RF GNSS Constellation Simulator

NAVYS BLACKLINE

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 48 pseudolites simultaneously, in a single unit.

Multipaths generation is a particular advantage of NAVYS compared to standard simulators. Indeed, it allows a capacity of 8 paths for every transmitter.

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 Blackline 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...

1 MAIN FUNCTIONS

- A SINGLE NAVYS UNIT GENERATES UP TO 384 TRANSMISSION CHANNELS (768 CHANNELS WITH COMBINER)
- HIGHLY FLEXIBLE SIGNAL GENERATORS COMPATIBLE WITH FUTURE GNSS SIGNAL EVOLUTIONS ONLY BY SW UPGRADE
- DRIFT-FREE PHASE/DELAY CONTROL ALLOWING THE HIGHEST LEVEL OF PERFORMANCES OR LOW-LEVEL RECEIVER TESTING
- PROPAGATION DELAY UP TO 900 MS ALLOWING OFF ORBIT RECEIVERS TRAJECTORIES
- PROGRAMMABLE WIDEBAND IF EQUALIZERS (COMPLEX FIR) FOR USER DEFINED BAND LIMITATION
- UNIQUE CAPACITY OF EWF GENERATION BEYOND DO-229D SPECIFICATIONS AND GPS L1 C/A SIGNALS
- MULTIPATH RICE/RAYLEIGH MODELLING (UP TO 7 ECHOES PER LOS CHANNEL), WITH USER-DEFINED OR DETERMINISTIC MODELS CAPACITY, UP TO 1KHZ UPDATE RATE
- BASELINE CAPACITY OF UP TO 4 ANTENNAS SIMULATION WITH THE SEPARATE RF OUTPUTS PER 12 CHANNELS MODULE
- REAL SIGNALS/DATA SYNCHRONIZED OPERATION FOR SYSTEMS AUGMENTATION OR SIGNALS RE-TRANSMISSION
- OPTIONAL CAPACITY JAMMERS GENERATION WITH REALISTIC RX/JAMMERS DYNAMICS CONTROLLED BY THALES ALENIA SPACE SW

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2 TYPICAL APPLICATIONS

- SPACEBORNE AND AIRBORNE RECEIVER TEST BENCH
- HIGH-END RECEIVER TESTING: GEODESIC RECEIVERS, MULTIBAND RECEIVERS, SCIENTIFIC RECEIVERS (ATMOSPHERIC STUDIES, REFLECTOMETRY, ETC...)
- PSEUDOLITES EMULATION
- GNSS JAMMING AND SPOOFING ENVIRONMENT
- ENVIRONMENTS STUDY (URBAN, CANYON, ETC...)

3 TECHNICAL CHARACTERISTICS

PROCESS DESCRIPTION AND RF FEATURES			
Number of available channels	12 per board, up to 4 boards in a single unit (i.e. up to 48 channels per unit). Each channel is connected to an 8 taps multipath module enabling the generation of up to 8 echoes. Channels can be gathered to increase the number of echoes.		
Channel attenuation	0 to 75 dB (0.1 dB step), 40 dB simulation plus 35 dB analog adjustment		
Delay	0 to 900 ms (1 ps resolution)		
Pseudorange accuracy	< 4 mm (either code delay or carrier phase)		
RF compensation	2 programmable 24 taps complex FIR filter per board		
Simulation EWF effect	2 programmable IIR filter (simulation) per board		
Output	1 nominal and 1 test after combiner and 1 per board before combiner (i.e. 4 per unit)		
Output frequency	1160 to 1610 MHz allowing versatile generation of any L-BAND GNSS from the standard version		
Output level	-110 to -175 dBm		
Test output level	-10 to -75 dBm		
Signal Bandwidth	100 MHz @ 3 dB		
Gain ripple	±0.2 dB (±1 dB without equalization)		
Delay ripple	< 5 ns (without equaliser)		
Output spurious	< -45 dBc typical dBc max		
Phase noise	- 10Hz: -75 dBc/Hz - 100 Hz: -95 dBc/Hz	- 1 kHz: -110 dBc/Hz - 10 kHz: -115 dBc/Hz	- 100 kHz: -116 dBc/Hz >1 MHz: -135 dBc/Hz
LO PLL phase drift	<3 mm over 100 s (integrated drift < 4 deg)		
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 (E1, E5a, E5b, E5 Alt BOC) - GPS (L1C/A, L1C, L2C,L5) - GLONASS, BEIDOU, SBAS, IRNSS		

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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 1, 10 or 100 Hz - All the multipath models parameters can be controlled at 1, 10 or 100 Hz
ADVANCED FEATURES	
External coder interface	Enables the use of an external coder for very long codes
IQ Replay	NAVYS allows to play any scenario (even very complex) previously recorded on site or through synthetic generation of IQ samples
COMBINER MULTI UNITS / INTERFERER	
GNSS combination	8 inputs (2 simulators, i.e. up top 96 channels or 8 constellations)
Interferer combination	4 inputs, +10 / -130 dBm power range, allowing up to 32 jammers with I-Flex
Output	1 nominal + interferer and 1 test
Output Frequency	1160 to 1610 MHz
Output level	-110 to -175 dBm
Test output level	-10 to -75 dBm
REAL-TIME CONTROL PARAMETERS	
Real-time Propagation parameters	All channel control parameters are driven by the control SW from 1 to 100 Hz. Code and carrier delay are expressed in phase, Doppler, Doppler-rate and jerk allowing smart HW embedded 1kHz
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
SCENARIO SOFTWARE	
Receiver types	Spaceborne, space-launchers, airborne, terrestrial, user-defined (ECEF, LLA)
GNSS constellation	GPS, GALILEO, GLONASS, BEIDOU, SBAS
Number of transmitters	Unlimited
Ionospheric, troposheric, orbit and clock	Various modelizations available
Receiver trajectory	Fixed, polynomial or files
Tx and Rx antenna patterns	Configurable by files
REMOTE CONTROL	
Interface	Ethernet
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 (from 0° with preliminary warm-up) - 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

developed by ThalesAlenia Space

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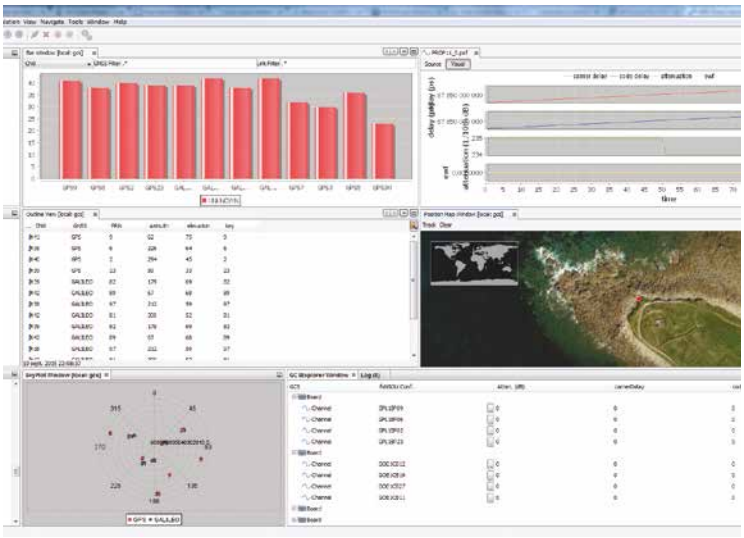
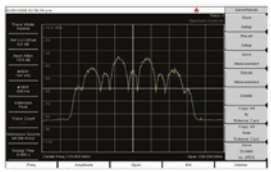
GRAPHICAL USER INTERFACE - SOFTWARE UNIT - (ESURVEY T-FLEX)



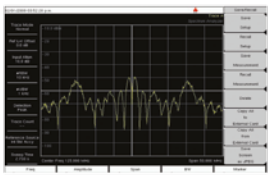
4 EXAMPLES OF TEST RESULTS

SPECTRA

Spectrum shot of the Galileo E5

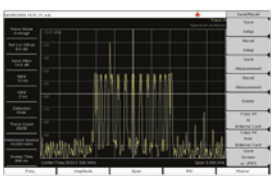


Spectrum shot of the Galileo E1

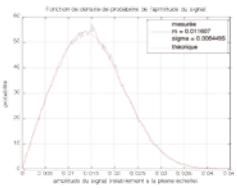


MULTIPATH

Jake's model real life spectrum

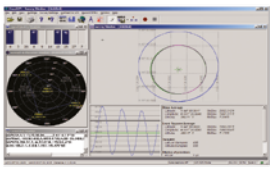


Amplitude probability density

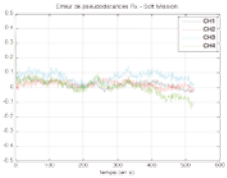


CIRCULAR TRAJECTORY SIMULATION

Trajectory (displayed by VisualGPS™)



Pseudorange errors



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

ORDERING INFORMATION

MODELS	PART NUMBERS
NAVYS 12 channels	15N60522 - x1
NAVYS 24 channels	15N60522 - x2
NAVYS 36 channels	15N60522 - x3
NAVYS 48 channels	15N60522 - x4
Upgrade + 12 channels	UPG - x1
Combiner multi units / interferer	15N60880

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