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What is a GPS Simulator?

As GPS receivers are built into more mission-critical devices for difficult application environments, and designed with the emerging capabilities of a multitude of GNSS constellations and augmentation systems, developers and manufacturers need better ways to guarantee performance. That's where a GPS simulator comes in.

Introduction

Although the test engineer has a variety of choices for testing GPS-based position, navigation and timing functions of their integrated GPS receivers, simulation offers the most flexibility, compared to testing with over-the-air signals ("live sky"), or record and replay solutions. Having complete control over the generation of GPS signals is the only way to have confidence in your hardware and software's ability to perform – under any condition.

GPS Transmissions

To understand a GPS simulator, it is helpful to understand some of the details of GPS transmissions. The GPS constellation consists of 24 satellites, orbiting every 12 hours, broadcasting navigation data on different frequencies. GPS is just one of several global navigation satellite systems (GNSS) in operation, or soon to be in operation. Most navigation applications today use the GPS L1 frequency at the radio frequency 1575.42 MHz. Onto this carrier frequency, satellites transmit identification information and a navigation message that contains synchronized time, the satellite's orbital data (ephemeris), and data on the expected positions of all the satellites in the constellation (almanac). It is from this data that receivers can accurately calculate its distance from several satellite signals at the same time to achieve its navigation solution through trilateration.

Simulating Exact GPS Transmissions

GPS simulators are radio frequency generating instruments that are capable of transmitting the same exact data as GPS satellites. However the value of a GPS simulator is in the ability to change a wide variety of parameters right from the test bench:

Data from the satellite:

- Date/time via the clock parameters
- Satellite ID (PRN code)
- Ephemeris and almanac

Position of the receiver

- Start position (latitude, longitude and elevation)
- Trajectory (motion path)

Conditions as seen by the receiver:

- Number of satellite signals
- Power level
- Atmospheric and antenna errors through models
- Multi-path conditions

Simulation Scenarios

It is the combination of all these parameters that make up a "scenario" for a GPS simulator. All Orolia GPS simulators can generate simple single-satellite signals to verify receiver signal acquisition and validate assembly. Some Spectracom GPS simulator models can simultaneously generate signals from many satellites, GPS and GLONASS, L1 and L2 frequencies, and satellite-based augmentation systems (SBAS); WAAS (North America), EGNOS (Europe), MSAS (Japan), and GAGAN (India). These GPS simulators even adjust signal transit time and relativistic effects to simulate receiver motions to ensure the system is capable of performing under any trajectory.

Simply use the pre-defined scenarios, or edit and save your scenario parameters through the front panel, through uploadable text files, or from the scenario-builder software, and start. The GPS simulator automatically generates the RF signals for testing GPS receivers using conducted signals through RF connectors and cables, or radiated signals using an antenna. Testing can be controlled remotely or automated using a variety of instrument interfaces and a SCPI command protocol.

Conclusion

Without a GPS simulator, attempts to test receivers with over-the-air signals or record-and-replay solutions would be limited to the satellites available at a particular time and place, and under current conditions. Testing remote locations or high velocities would be costly, time-consuming or impractical. And with "live sky" signals, test parameters would never be repeatable.

GPS simulators allow testing more parameters, more often, with extreme flexibility for development and manufacturing. Time and cost savings can also be achieved by using a GPS simulator.

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