skydel

GNSS SIMULATION

Safran, Leader in Resilient PNT Solutions

Through its acquisition of Orolia in 2022, Safran has become the world leader in resilient PNT. At 125 years old, Safran is the oldest aerospace manufacturer in the world, employs 100,000 people across 27 countries, and is acutely focused on designing, building, supporting high-tech solutions to contribute to a safer, more sustainable world.

When precision, integrity, and reliability matter most, you can count on Safran Electronics & Defense solutions' quality, performance and support to have you covered.

Why simulate GNSS?

GNSS signals have become woven into the fabric of the technology we use every day. They are so common that we hardly think how they work or how valuable they are.

Despite playing a key role in the operation of critical infrastructure, defense, transportation, space, and manufacturing, GNSS signals are weak and susceptible to jamming (both intentional and unintentional), interference, obstructions, and directed threats.

Skydel is Safran's powerful GNSS simulation engine. It can be purchased as a standalone software, or pre-installed on a COTS (commercial off the shelf) platform depending on your needs.

SAFRAN

GSG-7

GSG-7 is redefining the GNSS simulation industry with its easy-to-use simulation capabilities, extraordinary flexibility and high signal capacity. The newest positioning, navigation, and timing test solution offered through Safran's family of Skydel-based simulators delivers the highest standard of Global Navigation Satellite System (GNSS) signal testing and simulation in an easy-to-use, turnkey, small form factor. This advanced GNSS simulator enables you to generate the same RF signals as real satellites, allowing you to test your GPS / GNSS receiver device in any scenario.

- Simulation Iteration rate: 1000Hz
- # of signals: 700
- RF outputs: 1
- Size: 2U

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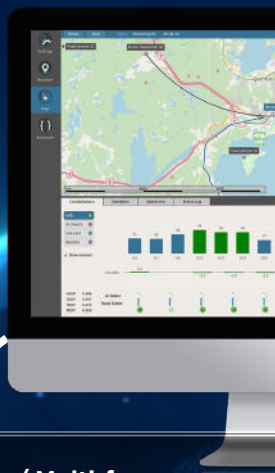


GSG-8 Gen2

The GSG-8 Gen2 simulator delivers the highest standard of GNSS signal testing and supports the growing need for location-aware applications and systems that require navigation or timing. With 6 front-facing RF outputs (and a combined one), this simulator is ideal for development, NavWar testing, and integration projects that require very high performance and an increased number of constellations and satellites in view, and multi vehicle / multi antenna scenarios.

- Simulation Iteration rate: 1000Hz
- # of signals: 2000+
- RF Outputs: 6 + 1 Combined (N-Type)
- Size: 4U
- Advanced Jamming: Yes (unlimited jammers)
- Up to 6 vehicle or antennas in a simulation
- Extractable 2TB SSD
- Sub-nanosecond-level synchronization between RF bands

Multi-constellation / Multi-frequency

- GPS, GLONASS, GALILEO, BEIDOU, SBAS, QZSS, NavIC, PULSAR, Custom.
- Support for restricted signals (GPS & Galileo).
- All-in-View simulation.

Real-time GNSS simulator

- Simulation entirely GPU-generated.
- Most parameters can be modified at runtime.
- 1000Hz simulation iteration rate
- Multi-vehicle & multi-antenna simulation
- Advanced multipath models

Powerful & simple automation

- Comprehensive API (Python, C#, C++).
- Innovative automatic Python scripting.

HIL (Hardware-in-the-Loop)

Available to any Safran platform, Skydel's Hardware-in-the-Loop feature is used to test real hardware (ex. GNSS receiver) with virtual stimuli. An asynchronous HIL setup involving a GNSS simulator allows you to send a true vehicle trajectory in real-time, and generate a corresponding GNSS RF signal.

Skydel HIL benefits:

- **Real-time:** Skydel is designed for the high iteration rate required to run real-time simulations of fast moving applications.
- **Low Latency:** Deterministic latency is minimal and accounted for with precise timestamps, meaning no jitter in your simulation.
- **Real-Time Performance Measurement Tools:** enables you to interpret data, adjust scenarios, and reduce inefficiencies on-the-fly.
- **Automated:** automation features make repeating and iterating your tests easy, giving you more time to test, and more confidence in your live application.

Unprecedented Control Automate in Seconds

Easy to use and comprising hundreds of commands, Skydel's API brings an unparalleled level of control over simulation, enabling you to build complex, elaborate and repeatable scenarios with open source client libraries for Python, C# and C++.

Benefits:

- Can control Skydel remotely using the API
- Remote program can run on the same (or separate) PC as Skydel
- API Libraries and Examples:
  - Python
  - C++
  - C#
- Ideal for configuring tests, repeated tests, precise time setting, or repeating tests from the GUI

Based on the "Command Design Pattern", all Skydel actions are sent to the engine using commands. These commands are processed identically whether originating from the GUI or remotely. All commands are logged and recorded in the Automate section and can be exported to a Python script.

Skydel Specs

(Available on all platforms)

Frequency Bands:

- All GNSS bands
- Multiple RF outputs depending on SDR configuration
- Baseband complex (zero IF) through IQ samples logging

Operating Systems:

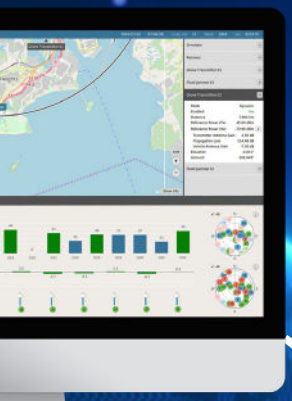
- Linux & Windows

GNSS Constellations and Signals:

- GPS: L1-C/A, L1C, L1-P(Y), L2-P(Y), L2C, L5;
- NavIC L1, L5, S-Band;
- GLONASS: G1, G2;
- G Galileo: E1, E5a, E5b, E6, E6PRS, E6 HAS, E5AltBOC, PRS (restricted signals), PRS-Noise, HAS-Noise;
- OSNMA
- BeiDou: B1, B2, B1C, B2A, B2B, B3I;
- QZSS: L1-C/A, L1 C/B, L2C, L5, L5S
- SBAS(L1/L5): WAAS, EGNOS, MSAS, GAGAN, SDCM, BDSBAS, KASS, SPAN
- Xona: PULSAR X1, X5
- Custom Signals
- Custom Constellation

Signal Accuracy:

- Pseudorange < 1mm
- Pseudorange rate < 1mm/s
- Inter-channel bias 0



GSG Anechoic

Streamlined Chamber Setup
Designed for comprehensive Over-The-Air (OTA) testing of CRPA and multi-element antennas, PNT systems, and related electronics.

- Multi-RF outputs and muli-frequency antennas,
- ensuring robust, multi-frequency simulation across GNSS constellations.
- Automatic antenna mapping for quick configuration, reducing setup time and complexity.
- Built-in time delay and power loss calibration, ensuring precise testing environments.
- Calibrates the entire system in just minutes, enabling rapid and repeatable testing cycles.

User-defined waveforms

- Chirp, CW, BOC, AWGN, BPSK & Pulse modulation + custom IQ file.
- Combine dozens of signals.
- Real-time results on spectrum.

Test / Validation / Integration

- Multi-vehicles, multi-antennas.
- HIL Low Latency.
- 6 DoF and orbital trajectories.

Plugins

- IMU
- Custom Signal
- RINEX Logger
- RTCM
- Anechoic builder + controller
- 3D Terrain Obscuration

GSG Wavefront

Very Large Number of Dynamic Interferences
Designed to test the jamming/spoofing resiliency of CRPA and multi-element antenna electronic systems, and for applications with high dynamics.

- Real-time automated phase calibration
- Generate spoofers, jammers, repeaters and alternate PNT sensors
- Scalable from 4 to 16 elements
- Phase coherence: 1°1σ
- High dynamic range
- Calibrate your entire system in minutes

Error Modeling:
- Pseudorange jumps, ramps
- Ephemeris Errors

Multipath Echo Generation
Multipath Propagation Presets
Almanac and Ephemeris custom data
Ionosphere Models – built-in and custom
Custom Antenna Patterns – both phase and gain modeled
Full navigation message bits modification for all constellations

Truth data logging:
- Downlink data
- Raw data
- NMEA
- RINEX
- HIL Input

IQ Data File Generation:
- Allows to saving of IQ data to file
- True software simulator
- IQ Playback as an output

Jamming and Spoofing

With no additional hardware required, Basic jamming and advanced jamming & spoofing allows users to simulate multiple threats simultaneously. Skydel software automatically determines signal dynamics between each, saving you time. It's also no longer necessary to purchase and synchronize multiple simulators or try to use simulator echo functions that were designed for other purposes.

Basic Jamming	Advanced Jamming	Advanced Spoofing
• Included in base license • No position for the jammer • Manual power level adjustments • Jammer types: CW, Chirp, BOC, BPSK, AWGN	• Optional feature • Introduces transmitters • Transmitter features: - Multiple dynamic transmitters - Transmit antenna patterns • Propagation loss calculated automatically • Jammer types: CW, Chirp, Pulse, BPSK, BOC, AWGN, IQ FILE	• Optional feature • Uses transmitters enabled by Advanced Jamming feature • Automatic signal dynamics calculation • Full control of all aspects of spoofer constellation • Supports repeaters and custom spoofers

ADVANCED GNSS SIMULATORS ENABLE YOU TO GENERATE THE SAME RF SIGNALS BROADCAST BY REAL (AND FUTURE) SATELLITES, ENSURING ACCURATE TESTING AND GUARANTEED PERFORMANCE OF YOUR GPS/GNSS RECEIVER DEVICES AND OTHER SYSTEMS.

POWERED BY TRUST

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