Skytraq low-cost Survey Grade (~USD 120) and uBlox ANN-MB patch (~USD 65)) as shown in Figure 1. The car-mounted system is carried through a stretch of roads ~12km during May 2022 for nearly 30 minutes in each run in Burdwan town in eastern India with an average car speed of 30-40 kmph depending on the local traffic conditions; RTK operation is performed using the open-source RTKLib GNSS data processing software concurrently @1Hz by both the GNSS modules sequentially using both the antennas; the real-time RTK solutions for GPS+Galileo+QZSS hybrid operation are recorded in the on-board computer.

Along with the RTK FIX and FLOAT solution percentages, no solution cases were noted; the position solutions, and variation of used satellites for solution during the data recording period for each module-antenna combination are noted. Then the position solutions for different receiver-antenna combinations are converted as points on Google Earth Pro maps which are compared with the time variation of satellite availability to understand the performance of the dynamic RTK using compact, low-cost GNSS modules.

Preliminary results of the exercise show that due to the obstructions created by buildings and trees on the sides of the roads of varying width, number of satellites used for solution varies in a hardware-dependent manner and in some cases no satellites are available for use causing a loss of position solution. For different receiver-antenna combinations, 3-10% RTK FIX solutions are obtained while the loss of solution varies from 2-20%. The solution quality varies with different combinations of GNSS module and antenna combination, and the best solutions are obtained for the dual frequency uBlox F9P and Skytraq low-cost, survey grade antenna combination. In many cases, loss of solutions and deviation from the trajectory in the Google Pro Map is noticed. Analysis of the corresponding location reveals that the phenomenon are caused by satellite signal obstructions due to dense trees on both sides of the roads and tall buildings on the curved roads respectively. However, in relatively obstruction-free or open-sky environments (e.g. on flyovers) good quality solutions are conveniently obtained. The results would be useful for popularization of RTK for real-life applications in the Indian context. The presentation would elaborate the full results obtained during the exercise.