Equipment development approaches for GLONASS navigation signal simulation with the purpose of user navigation equipment testing

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Krasnoyarsk, 18- 22 may 2015

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The capability enhancement and refinement of user's navigation equipment (UNE) requires the development of innovative test and checkout equipment (TCE). Advanced TCE is designed for engineering and checkout of UNE installed on highly dynamic objects and operating with signals of several GNSS constellations in clutter and jamming environment both in autonomous mode and integrated with platformless inertial navigation systems (INS).

DEVELOPMENT OF TEST AND CHECKOUT EQUIPMENT WITH THE PURPOSE OF USER NAVIGATION EQUIPMENT TESTING

Range of working frequencies:

1570...1615 MHZ.

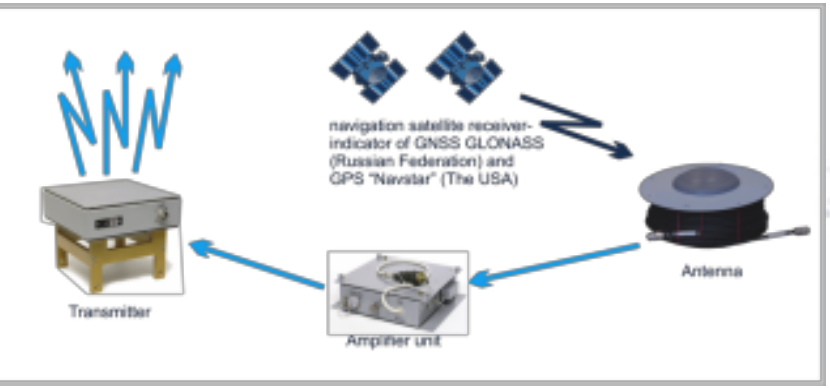
Length cable is from 20 to 112 m

Operating conditions:

- range of operating temperatures for PA unit: from minus 60°C to plus 80°C;
- range of operating temperatures for other units: from minus 40°C to plus 55°C;
- external mechanical factors: in accordance with the requirements of GOST V 20.39.304-95 for equipment of group 1.1.

Power supply:

220V 50 Hz AC or (23 – 32) V DC



Development of test and checkoutequipment for digital and analog technique

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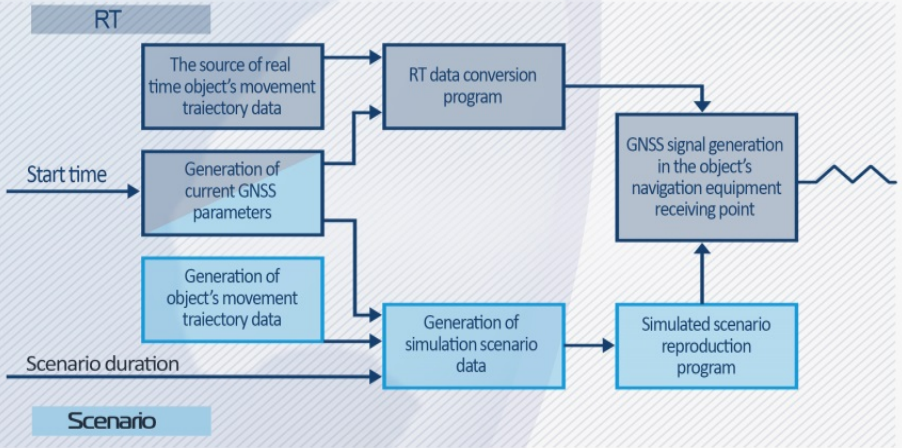
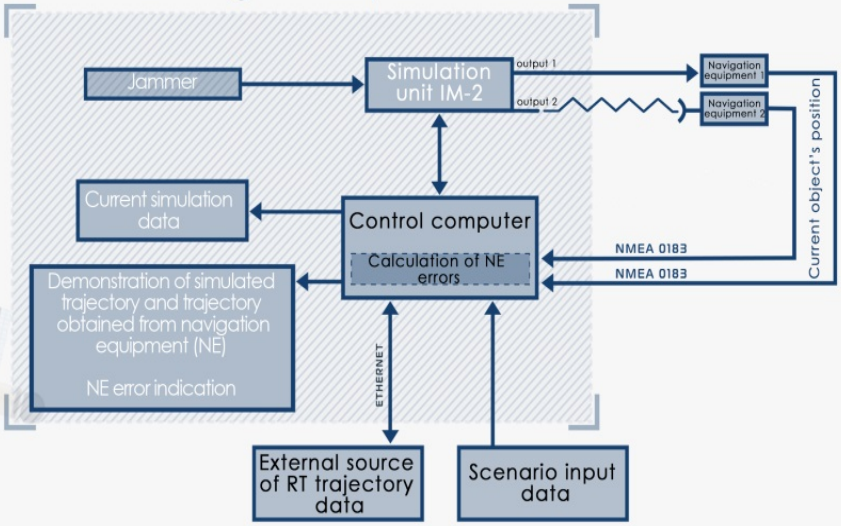
PERFOMANCE CHARACTERISTICS:

- TYPES OF SIMULATED NAVIGATION SIGNALS: GPS, GLONASS, SBAS
- NUMBER OF SIGNALS SIMULATION CHANNELS: 24 in any combination
- NUMBER OF INDEPENDENT/SIMILAR RF POWER OUTPUTS: 2
- SIGNAL POWER LEVEL: -120 dBW to -180 dBW with step: 0,25 dBW
- MEAN SQUARE ERROR:
  - OF PSEUDORANGE SETTING: < 0.1 m
  - RATE OF PSEUDORANGE CHANGE: < 0.01 m/s
- POWER SUPPLY: 220 V ± 10%
- REFERENCE OSCILLATOR STABILITY: $5*10^{-9}$($1*10^{-11}$) per day
- CONSUMED POWER: 400 W
- DIMENSIONS OF SIMULATION UNIT: 420 mm*195 mm*250 mm (W*H*D)
- SIMULATION UNIT WEIGHT: 10 kg
- LIMIT DYNAMIC FEATURES:
  - OBJECT'S SPEED: 8000 m/s
  - OBJECT'S ACCELERATION: ± 1000 м/сек^2
  - OBJECT'S RATE OF ACCELERATION CHANGE (Jerk): ± 500 м/сек^3

Generation of input data for simulation process



Navigation ewuipment test stend



Development of jamming-resistance test for radio-receiving equipment

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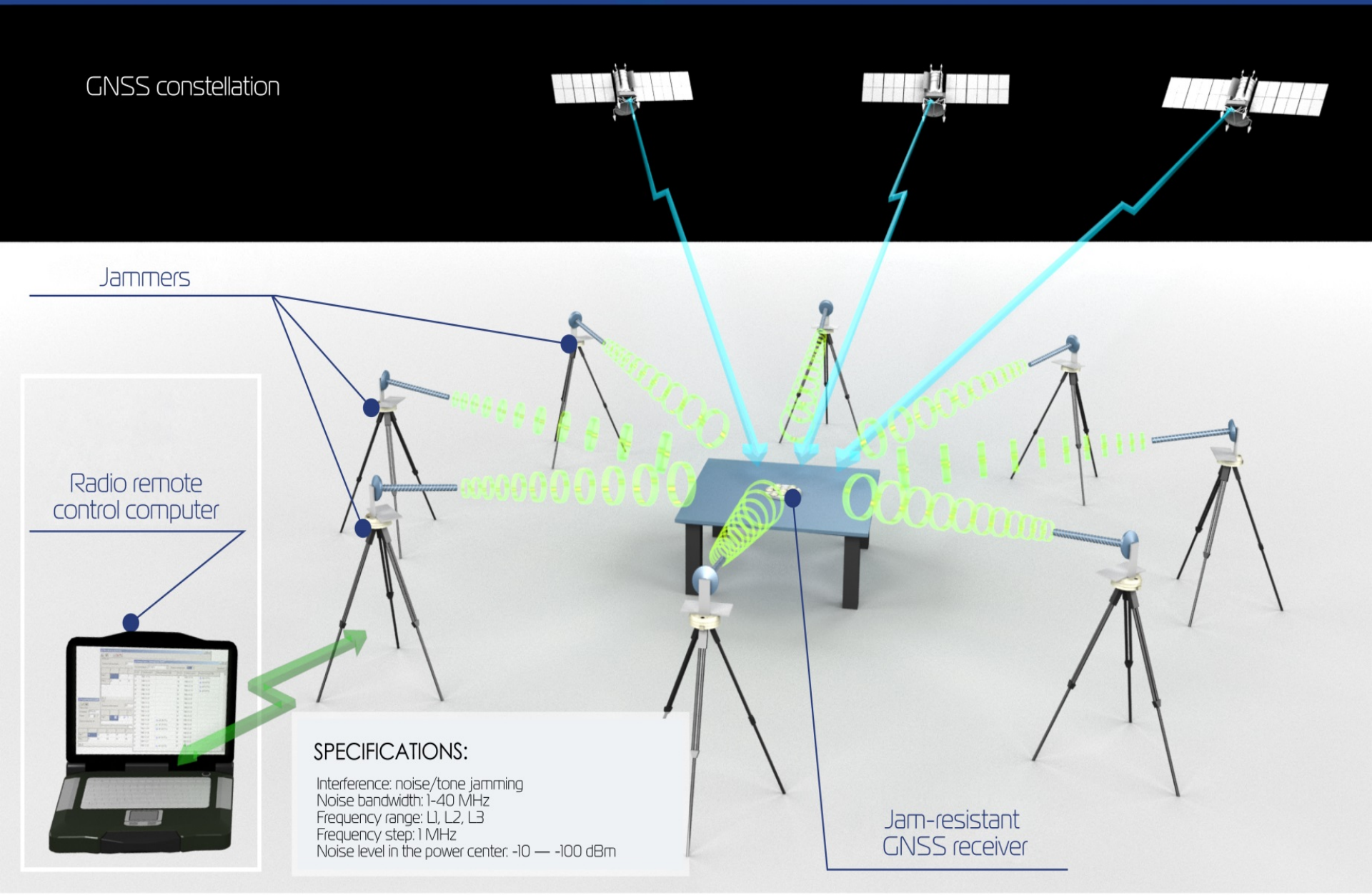
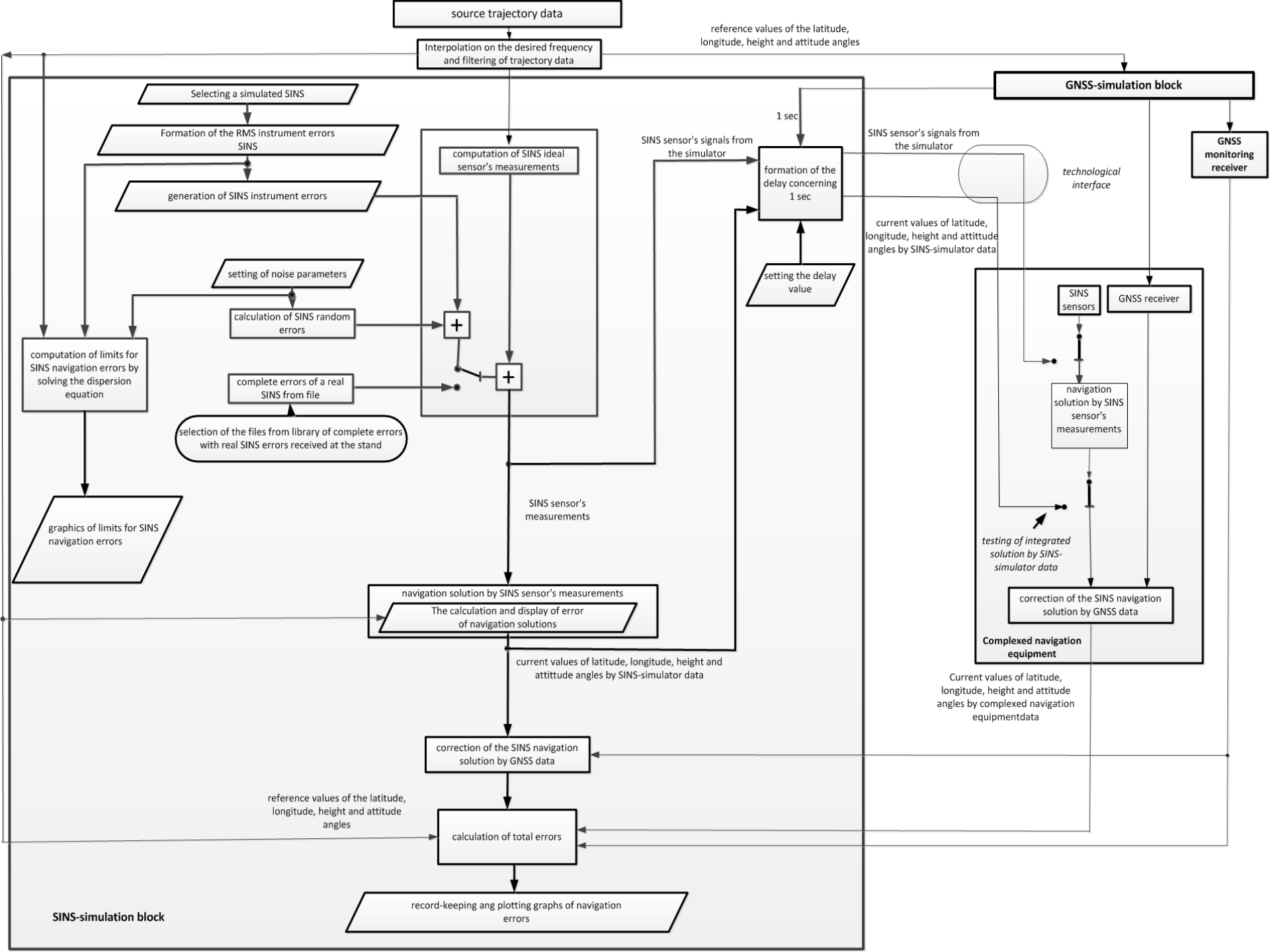


SPECIFICATIONS:

Interference: noise/tone jamming
Noise bandwidth: 1-40 MHz
Frequency range: L1, L2, L3
Frequency step: 1 MHz
Noise level in the power center: -10 — -100 dBm


source trajectory data
Interpolation on the desired frequency and filtering of trajectory data
reference values of the latitude, longitude, height and attitude angles
GNSS-simulation block
GNSS monitoring receiver
Selecting a simulated SINS
Formation of the RMS instrument errors SINS
generation of SINS instrument errors
computation of SINS ideal sensor's measurements
1 sec
SINS sensor's signals from the simulator
formation of the delay concerning 1 sec
SINS sensor's signals from the simulator
technological interface
current values of latitude, longitude, height and attittude angles by SINS-simulator data
setting the delay value
setting of noise parameters
calculation of SINS random errors
computation of limits for SINS navigation errors by solving the dispersion equation
complete errors of a real SINS from file
selection of the files from library of complete errors with real SINS errors received at the stand
graphics of limits for SINS navigation errors
SINS sensors
GNSS receiver
navigation solution by SINS sensor's measurements
testing of integrated solution by SINS-simulator data
correction of the SINS navigation solution by GNSS data
Complexed navigation equipment
SINS sensor's measurements
navigation solution by SINS sensor's measurements
The calculation and display of error of navigation solutions
current values of latitude, longitude, height and attittude angles by SINS-simulator data
Current values of latitude, longitude, height and attitude angles by complexed navigation equipmentdata
correction of the SINS navigation solution by GNSS data
reference values of the latitude, longitude, height and attitude angles
calculation of total errors
record-keeping ang plotting graphs of navigation errors
SINS-simulation block