



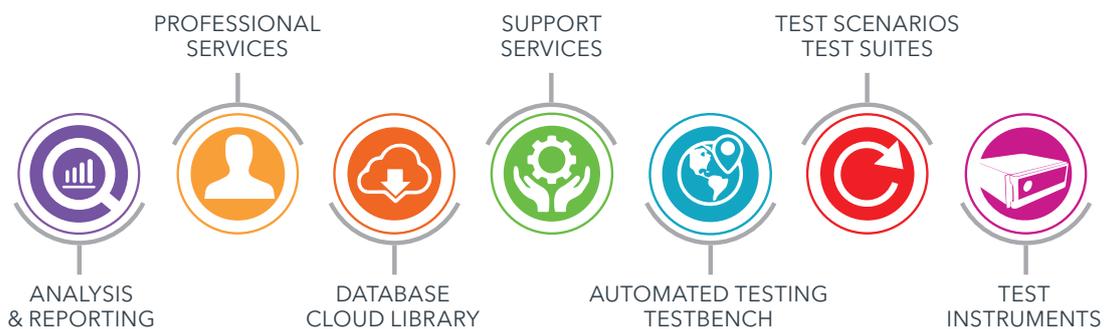
Improving PNT for Smarter Drones

GNSS for Drones

One of the key technologies common in drones today is the GPS/GNSS feature. Helping to provide positioning, navigation, and timing information, GNSS can enable important functions such as autonomy and critical safety. From hobby flying, through surveying and filming, to military/ISR applications, accurate and stable GNSS is vital for both developers and users.

Key GNSS Functions in Commercial & Civilian Drones

GPS hovering | Follow-me / return home | Georeferencing | Geofencing
 Auto take-off/landing | Automated planning | Attitude determination



Leaders in the evolution of global navigation satellite systems since 1985

Navigation Technologies for Drones

GPS/GNSS for Standard Positioning

This is the most common use of GPS/GNSS in drones. Solely using GPS/GNSS signals that are freely available in space reduces the hardware cost to a single chip. This method provides a typical positioning accuracy of around 5m.

RTK or PPK for Precise Positioning

Typically, RTK or PPK is needed for survey grade applications where having ground control points (GCPs) gets expensive. RTK or PPK provide very accurate location data for geotagging and drone alignment while capturing images. This comes in a few flavours as shown below.

Relative Positioning

Relative navigation becomes important when you have a group of drones involved in certain applications such as formation flight and aerial refueling. This technology estimates the position and attitude of a drone with respect to the body frame of another drone.

Standard positioning is all about understanding your customers' requirements and developing test cases for replicating these use cases and environments in the lab. Here simulators offer a unique capability to verify the specs and provide a clear benchmark for measurement.

The precise geotagging required for survey applications can be achieved using high precision GNSS technology like Real-Time Kinematics (RTK). The following two diagrams give you an idea of the extent to which a simulator can be used for various RTK configurations.

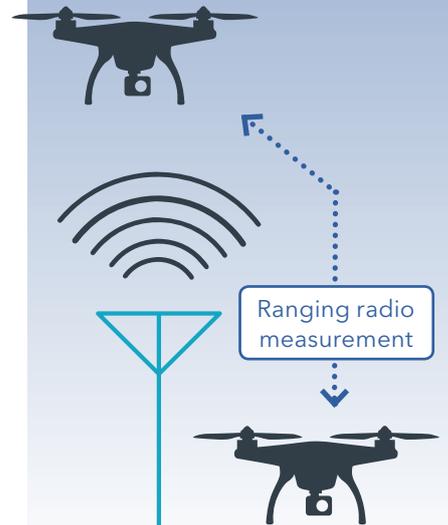
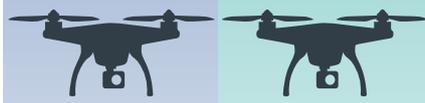
Using the test setup in the diagram below to test Relative Positioning in the lab is a great way to save time and money. It takes a lot of effort to test this in the field - where the test would typically involve flying two or more drones in close proximity to each other.

GPS/GNSS for standard positioning [Simulation]

RTK or PPK for precise positioning [Configuration 1]

RTK or PPK for precise positioning [Configuration 1 & 2]

Relative positioning



GPS RF1 signal

Base station embedded in simulator

Corrections Data over Serial in RTCM format

Corrections data

Known or unknown Base Station

Ranging radio measurement

SPS7000 Simulator

GPS RF2 signal

GPS RF1 signal

Simulators are a great resource for testing the limitations of a product, having a regression test plan, and including corner test cases. While these are all needed, simulators are limited when a real-life scenario is required.

Record and Playback Testing

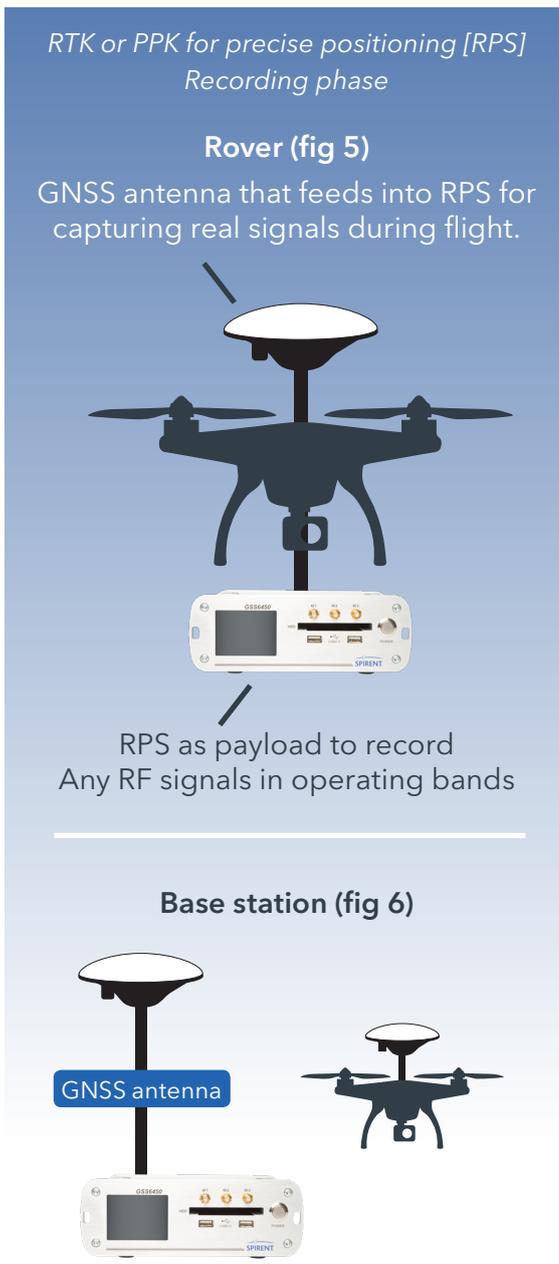
This is when a record and playback system (RPS) comes in handy. An RPS system captures real signals in the GNSS frequency band that can be repeatedly played back. For scenarios where there is a need to test the drone’s navigational performance in a downtown

environment, or in an environment where interference is an issue, RPS offers a great solution. All you need to do is record the signal in the desired environment once using the setup shown in Figure 5.

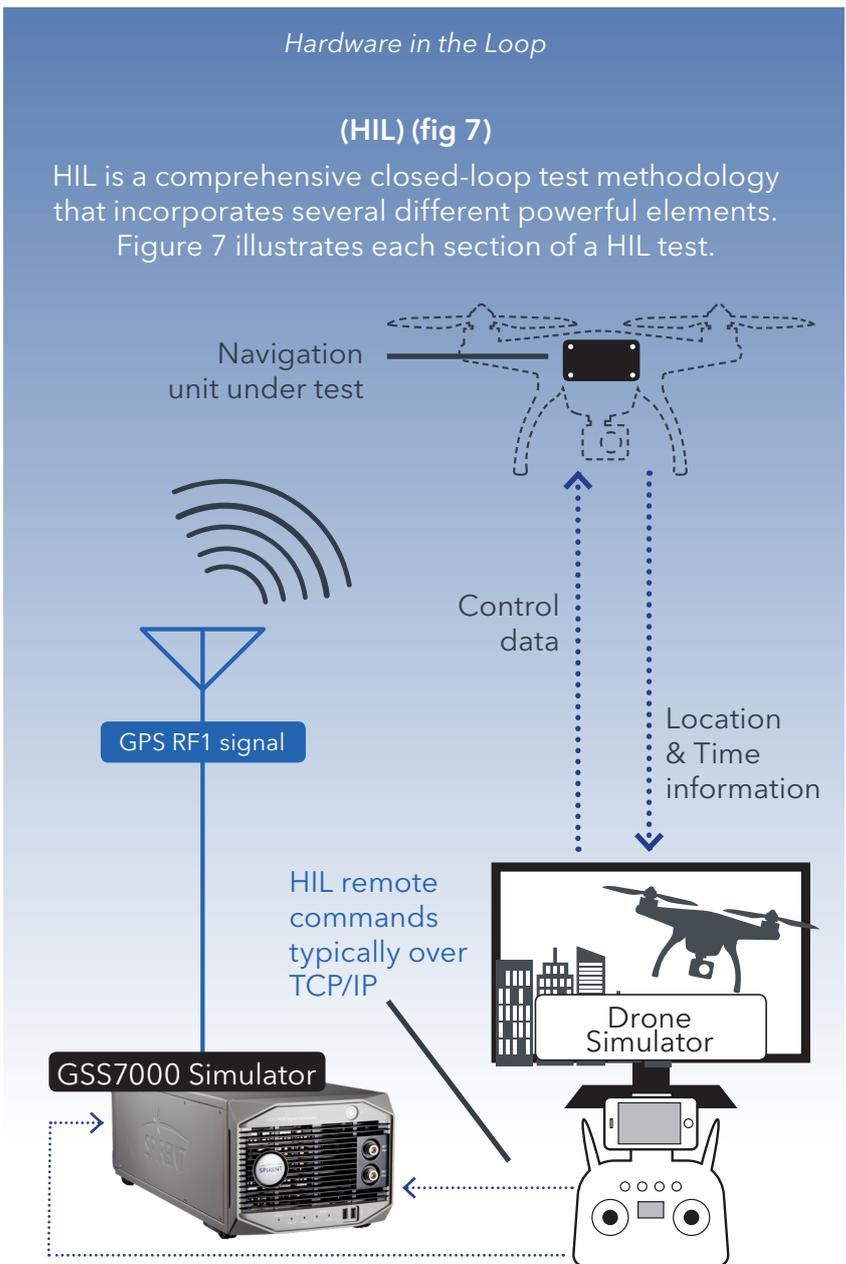
Once captured it can be repeatedly played back.

Any multipath and interference within the bandwidth & dynamic range of the RPS system will be captured reliably.

Where there is a need to extend the concept of RTK testing above, it can be achieved using our GPS synced units for the base station as well as the rover.



RPS can be stationary or on another drone for relative positioning



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Simulation: GSS7000

The Spirent GSS7000 produces a comprehensive range of emulated multi-GNSS, multi-frequency RF signals with class leading flexibility, coherence, fidelity, performance, accuracy and reliability.



Record & Playback: GSS6450

The GSS6450 takes RF recording and playback systems to a whole new level of performance and flexibility, while being housed in a small battery powered, portable case.



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