ICG-14

New Russian High Precision Navigation Module

8-13 December 2019
Bengaluru, India

Sergey Silin
Igor Lisovoi
JSC «Navis Inc.» was established in 1996.

Main line of business: Development, production and servicing of mass-market navigation equipment for GNSS:GLONASS, GPS, GALILEO, BEIDOU, SBAS, SDCM.

In the enterprise structure:
Development Center - Provides a complete navigation user equipment development cycle

In-house production - including microelectronic, allows to manufacture serial navigation user equipment according to the highest requirements

Testing Laboratory - provides certification tests, as well as experimental and serial samples of navigation user equipment

Service - performs commissioning works, warranty and post-warranty servicing of navigation user equipment
For more than 20 years NAVIS Inc. has been producing commercial modules, which are used in navigation equipment in a variety of areas.
**OEM modules of previous generations**

The line of commercially produced receivers is quite wide and has been running for several generations.

**NAVIOR-24/24S**
- 24 Channels
- GLONASS/GPS

**SN-4706**
- 24 Channels
- GLONASS/GPS

**NV08C-CSM**
- 32 Channels
- GLONASS/GPS/GALILEO/BEIDOU

**NV08C-MCM**
- 32 Channels
- GLONASS/GPS/GALILEO/BEIDOU

The company has not only extensive experience of developing navigation equipment of different types, but also experience of creating different infrastructure. During 2000-2011, a step-by-step complex creation of differential GNSS GLONASS/GPS subsystems providing a high-precision radio navigation field was carried out.
# New generation NV08C modules line

<table>
<thead>
<tr>
<th></th>
<th>NV08C-MCM</th>
<th>NV08C-CSM</th>
<th>NV08C-miniPCI</th>
<th>NV08C-CSM-DRD</th>
<th>NV08C-RTK</th>
<th>NV08C-RTK-A</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of tracking channels</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 x 32</td>
</tr>
<tr>
<td><strong>Coordinate accuracy (RMS)</strong></td>
<td>&lt; 1.5 m</td>
<td></td>
<td></td>
<td></td>
<td>RTK: 1 cm + 1 ppm</td>
<td></td>
</tr>
<tr>
<td><strong>Heading Mode</strong></td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td>Supported</td>
<td>0.1° @ 2 m</td>
</tr>
<tr>
<td><strong>Date rate</strong></td>
<td>1, 2, 5, 10 Hz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Raw data</strong></td>
<td>Pseudorange, phase measuring, Doppler, signal/noise</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>RAIM</strong></td>
<td>Supported</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Protocols</strong></td>
<td>NMEA 0183, BINR, RTCM 2.x</td>
<td></td>
<td></td>
<td></td>
<td>NMEA 0183, RTCM 3.x</td>
<td></td>
</tr>
<tr>
<td><strong>1PPS</strong></td>
<td>15 ns(RMS), 38.5 ns discreteness, Data Rate up to 10 Hz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Filtering</strong></td>
<td>Coordinate filtering</td>
<td>Calman filter, secondary filter, phase differential filter</td>
<td></td>
<td></td>
<td>Coordinate filtering, Calman filter, secondary filter, phase differential filter</td>
<td></td>
</tr>
<tr>
<td><strong>GNSS Assisted</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Supported</td>
</tr>
</tbody>
</table>
Real Conditions Testing

Together with our partners and customers we carry out many thousands of high-precision navigation measurements every year in relative and absolute modes of determining coordinates, in conditions of different ionosphere perturbations, at different distances from the base station in order to develop methods of testing navigation modules.

Taking into account the versatility of the developed module and the possibility of its application in the widest areas, we constantly expand the fields of application for which our equipment is being tested.

The equipment of NAVIS Inc. is part of mobile laboratories moving through the vast spaces of our country, in conditions of dense urban development the equipment is tested in large cities, walks on the harsh seas of the Northern Sea Route, flies by aircraft and even by balloon.

All this is done to constantly improve and develop new technologies to meet modern and promising consumer requirements.
Real Conditions Testing
Integration algorithms

Integration has improved the reliability and reliability of navigation definitions.
✓ Accuracy of estimation of speed and orientation angles is increased.
✓ Frequency of navigation determinations output is increased to 500 Hz.
✓ The delay of issue of the decision is reduced (latency ≈ 2 ms)

Relevant even when using the smallest (< 3x3 mm) and cheapest (< 10 $) sensors
The Latest Russian Module

NAVIS Inc. has developed a new processor of digital processing of navigation signals NP216C. It is the latest domestic three-core processor at 270 MHz, with 512 KB of RAM. Dimensions of 17x17 mm allowed to accommodate 415 million elements per electrical circuit. The chip weight does not exceed 1.5 g. The chip operates in a wide range of climatic conditions, while providing operating time to failure of not less than 120 thousand hours. The processor is designed for use in electronic equipment as a device for multichannel digital signal processing of GLONASS, GPS, GALILEO and BEIDOU navigation systems, signal tracking, obtaining primary and secondary navigation definitions and output of received data according to standard exchange protocols.
The Latest Russian Module

_NV216C-RTK-A Module Development Objectives:_

- Development of small-size RTK-module in order to correspond to the current state of the high-precision modules market;
- Support of existing consumers of line modules NV08C-RTK.
The purpose of the Latest NV216C-RTK-A module

The dual-frequency NV216C-RTK-A module is designed to receive GNSS signals in L1 & L2 bands, to provide information on raw data and consumer coordinates in autonomous and relative modes (DGNSS/RTK/PPP). The NV216C-RTK-A module provides connection of two antennas and along with RTK mode supports angle-meter mode (Heading).
The Latest OEM Module NV216C-RTK-A

- Multi-frequency GLONASS, GPS, GALILEO, BeiDou, SBAS
- Support for baselines up to 30 km
- RTK angle gauge mode (heading/roll or heading/pitch)
- Extended multi-frequency RTK algorithm
- Integrated GNSS INS algorithm
- Base and rover mode
- Rate of solutions output up to 500 Hz (in complex mode)
- Centimeter accuracy in RTK mode
- Individual GLONASS group delay calibration
- GLONASS automatic inter-frequency calibration
- Extended RAIM algorithm for stand-alone and RTK mode
- Low Power Consumption < 1W
- Simple integration, pin2pin compatibility with the NV08C line
- NMEA 0183, RTCM 3.1 Protocols
- Service conditions from -40 to 85 °C
The Latest OEM Module NV216C-RTK-A

Coordinate error (RMS, plane/height):
Offline - 1.2 / 1.6 m
In DGNSS mode - 0.6 / 0.8 m
In SBAS mode - 0.8 / 1.0 m
In RTK mode - 5 / 10 mm 1 mm/km
In RTK mode - 10 / 15 mm 1 mm/km

Speed error (RMS, plane/height): 2/3 cm
Error of PPS generation: < 20 ns
Time of obtaining the first coordinates (maximum):
Cold/warm start - 36 s
Hot start - 5 s
Restart - 1 s
RTK (from the moment of 3D solution receipt) - < 10 s

Overall dimensions
46 x 35 x 9.9 mm
Input voltage 3.3... 5.0 V
Power consumption < 1W
Conclusion

Successful development of domestic navigation technologies, improvement of GLONASS system and the need for import substitution opens up huge opportunities for system integrators and manufacturers to create and promote their own samples of equipment on the Russian market.

Combining the accumulated technological experience in various fields with domestic production provides a unique opportunity to create advanced domestic solutions demanded in various spheres, which are not inferior in their capabilities to the best world analogues.

Application of multi-system multi-frequency navigation module NV216C-RTK-A in domestic samples of high-precision navigation equipment will allow to fully realize on the Russian market the potential of modernizing GLONASS system, including in terms of commercialization of domestic satellite navigation technologies.
THANK YOU FOR ATTENTION!