



Ninja Model C-IIR6 expandable to C-I4R24. Enclosure may differ from one depicted here.

iP-Solutions has over 20 years experience of developing GNSS solutions, both high-end receivers and simulators.

With extensive experience in GNSS and particular expertise in Ionospheric scintillation monitoring, iP-Solutions has developed new models and approaches to simulation, presented in multiple publications, articles in GPS World and Inside GNSS magazines and two text books, published with Cambridge University Press.

Our simulators are the accumulation of over seven years of collaboration with the Japan Aerospace Exploration Agency (JAXA). They bring high signal quality and industry-leading accuracy at sensible prices.

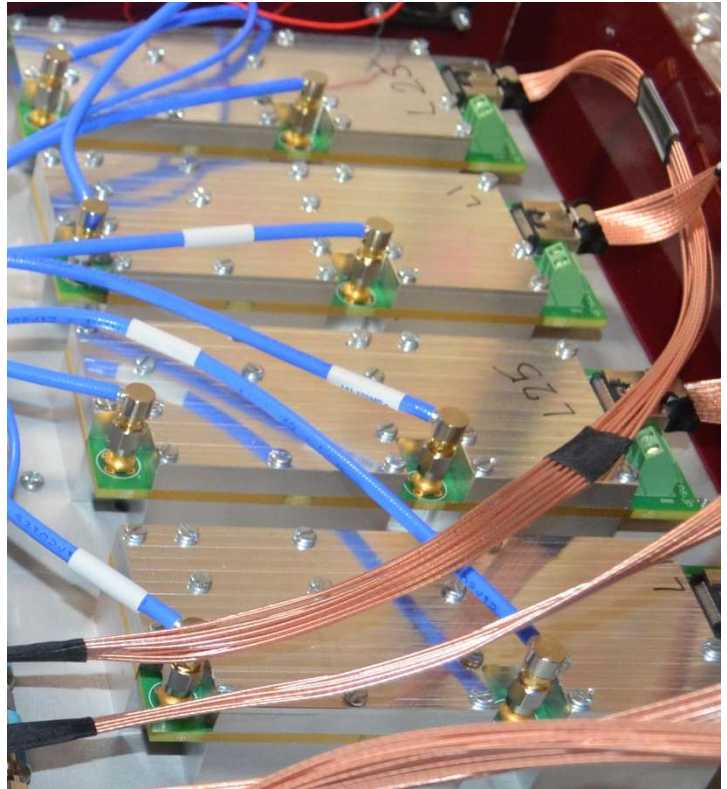
Custom models and signals can be implemented through ANSI C Model API and Signal API.

Ninja hardware

The Ninja is high-end, industrial grade simulator, which is using 14-bit resolution Pegasus RF cards. It is different from Replicator model in that it supports higher power range, higher power resolution, more RF cards (up to 32), HIL simulation, 1,000 Hz (1 millisecond) update rate.

The Ninja is available as a single unit simulator and as a simulation complex. The Ninja Complex has a Master unit, which is in charge for communication with host PC. The Master unit can be connected with up to eight RF units, each of which contains six RF cards. Each RF card allows to simulate multiple signals on a specific central frequency.

The Ninja’s modular structure allows to build up the system with up to 32 RF cards and up to 8 RF outputs. Ninja supports HIL test.



In difference to the Replicator simulator, the Ninja’s cards are set to a specific signal during factory configuration. The Replicator allows to playback signals recorded by our PORTOS recorder, whereas the Ninja allows simulation mode only.

Minimum Ninja Complex configuration includes 19-inch rackmount Master and at least one 19-inch rackmount RF unit. A standalone Ninja N11/4R6 consists of a one unit, which combines Master and RF units in a single enclosure.

The Host PC operates control software ReGen™.



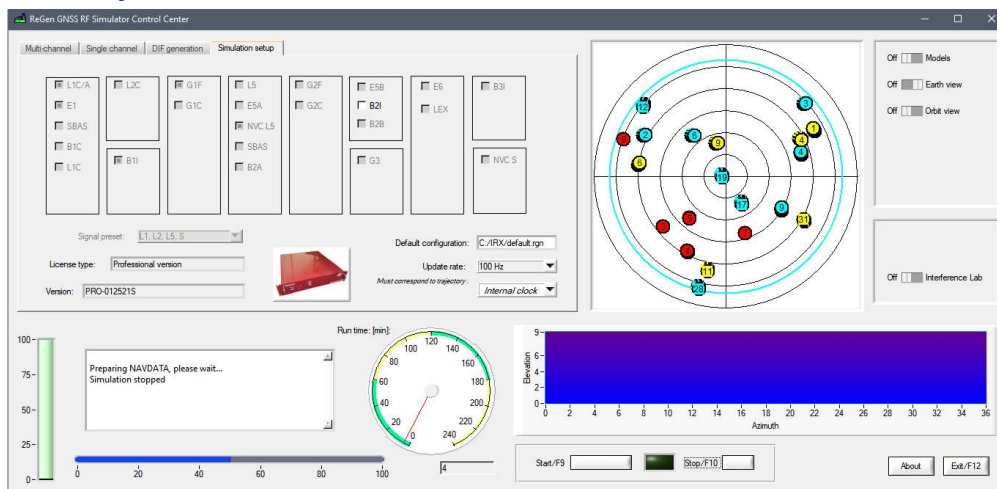
The ReGen™ control software

The ReGen control software has similar features and functionality for Ninja and Replicator simulator models. The ReGen software allows a user to control the following:

- Position, Start Time, Duration, Static Position or Dynamic Trajectory

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- *Signal propagation models (true and broadcast) for ionosphere and troposphere (Klobuchar, Saastamoinen, Hopfield, NATO, Black model)*
- *Step, Ramp, Acceleration of Pseudorange and Carrier Phase Errors;*
- *Orbital parameters (true and broadcast);*
- *Navigation message parameters and bits;*
- *User trajectory input.*

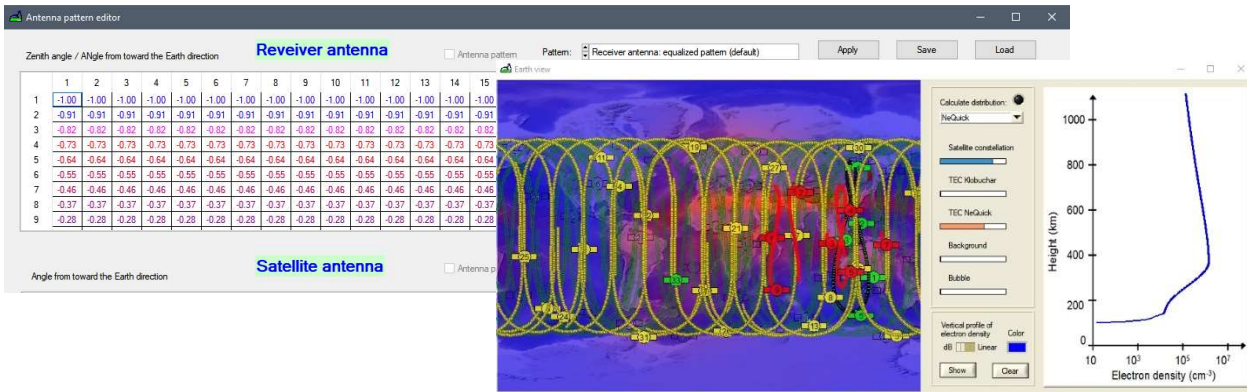
Additional ReGen feature for Ninja is that it allows to control the above parameters for each RF unit i.e. for each antenna.



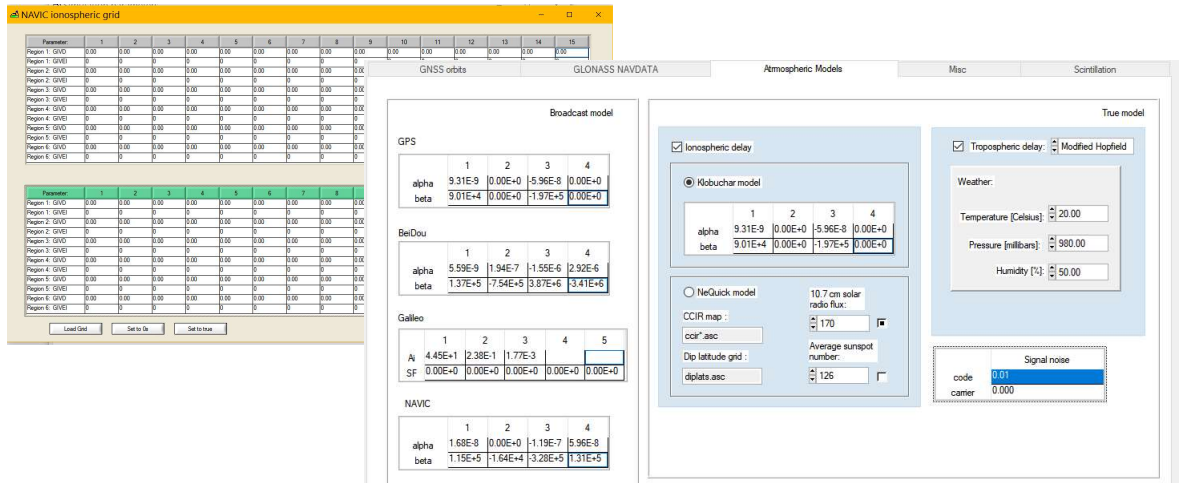
The ReGen simulator control software, shown simulating GPS, QZSS and NAVIC signals (Ground track window shows orbits for different simulation periods for better visualization).

ReGen advanced features (professional version and optional)

- *Multipath simulation.*
- *Receiver antenna pattern editor.*
- *Satellite antenna pattern editor.*
- *Obstruction editor.*
- *Single channel simulator: allows to switch off code, carrier and data, set a Doppler profile*
- *Receiver in the loop function with NMEA input from a receiver under the test and accuracy analysis functions.*
- *Trajectory simulator with various segment commands.*
- *Various clock degradation models.*
- *Output of simulated data in NMEA format.*
- *Advanced ionosphere simulation:*
 - NeQuick model, ionospheric gradient error editor,*
 - scintillation simulation, ionospheric bubble simulation*
 - fault scenarios (RTCA LAAS ICD and FAA CAT-1 LAAS spec).*

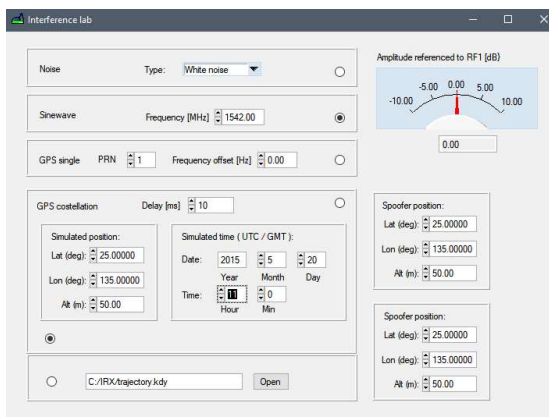


The ReGen panels with antenna pattern editor, satellite ground tracks over NeQuick ionospheric model and vertical TEC distribution.



The ReGen panel with NavIC true and simulated grid model parameters, atmospheric parameter models.

Interference Lab

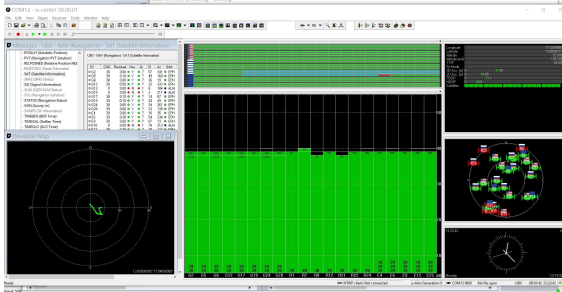


The ReGen panel with Interference Lab

ReGen™ for Ninja Complex can also include Interference Lab software and hardware module to simulate spoofing and interference. The module include 6 RF cards with extended power range .

Interference signals can be simulated as a noise, single harmonic, spoofing GNSS signals and meaconing signals with 90 dB power range.

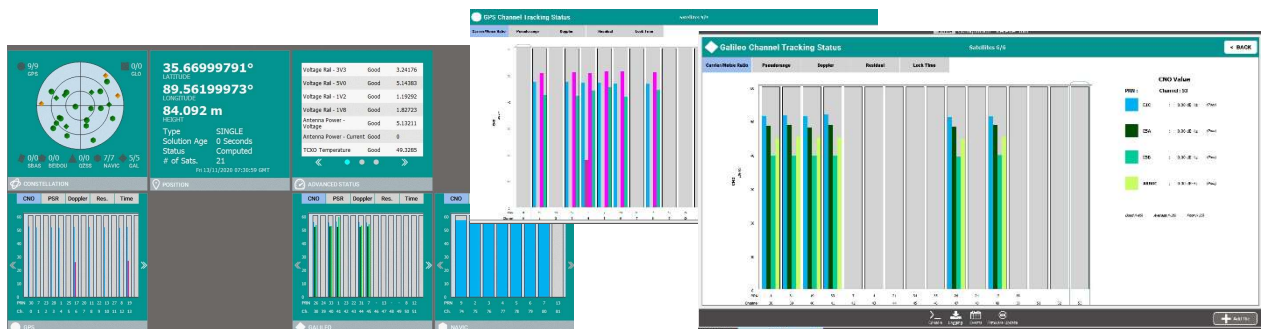
Test examples with various receivers



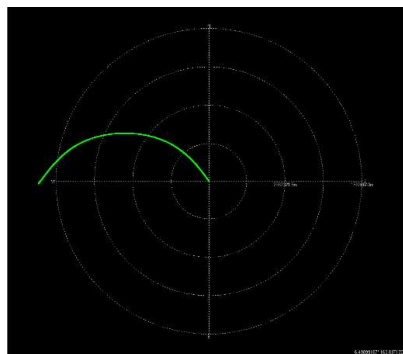
uBlox 9 working with dual frequency GPS, GLONASS and Galileo simulated signals. The scatter plot is usually within 50 cm from true position.



Septentrio receiver with dual and triple frequency GPS, GLONASS and Galileo simulated signals

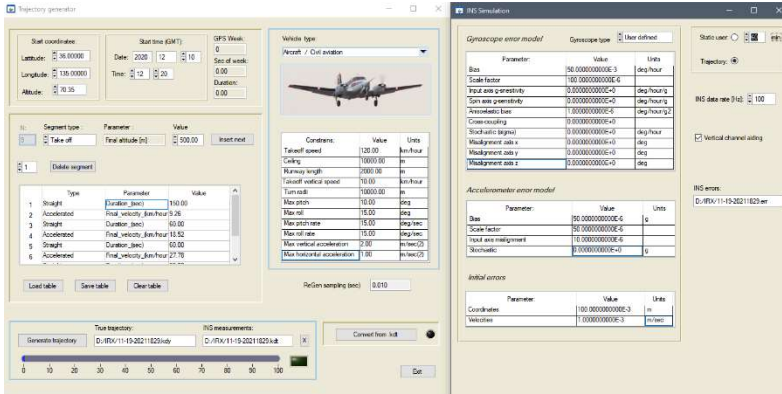


Novatel OEM7 working with the Ninja dual and triple frequency GPS, Galileo, NavIC and GLONASS simulated signals.

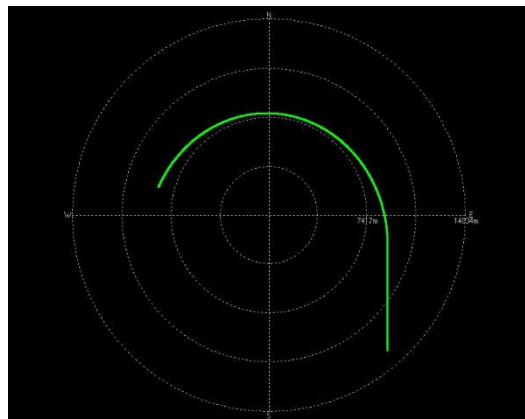
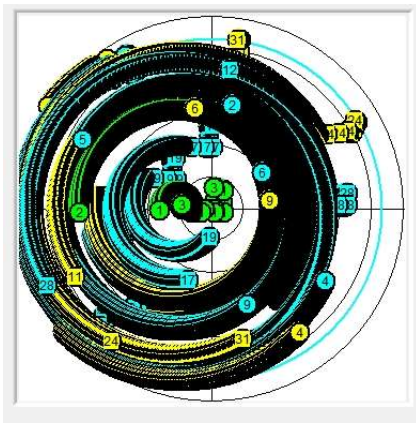


A spaceborne receiver on LEO satellite (test by an ESA project team) working with simulated GPS signal.

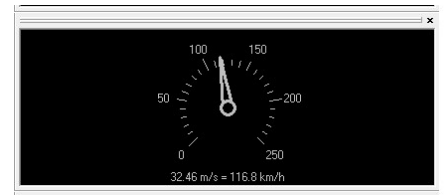
6-DOF trajectory generator and INS simulator



INS and trajectory generator add-on to ReGen.



Constrains:	Value	Units
Takeoff speed	120.00	km/hour
Ceiling	5500.00	m
Runway length	2000.00	m



ReGen Skyview plot for simulated flight vehicle path and uBlox deviation map with position estimate.

The Ninja configurations

Configuration	Model	Functions	Features
Ninja	N-IIR6	1 output, 6 frequencies, at a time	1 unit
Ninja Complex 4	C-IIR6	1 output, 6 frequencies at a time	2 units, upgradable within C model range
Ninja Complex 4	C-I4R24	4 outputs, 24 frequencies at a time	5 units

Model legend: S/R/N/C-A/C/I-X-rY : model-academic/commercial/industrial - Number of RF outputs - number of simultaneously available RF frequencies

Specification

	Parameter	
1	Signals	GPS L1C/A, L1C, L2C, L5, BeiDou B1I, B1C, B2a, B2b, B2I, B3I, Galileo E1, E5A, E5B, E6, QZSS L1C/A, L1C, L2C, LEX, NAVIC L5, S, GLONASS L1OF, L2OF, L1OC, L2OC, L3OC, SBAS and user defined signals.
2	Frequency, bandwidth, structure	In accordance with ICDs
3	Power control	
	Range	50 dB
	Resolution	0.1 dB
	Real-time between satellites	Yes
4	Connectors	
	RF OUT (one for each RF unit)	N female, DC block . 50 ohm
	Trigger	BNC female
	1 PPS OUT (one for each RF unit)	BNC female
	1 PPS IN	BNC female
	External clock IN	BNC female
	External clock OUT	BNC female
	Power	5/12 VDC , 4 W (AC/DC adapter is included)
5	Accuracy	
	Code phase	< 1 mm RMS
	Carrier phase	< 1 mm RMS
	Bias between RF channels	< ±2 ns
6	User dynamics	
	Update rate	1,000 Hz
	Vehicle type	Car, aircraft, satellites
	Maximum Velocity	As required by trajectory
	Maximum Acceleration	As required by trajectory
	Maximum Jerk	As required by trajectory
	Maximum duration	10 days
	Control software	ReGen, 6-DOF Trajectory Generator, Interference Lab
7	Time base	
	Clock type	OCXO
	Aging	±0.1 ppb /day
	Stability	±0.1 ppb
8	Environmental (for indoor use only)	
	Operating temperature	Room temperature
	Operating humidity	Room humidity
	Dimensions (each unit)	Rack-mount, 19 inches, 2U.
	Weight (each unit approx.)	~ 12 kg