e-survey

Athena™ GNSS Engine

Next-Generation GNSS RTK

Overview

This document provides a brief overview of Hemisphere GNSS' Athena RTK engine.

What Is Athena RTK?

Athena RTK (real-time kinematic) is Hemisphere GNSS' next-generation RTK engine redesigned to support all available constellations, and take advantage of the new signals available to the GNSS community. This future-proof foundation enables Athena to have market-defining performance, flexibility, and reliability. Athena was designed to seamlessly integrate into existing product portfolios, supporting all major industry correction formats and standards.

RTK is one of the most popular high-accuracy positioning techniques in the GNSS industry. RTK relies on nearby GNSS reference stations to transmit correction data in real time to a remote receiver. The reference data is typically transmitted over internet or via radio. In the case of internet connectivity, cell modem connection is a typical option, as most modern GNSS receivers or controllers offer this capability.

State-of-the-art RTK systems are measured on two key criteria: accuracy and initialization time. Under ideal conditions, most RTK systems can deliver centimeter-level accuracy in a matter of seconds. However, as the technology has matured, users now expect this same performance even under challenging conditions. These environments are what separate the top performers from the non- contenders.

How Does It Work?

The first key aspect of RTK is relative positioning, which uses differencing observations to cancel similar error sources for nearby receivers. The error sources for both the rover and reference receiver are nearly identical, leaving very accurate measurements when we difference the signals, making the RTK method robust and efficient.

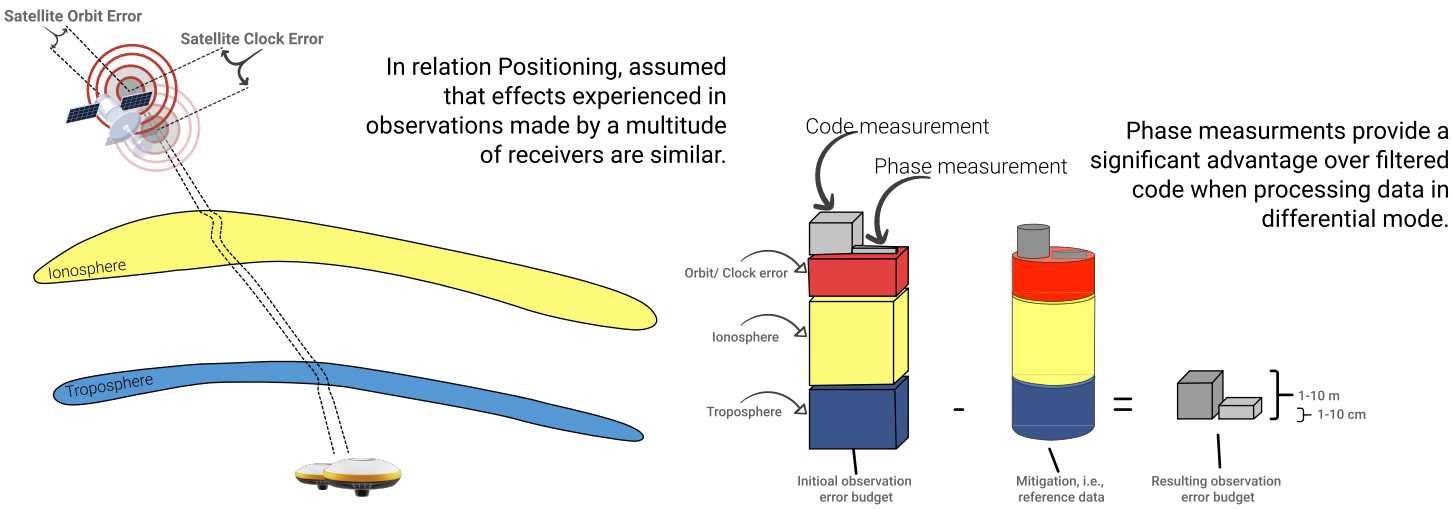

Figure 1 – Description of the RTK Method - Error sources and corrections

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The second key aspect of RTK is the use of carrier phase measurements rather than pseudorange measurements. In order to use carrier phase measurements, it is necessary to estimate the unknown number of cycles present between the satellite and receiver. This process is known as Ambiguity Resolution, and when successful, unlocks the millimeter-accuracy of the carrier phase measurements—allowing for ultra-precise positioning.

The Athena RTK engine was designed with the most advanced error mitigation techniques in the industry. Its multi-task architecture allows it to use advanced carrier phase ambiguity resolution processes to significantly improve performance in harsh environments without slowing down. Unlike traditional RTK engines, the Athena engine reduces the size of "jumps" when switching between fixed and float positioning solutions. Instead, a smoother transition occurs, which improves overall usability.

Performance

Initialization time is the time it takes for the RTK system to become usable.

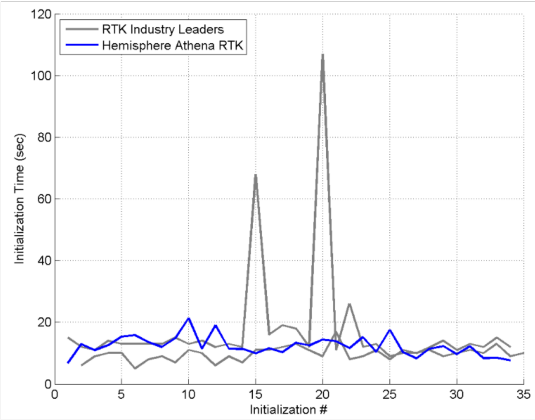

Figure 2 shows the initialization performance of three brands—Hemisphere and two industry leaders, for a baseline of nearly 20 kilometers. By this metric, Athena is very competitive—performing as good or better in most instances, typically taking 15 seconds to reach full accuracy.

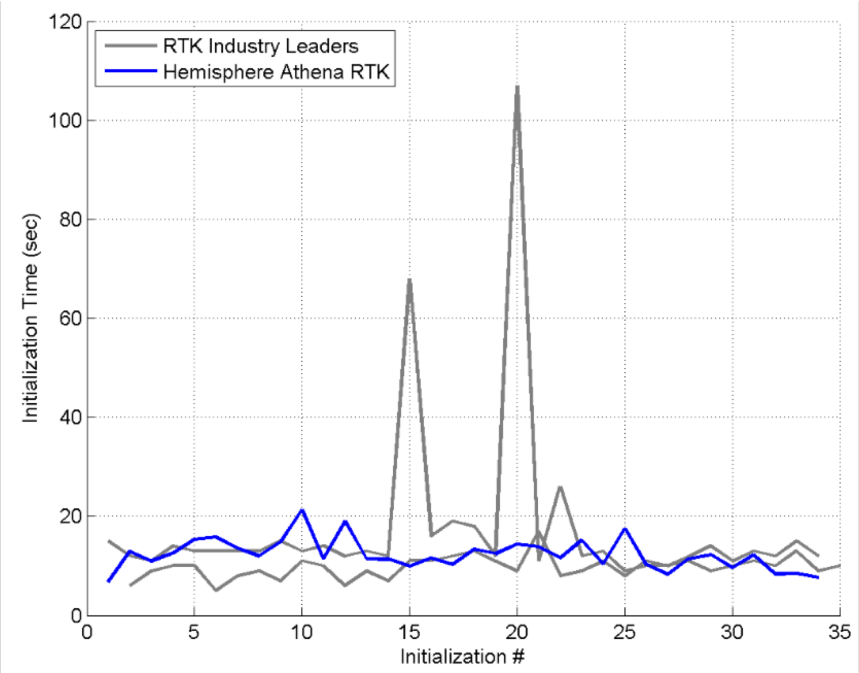

Figure 2 – Initialization Time - Hemisphere vs. RTK industry leaders

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Today, GNSS users expect their equipment to perform well in moderate canopy as shown in figure 3. Canopy makes tracking of the GNSS signals much more difficult and requires excellent quality control and ambiguity resolution algorithms to ensure bad data can be filtered out properly. Additionally, Athena takes advantage of the third GNSS frequency now available on some constellations to make its performance in these environments even more robust.

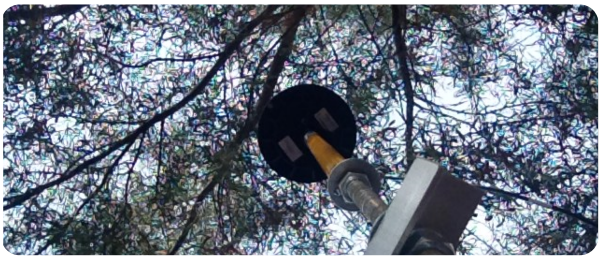
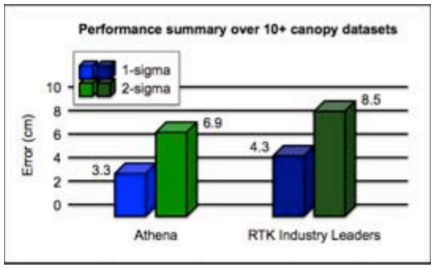


Figure 3 – Example of a canopy environment where users use RTK systems

Figure 4 summarizes Athena's performance versus the RTK industry leaders for a large number of canopy datasets. Overall, the Athena RTK engine performs nearly 30% better than the industry leaders.

Figure 4 – Canopy Performance - Hemisphere vs. RTK industry leaders



The table below summarizes the full features of Athena RTK as well as the expected performance parameters of the system.

Summary

Athena is Hemisphere's new RTK engine, built from the ground up to take advantage of the new GNSS constellations and signals available to the GNSS community. With state-of-the-art error modeling, quality control, and ambiguity resolution algorithms, Athena is a solid foundation for customers developing innovative products and services based on this technology.

Performance Summary	
Horizontal Position Accuracy	8 mm + 1 ppm
Vertical Position Accuracy	15 mm + 2 ppm
GNSS Constellations	GPS, GLONASS, BeiDou, Galileo, QZSS
Frequency Support	Triple-Frequency
Correction Support	Hemisphere Proprietary, RTCM v2.3/v3.2, CMR, CMR+
Reliability	> 99%*
Scintillation	State-of-the-Art Performance
Compatibility with 3rd Party Reference Stations	Seamless**

* Observed under nominal constellation and multipath conditions.
** When using supported correction types.