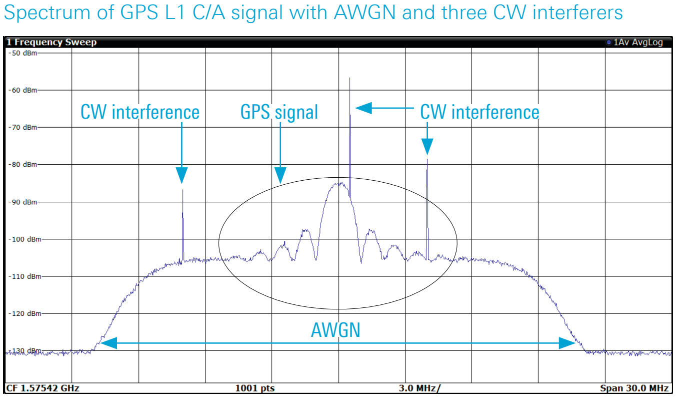
Simplify coexistence and interference testing for GNSS receivers

The R&S®SMW200A GNSS simulator offers an easy and convenient way to test your receiver design against a wide variety of potential interferers and jammers. Test cases extend from simple coexistence simulations to complex interference scenarios with localized emitters.

Your task

Today, GNSS receivers are used in many applications, such as car navigation systems, drones and aviation instrument approach procedures. Therefore, these devices need to provide highly accurate position fixes and high availability even under adverse conditions. Multiple other services, such as LTE, also make use of frequencies close to the GNSS bands. Receivers have to be designed in a way that allows safe coexistence of these signals to prevent performance degradation.

Spectrum of GPS L1 C/A signal with AWGN and three CW interferers



A receiver must also be resilient against unintentional interference (i.e. out-of-band transmissions from amateur radios) as well as intentional interference (i.e. jamming or spoofing). To prove the robustness of GNSS receivers against interference, they have to be tested against all kinds of interfering signals for all available GNSS constellations and frequency bands. To obtain meaningful and repeatable results, tests are best performed with a GNSS simulator in a controlled lab environment.

Rohde & Schwarz solution

The R&S®SMW200A GNSS simulator provides a compact and efficient solution for creating such complex interference scenarios. The GNSS simulator allows the simulation of up to 144 satellites from different constellations on different frequency bands. Thanks to the nature of the R&S®SMW200A as a vector signal generator, up to four independent basebands can be configured to simulate either GNSS signals or interferer signals. This flexible configuration enables quick coexistence testing for several digital standards such as LTE. Apart from that, the R&S®SMW200A lets users replay any arbitrary user-defined waveform. This way, even advanced interference tests can be performed. Such waveforms can be created, for example in Matlab, or more conveniently using the R&S®Pulse Sequencer software. The R&S®Pulse Sequencer software also makes it possible to generate dynamic simulations with a moving GNSS receiver. Software options allow up to four additional, independent AWGN/CW sources, bringing the number of simultaneous interferers to seven. While previous approaches used separate devices, the R&S®SMW200A GNSS simulator combines all features required for interference testing into one instrument. This is a cost-optimized solution that speeds up the creation of complex and realistic test scenarios. When used together with two R&S®SGT100A RF extension units, the GNSS simulator provides four RF output ports, making it suitable for multi-antenna or multi-vehicle scenarios.

CW and AWGN interference

The figure on the left shows the spectrum of a GPS L1 C/A signal with added white noise and three CW interferers. Thanks to the flexibility of the R&S®SMW200A, no additional hardware is required for this setup. CW signals and AWGN are among the most common forms of

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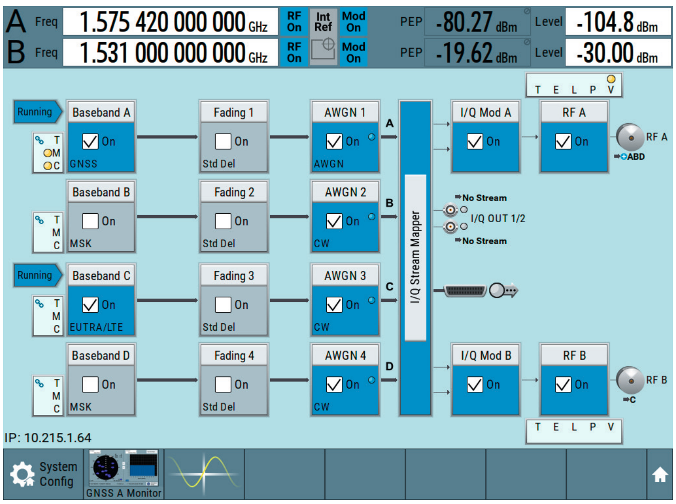
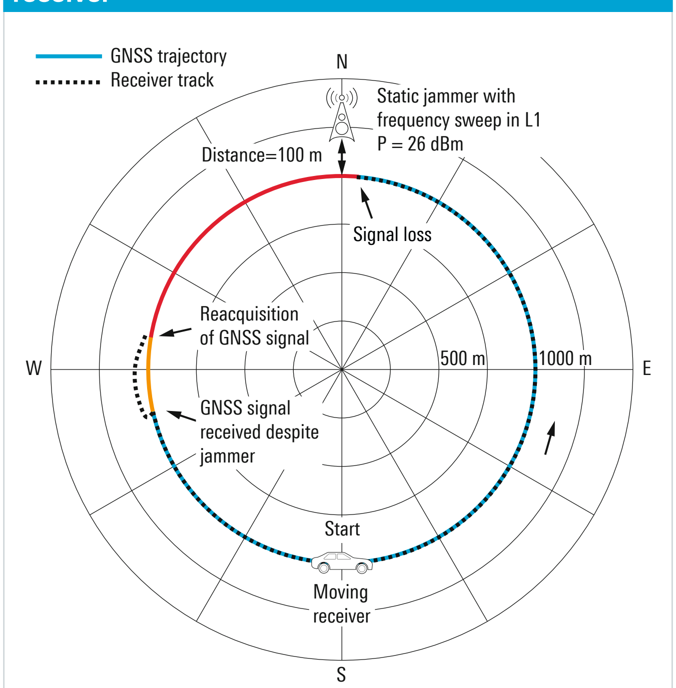
interference encountered by a receiver. CW interference can have many sources. Unintentional interference is often caused by out-of-band harmonics of amplifiers or transmitters. COTS GNSS jammers, which have become more and more widespread, also use CW signals to disrupt GNSS signal reception. The AWGN module can also be used to simulate antenna and amplifier noise or to evaluate performance in the presence of noise jammers.

Coexistence test for LTE with additional AWGN and CW interference



Effects of a localized GPS jammer on a moving receiver



Coexistence testing

While the GNSS frequency bands themselves are reserved for satellite navigation, the remainder of the L-band is heavily used by various other services. For example, both LTE and satellite uplinks and downlinks operate close to the L1 band. It is therefore crucial to validate the safe coexistence of those signals. The R&S®SMW200A makes this easy by supporting a great number of modern communications standards. Setting up an LTE signal next to a GNSS band is as simple as selecting the appropriate module and starting the simulation, allowing a quick and accurate assessment of the performance impact on the receiver. Custom digital modulations can also be used, of course.

Dynamic simulation of a jammer scenario

The scenario on the left shows a co-simulation of a moving GNSS receiver and a static jammer. The test case is to examine the receiver's behavior nearby an interference source when it loses its position fix and determine how long it takes the receiver to reacquire the GNSS signal.

The R&S®SMW200A generates GNSS signals for a receiver moving counterclockwise on a circular trajectory. The receiver starts at the 6 o'clock position in the southernmost point of the map on the left. A jammer is placed at the 12 o'clock position, 100 m north of the trajectory. The R&S®Pulse Sequencer software is then used to calculate the received jammer signal for all positions along the trajectory. Both signals are combined in an external combiner and fed into a GNSS receiver.

The receiver can provide a position when starting its movement (blue part of the trajectory). With the receiver moving closer to the jammer, the power level of the jammer signal increases until the receiver loses its lock on the GNSS signals (red part of the trajectory). When the receiver moves further away from the jammer, the power level of the jamming signal decreases, which allows the receiver to reaquire the GNSS signals (orange track).

Benefits

- Generation of complex GNSS scenarios
- Up to seven interferers out of one box
- Wide range of different interferer signals, e.g. CW, AWGN, LTE, pulsed waveforms
- Harmonized co-simulation of GNSS and interferer signals

See also

www.rohde-schwarz.com/product/smw200a

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PD 3607.9114.92 | Version 01.00 | January 2019 (ch)
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3607911492

3607.9114.92 01.00 PDP 1 en