Navigation
Simulators

OPTIMUM RELIABILITY

OPTIMUM PRODUCT

OPTIMUM SAFETY

Spacelink System

RF GNSS Constellation Simulator: Navys

The ELTA GNSS Constellation Simulator called Navys is the perfect tool to perform advanced testing of GNSS receivers and systems. In addition to classical services such as state-of-the-art realistic satellite to user position synthesis, it allows user defined test scenarios with uncommon disturbance simulations (e.g. space born receiver testing).

Moreover Navys was designed to provide multiband, high-quality and large bandwidth signals, aiming at generating accurate positioning, with up to 16 pseudolites simultaneously, in a single unit.

A wide range of functionalities is made accessible, among which spacecraft and user trajectories, atmospheric propagation phenomena (ionosphere and troposphere), multipath propagation (LOS, NLOS, user defined model), customised signals (ranging codes, subcarriers, mapping, navigation data...).

Based on the generic components of the ELTA Spacelink family, and developed by the R&D team, Navys demonstrates ELTA's skills in the field of high-speed digital signal processing and system integration.

MAIN FUNCTIONS:

- Highly flexible FxNSGU signal generators
- Drift-free phase/delay control loop
- Propagation delay up to 500 ms
- Programmable wideband IF equalizers (32 taps complex FIR)
- Multipath Rice/Rayleigh modelling (up to 8 echoes)

TYPICAL APPLICATIONS

- Spaceborne and airborne receiver test bed
- High-end receiver testing : geodesic receivers, multiband receivers, scientific receivers (atmospheric studies, reflectometry, etc...)
- Pseudolites emulation
- GNSS jammers

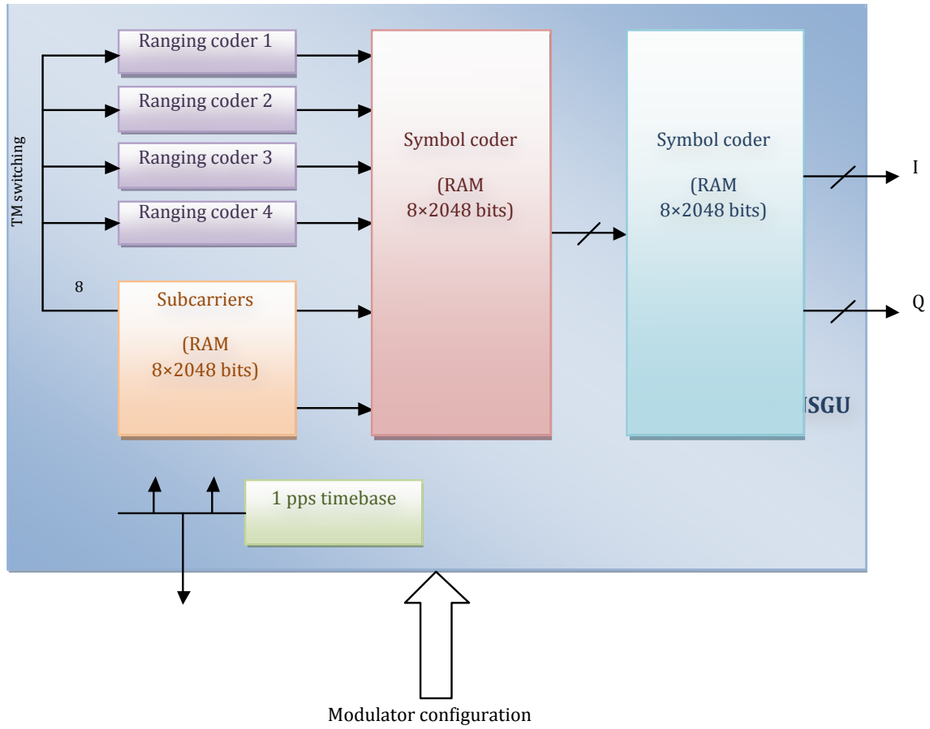
PROCESS DESCRIPTION:

CHANNEL PARAMETERS

• Nr of available channels :	4 per board, up to 4 boards in a single unit (i.e. up to 16 channels per unit). Each channel is connected to an 8 taps multipath module enabling the generation of up to 7 echoes in addition of the direct path.
• Channel attenuation:	0 to 50 dB (0.1 dB step)
• Delay:	0 to 500 ms (1 ps step)
• Pseudorange accuracy:	< 4 mm (either code delay or carrier phase)
• IF channels:	2 per board
• IF signal frequency:	10 MHz to 250 MHz
• IF bandwidth:	100 MHz @ 3 dB
• IF channel equalizer:	programmable 32 taps complex FIR filter
• IF IIR filter:	programmable 4 taps IIR filter (simulation)
• IF output spurious:	< -50 dBc typique ; < -45 dBc max

FLEXIBLE NAVIGATION MODULATORS

• Type:	full programmable RAM/Register based modulator (one per signal channel)
	- Generic BOC(m,n), with respect to the 120 Fo,
	- CBOC, TMBOC, AltBOC
	- BPSK, QPSK, n-PSK, QAM...
	- All civilian Galileo signals in all bands
	- GPS L1 C/A, L2C(TDM), L5
	- GLONASS, COMPASS, IRNSS...
• Mapping:	up to 256 I/Q symbols
• Number of ranging coders:	4 per modulator
• Number of subcarriers:	7 per modulator, plus 1 for the TM switching
• Ranging coder	
- Gold code generator:	two 41 bits LFSR
- RAM code generator:	up to 16384 chips
- Secondary code generator:	up to 100 bits circular shift register
- Navigation data generator:	up to 16384 bits/s
- TM switching:	controlled through a dedicated subcarrier
• Configurations provided:	GPS and Galileo already available



MULTIPATH GENERATORS

- Two Distinct Modes
- Rice/Rayleigh model (advanced Jake's tap model)
- Specular mode
- Number of taps/echoes: 8 per channel
- Individual tap/echo delay: up to 8 µs (by steps of 8 ns)
- Real-time
  - All the model parameters can be controlled by scenario playback at 10 or 100 Hz
  - All the multipath models parameters can be controlled at 100 Hz, up to 8 channels at same time

DUAL 16 CHANNELS COMBINER and DUAL UP CONVERTER

• Channels:	L1 (1550-1610 MHz / B-band) and L2-E5-E6 (1160-1300 MHz / A-band)
• Gain ripple:	±1 dB (without equaliser)
• Delay ripple:	< 5 ns (without equaliser)
• Output level:	-100 to -150 dBm, A-band and B-band
• Test output level:	-20 to -70 dBm, A-band and B-band
• Phase noise	
- 1 Hz	-30 dBc/Hz
- 10 Hz	-60 dBc/Hz
- 100 Hz	-80 dBc/Hz
- 1 kHz	-100 dBc/Hz
- 10 kHz	-110 dBc/Hz
- 100 kHz	-120 dBc/Hz
- >1 MHz	-125 dBc/Hz
• LO PLL phase drift:	<3 mm over 100 s (integrated drift < 4 deg)

PROCESS DESCRIPTION (SUIT):

SCENARIO PLAYBACK

- Real-time Propagation parameters
  - Delay: geometric, ionospheric and tropospheric delays
  - Noise: rms values of the carrier phase noise and code delay noise
  - Attenuation: with respect to the FxNSGU configured level
- Real-time Multipath parameters
  - Rice/Rayleigh mode: Rice factor, tap delay, mobile speed of tap
  - Specular mode: delay, phase, frequency, amplitude of echoes
- Playback rate: 1, 10 or 100 samples/s, internally interpolated to 10 ksamples/s

SCENARIO SOFTWARE

- Receiver types: spaceborne, airborne and terrestrial
- GNSS constellation: GPS, GALILEO, user-defined
- Number of pseudolites: Up to 16
- Ionospheric, troposheric, orbit and clock errors
- Receiver trajectory: fixed, polynomial or files
- Tx and Rx antenna patterns: files

developed by ThalesAlenia Space

REMOTE CONTROL

- Interface: Ethernet 10/100
- Protocols
  - TCP/IP for remote monitoring and control
  - FTP for scenario file upload
  - HTTP for remote GUI

ENVIRONMENTAL CONDITIONS

- Operating
  - Temperature: 10 °C to 40 °C
  - Humidity: Up to 95 % at 30 °C
- Non Operating
  - Temperature: -40 °C to 70 °C
  - Humidity: Up to 95 % at 30 °C

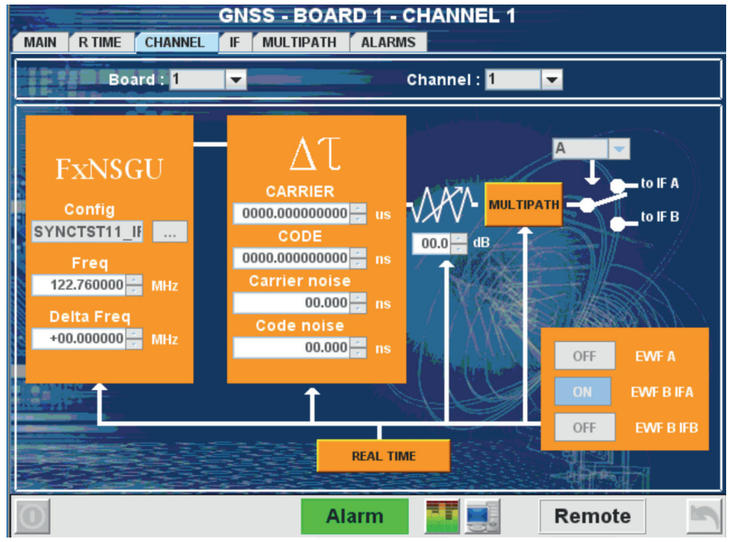
POWER LINE

- Voltage: 100 to 250 VAC / 47 to 63 Hz
- Power: ≤ 300 Watts
- Weight: 20 kg

PRODUCT REFERENCE

- GCS 16 Channel: DRA301000
- GCS 8 Channel: DRA301137
- GCS 4 Channel: DRA301136
- GDUP2 Dual Up Converter: DRA301118

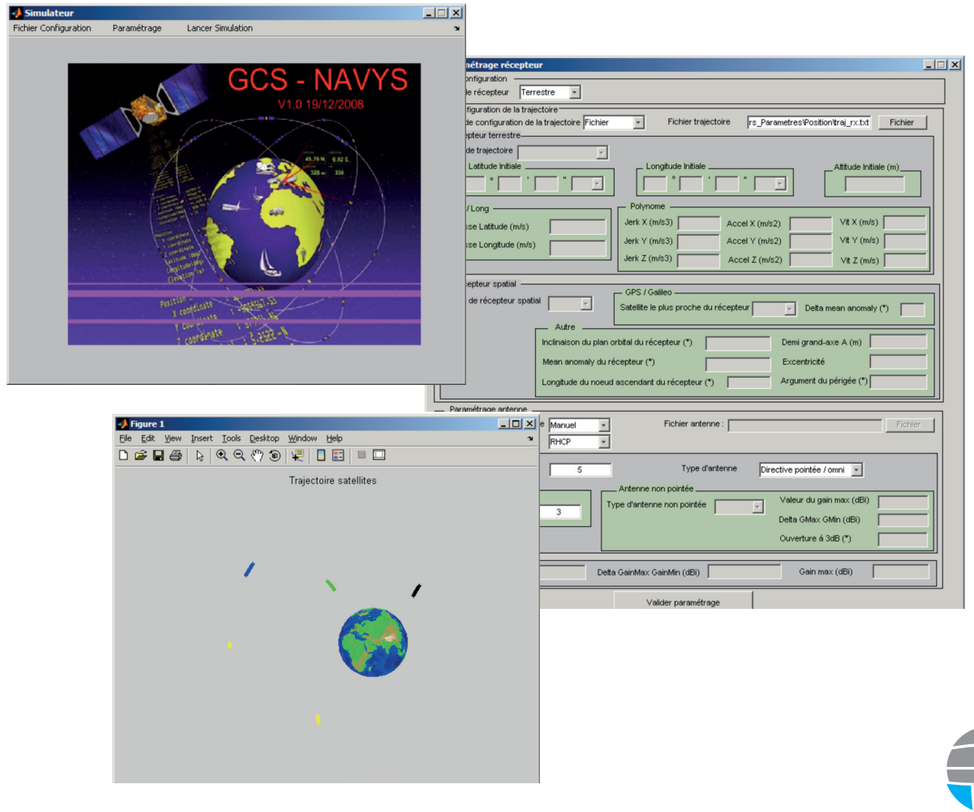
GRAPHICAL USER INTERFACE – HARDWARE UNIT



Note : the interface is remotely available through the HTTP web server installed in the unit.

GRAPHICAL USER INTERFACE - SCENARIO SOFTWARE

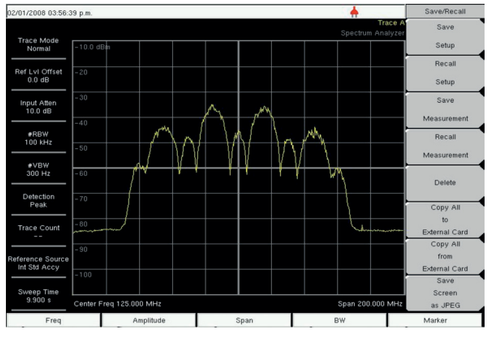
ThalesAlenia Space



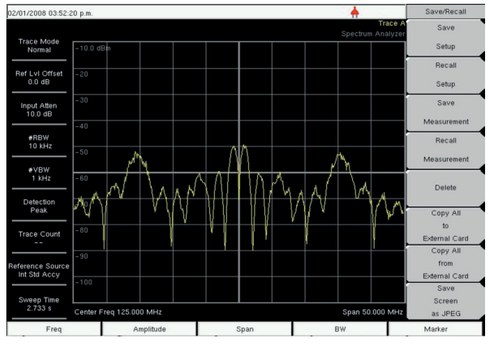
SOME TESTS RESULTS

SPECTRA

Spectrum shot of the Galileo E5

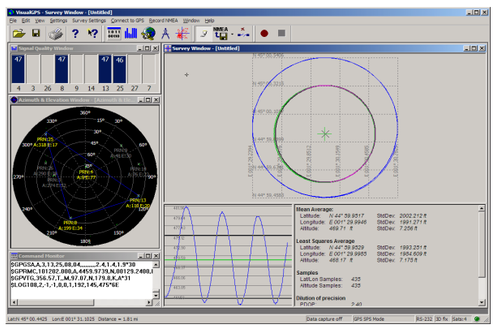


Spectrum shot of the Galileo E1

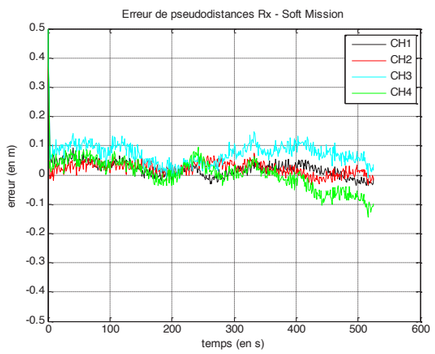


CIRCULAR TRAJECTORY SIMULATION

Trajectory (displayed by VisualGPS™)



Pseudorange errors

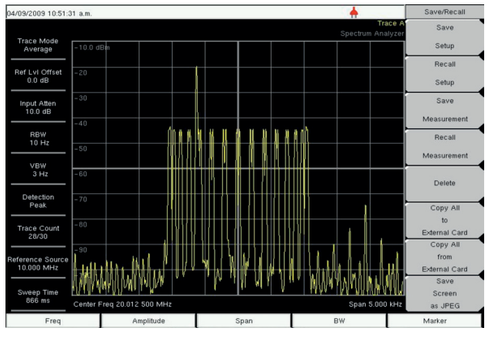


***Note**: the pseudoranges and positions are measured by a SIRFIII chipset.*

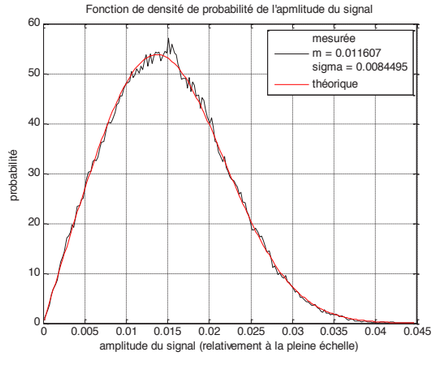
SOME TESTS RESULTS

MULTIPATH

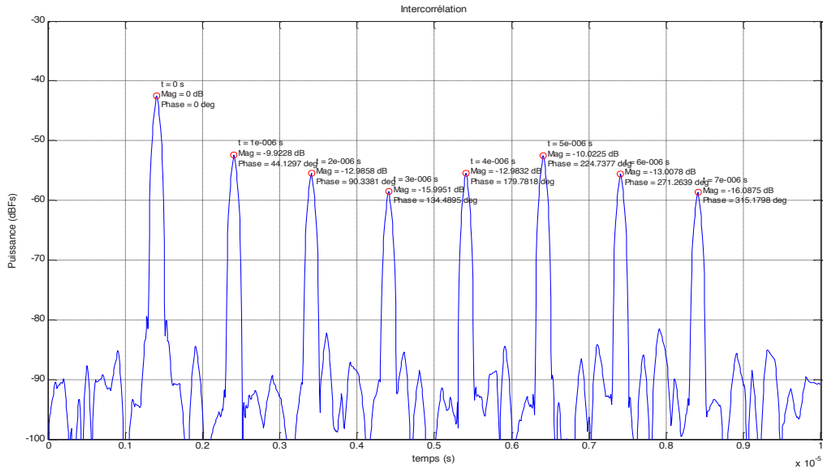
Jake's model real life spectrum



Amplitude probability density



RICE/RAYLEIGH MODEL



SPECULAR MODEL

Echo amplitude and phase checked by

PRBS transmission / RF signal recording / cross-correlation

ELTA

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