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Evaluation of Commercial GNSS Receivers for Ionospheric Scintillation Monitoring

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Unless specifically targeted to an ionospheric market, commercial GNSS receivers have historically not been well suited for amplitude scintillation measurements due to limitations in resolution, sample rate, and measurement bandwidth for reported signal strength. A rule of thumb is that amplitude measurements should have at least 0.1 dB resolution and 20 Hz sampling for ionospheric scintillation monitoring.

Because the GNSS market is constantly changing, and workhorse scintillation receivers may become obsolete or unsupported, it is important to evaluate new receivers. Furthermore, the ionospheric scintillation community would like to use new GNSS constellations and signals as soon as practicable to maximize sky coverage and frequency coverage. Fortunately, it has become more common recently, in part thanks to real-time kinematic (RTK) surveying needs, to have higher sample rates for GNSS observables available.

Boston College will evaluate several commercial GNSS receivers under equatorial scintillation conditions in March 2023. The receivers will range from low-cost development kits to higher-end RTK receivers. In part, the intent is to perform an updated comparison similar to Reference [1]. We will compare scintillation measures and tracking performance among receivers and present some initial findings. In addition, we plan to investigate an alternative means of evaluating the suitability of signal strength reporting that may be possible to perform under routine conditions without the presence of scintillation (natural or simulated). Ultimately, it may be possible to request relatively simple data in advance of receiver purchase to confirm its amplitude sensitivity.

Part of the new methodology will attempt to utilize the detection of intersatellite interference patterns in the signal strength data [2]. These patterns form as a result of Doppler matching between satellite pairs and can provide an independent means to assess the resolution and bandwidth of amplitude measurements. There are several questions to be answered, however. Can the interference patterns be detected in a more automatic manner? Can the data collection be planned to maximize the opportunity of capturing interference events? Reference [2] studied GPS Coarse/Acquisition (C/A) code signals; more modern signal structures will likely yield similar effects, but will they affect the detectability of the patterns? We will present an initial assessment of using intersatellite interference to evaluate reported GNSS signal strength during this talk.

References

[1] E. R. de Paula et al., "Performance of 6 Different Global Navigation Satellite System Receivers at Low Latitude Under Moderate and Strong Scintillation," *Earth and Space Science*, **8**, December 2020, e2020EA001314, doi:10.1029/2020EA001314.
[2] T. L. Beach and C. A. Baragona, "Quasiperiodic scintillation and data interpretation: Nongeophysical GPS amplitude fluctuations due to intersatellite interference," *Radio Science*, **42**, 3, June 2007, RS2010, doi:10.1029/2006RS003532.