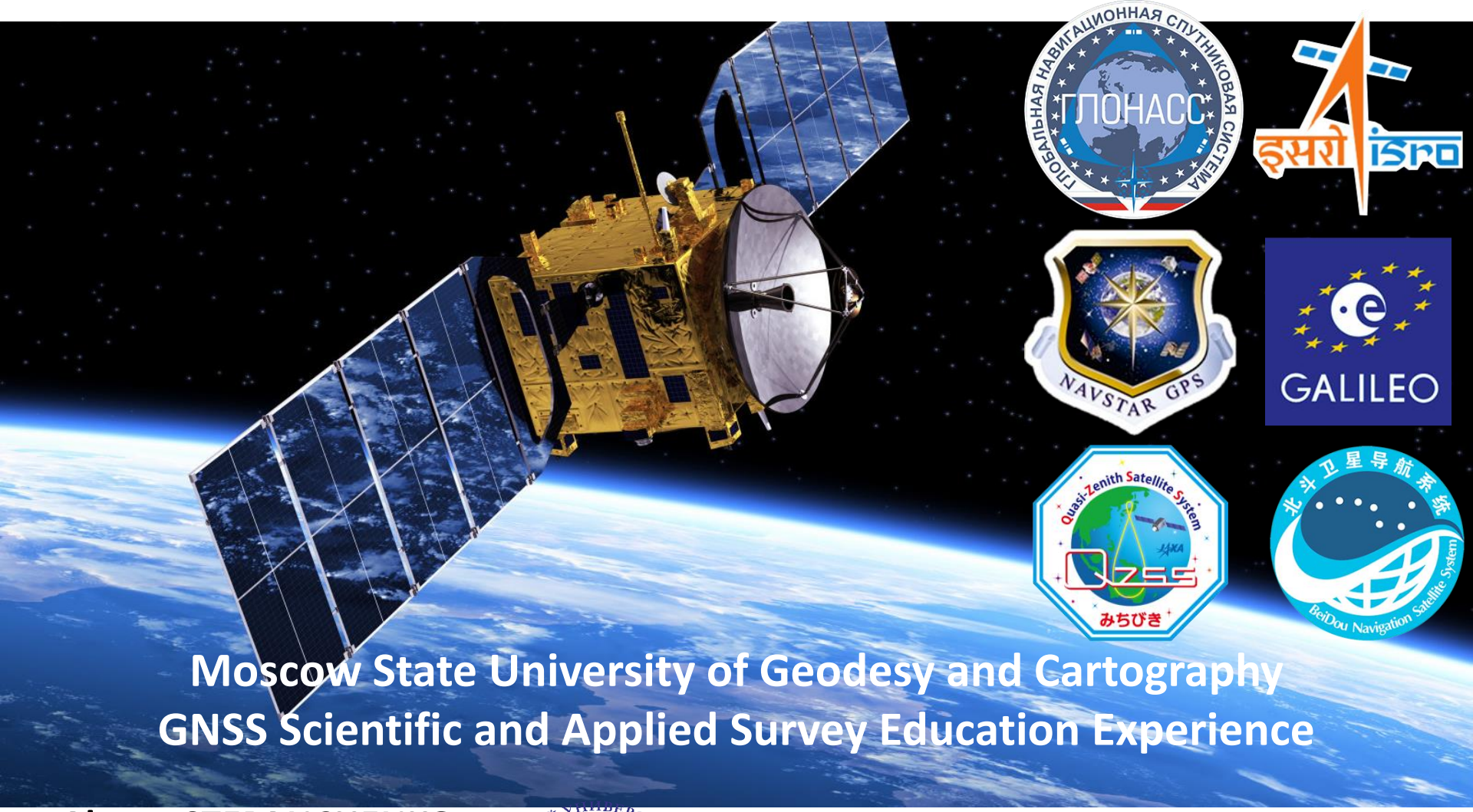


Moscow State University of Geodesy and Cartography
GNSS Scientific and Applied Survey Education Experience

Alexey STEPANCHENKO,
Alexey PORTNOV,
Andrey KUPRIYANOV,

Moscow State University
Geodesy and Cartography

United Nations
14th Meeting of the International
Committee on Global Navigation Satellite Systems
ICG-14
8 – 13 December, 2019 Bangalore, India

Moscow State University of Geodesy and Cartography

1779-2019

ICG-14, 2019 Bangalore, India

Moscow State University of Geodesy and Cartography

Moscow State University of Geodesy and Cartography (MIIGAiK) is one of the oldest educational institutions in the Russian Federation, has been founded in 1779.

In 2010 MIIGAiK became an official partner of the Bologna club and actively supports and promotes the idea of the Bologna process which targets at the approximation and harmonization of higher education systems of European countries with the aim of creating a common European Higher Education Area (EHEA).

Annually, the hundreds of specialists in areas of cadastre, cartography, construction, space technology graduates in university to be employed in Russian Federation and the world.

Moscow State University of Geodesy and Cartography

➢ **More than 5,500 students and the post graduators are studying in MIIGAIK at the present time;**

➢ **The class of graduators is more than 500 annually;**

➢ **Moscow State University of Geodesy and Cartography has multi-level educational system:**

- Pre-higher education courses, professionally oriented for high-school children, including distance education
- Bachelor's program
- Specialist program
- Ph.D. degree program
- Extended education courses
- Professional development programs
- Graduate school
- Doctoral candidacy

University Infrastructure

- 2 educational campuses;
- 2 colleges;
- the oldest library with a reading room and a huge selection of scientific literature, magazines and rare books of great value to the country;
- 5 computer centers;
- laboratory with professional survey equipment;
- calibration installation;
- space information validation complex;
- station for receiving space data;
- gym, dance and games rooms, aerobics room;
- 2 hostels for students and graduate students;
- phytobar; solarium;
- spacious dining room and 3 buffets.
- table tennis hall;
- astronomical observatory;
- museum complex;
- 2 large geopolygons located in Moscow and Tula regions

International Projects Implementation Experience

Since 2008 year, MIIGAIK took part in the educational grants of the European Commission, MIIGAIK also became a coordinator of several projects. MIIGAIK has extensive experience in the participation and implementation of the next international projects TEMPUS and ERASMUS+:

- "Lifelong Learning for Sustainable Development" (SUSDEV, 2016-2019)
- "Piloting ECVET to the National VET system of Russia and Uzbekistan" (RUECVET, 2016-2019)
- "Enterprise cooperation via spin-off companies network" (UNISON, 2016-2019)
- "Modernization of Doctoral Education in Science and Improvement of Teaching Methodologies" (MODEST, 2018-2021)
- "Professional Development of Vocation Education Teachers with European Practices" (Pro-VET, 2018-2021)
- Jean Monnet Module "Green Terra Development: EU policy and practice" (GRETERE, 2018-2021)

Industry Market Leaders Cooperation

ЦНИИМАШ
TSNIIMASH

РОСРЕЕСТР
Федеральная служба
государственной регистрации,
кадастра и картографии

Ростех

РКС
РОССИЙСКИЕ КОСМИЧЕСКИЕ СИСТЕМЫ

ГЛОНАСС/ГНСС Форум
Ассоциация разработчиков, производителей и потребителей оборудования и приложений на основе глобальных навигационных спутниковых систем

Роскартография

Швабе
Основано в 1837 году

ВНИИФТРИ

КОНСТРУКТОРСКОЕ БЮРО НАВИГАЦИОННЫХ СИСТЕМ
НАВИС

УОМЗ

The main specialties and areas of application in MIIGAIK

- ✓ GEODESY (Applied survey, Astronomy, Space geodesy)
- ✓ Photogrammetry and remote sensing
- ✓ Gravimetry
- ✓ Aerial survey (Remote sensing and monitoring of the Earth from space)
- ✓ Laser equipment and laser technology
- ✓ Information systems and information technologies
- ✓ Applied informatics (in survey, in informatics systems)
- ✓ Management and technologies of information protection
- ✓ Land management and land cadastre (Municipal cadastre)
- ✓ Cartography
- ✓ Optoelectronic equipment and systems
- ✓ Jurisprudence
- ✓ Finance and credit
- ✓ State and municipal management
- ✓ Enterprise management

Applied Surveying Modern Equipment

Primary Areas of Application:

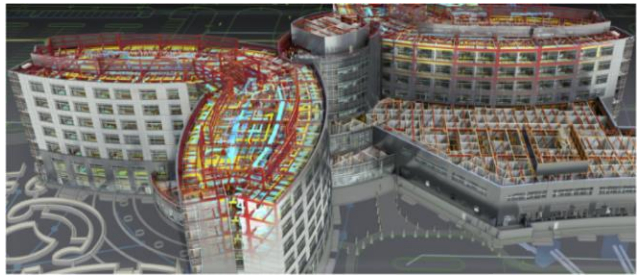
- geodesy, cadastre, construction, geophysics, transportation, agriculture

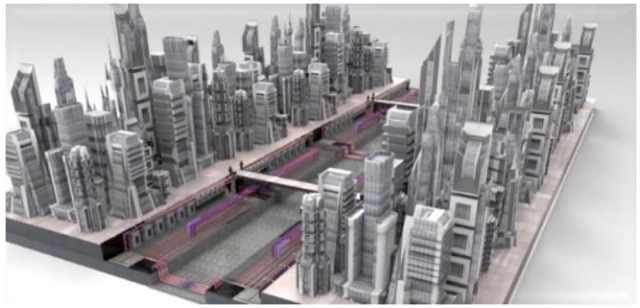
- construction, survey, monitoring, 3D-design

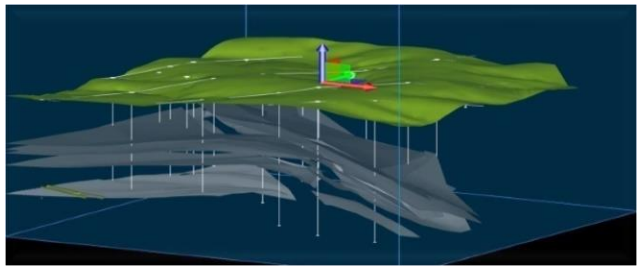
-monitoring construction deformation

- survey, resource management, 3D-modeling, construction of a digital terrain models, DTM.

- geospatial data management, point coordinate control. Makes it easier to process the information from any type of equipment supported, while open source software is available



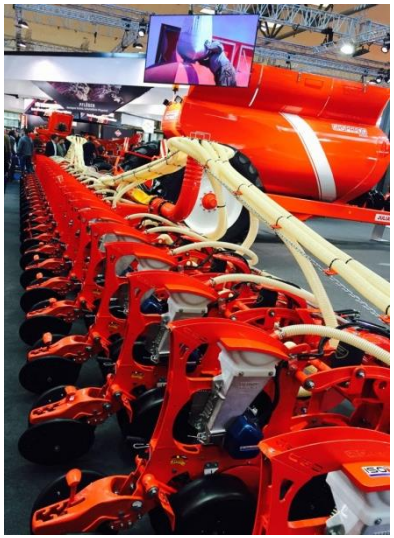




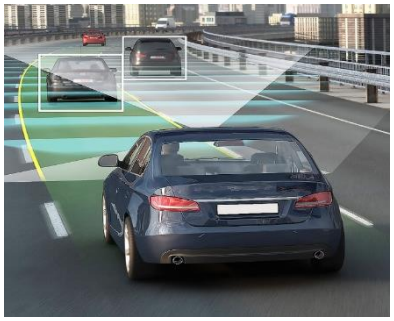
Applied Surveying Modern Technologies

GNSS technologies are the connection link between various application areas, which are: applied survey, radio navigation, agriculture, the railway industry, modern geographic information systems that are also based on GNSS technology

Applied Surveying Application Areas Trends



Precision farming is based on the combined GNSS technology/robotic systems use for high-precision positioning. It allows user to perform operations of the formation of fields, tillage, sow, grow and harvest. The components used are the field planning UAV systems, automatic driving mechanism, GNSS equipment, a steering module, hydraulic unit and cameras are optional. Usually these systems are equipped with a control panel.



Transport control is a combination of the GNSS and GIS technologies use. Data from the vehicle is transmitted to a special server, then it is processed to display current target location in real time.

Autopilot is based one the scanning and geographic information technologies simultaneous application. The vehicle is linked to road surface markings, which are scanned in real time. Combined with real-time data, this technology provides accurate vehicle routes to user and able to control vehicle movement along the highway autamatically.

Indoor Navigation is the GNSS technology operation jointly with Wi-Fi signals receiver. Calculation and combining algorithms of data processing make it possible to nagigate inside buildings. allow indoor navigation. The location is calculated by comparing the signal level from the surrounding Wi-Fi points measured in real time with pre-measured values tied to a location map.

Applied Surveying Application Areas Trends

3D - modeling is associated with laser scanning technology. The models are created based on the results of surveys and topographic jobs. 3D Digital Terrain Model is used during the construction of the building or the laying of communications.

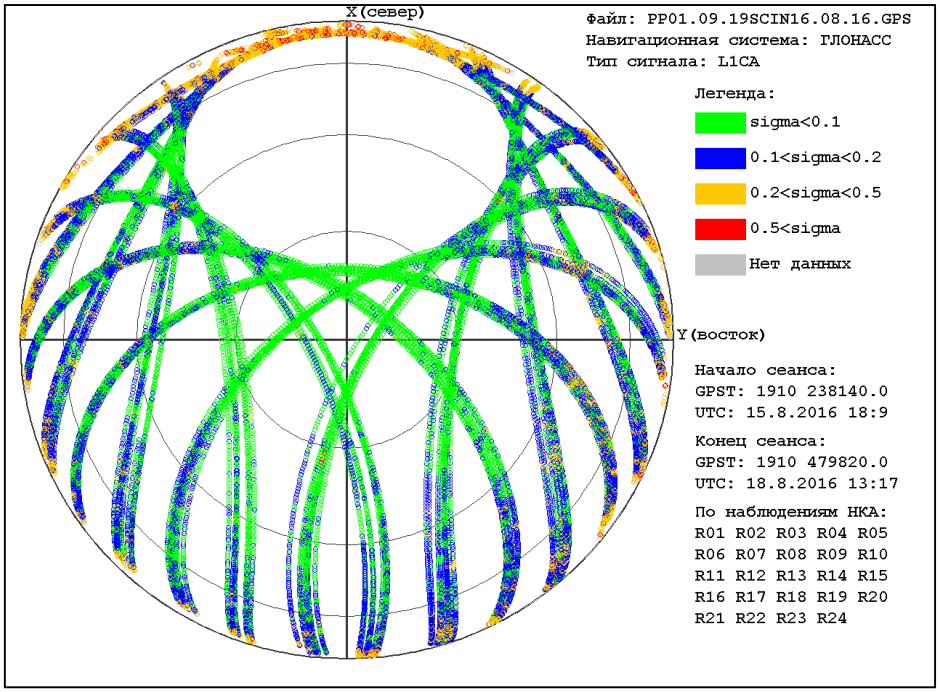
SMART-City concept is a combination of technologies. Key roles here are played by navigation/geospatial, and the Internet of Things (IoT) data processing. It is tight integration of the information and communication technologies.

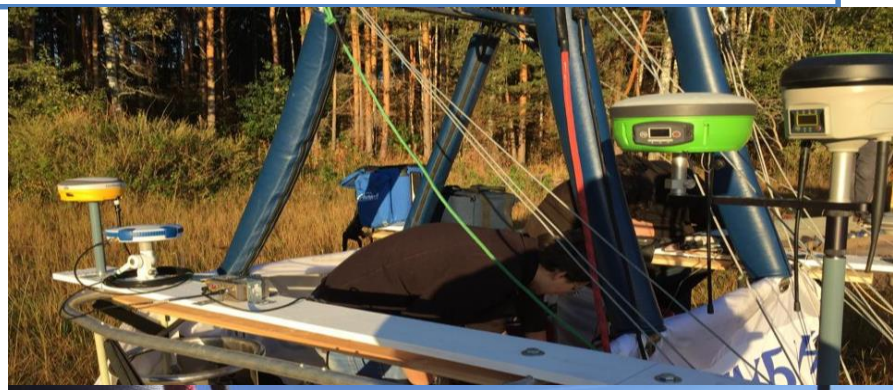
The positioning of **marine, land, air and space objects** are also directly related to GNSS technology. It is used for ships (mooring ships on piers), trains (control of high-value cargo), ground objects (ERA-GLONASS), people (employees movement and access control), aircraft (ICAO landing technologies), low-orbit spacecraft monitoring.

The classic jobs of applied geodesy, such as: **construction, engineering surveys, hydrographic work**, are also being constantly improved and maximize the utilization of all the modern technologies.

MIIGAiK GNSS Technology Research Activity

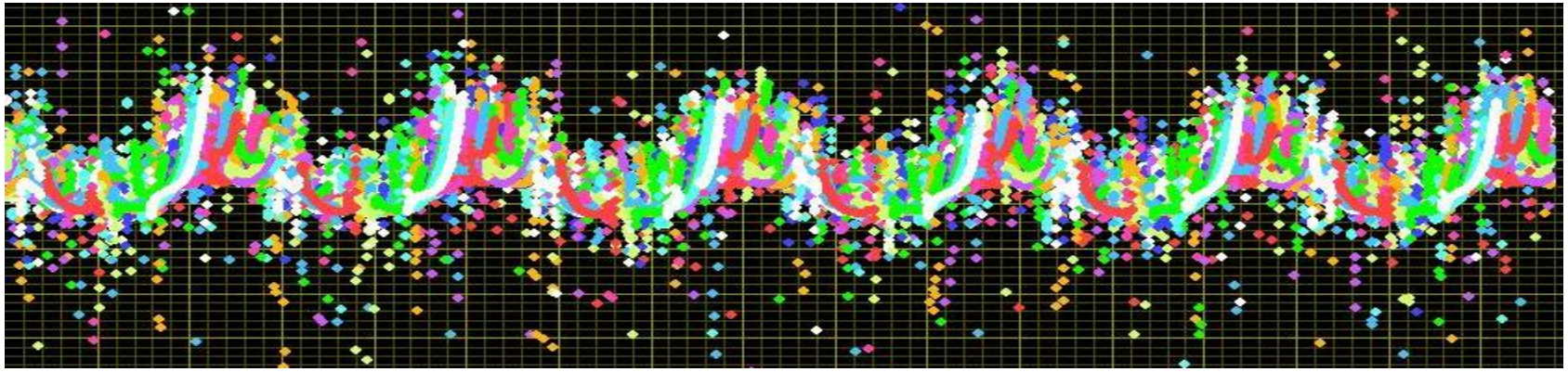
Being deeply involved in practical experiments with modern equipment students and post-graduates obtain highly specialized skills in a variety of application areas. For example, based on existing software and the results of processing multiple experiments data, applied survey engineers become able to develop their own software.



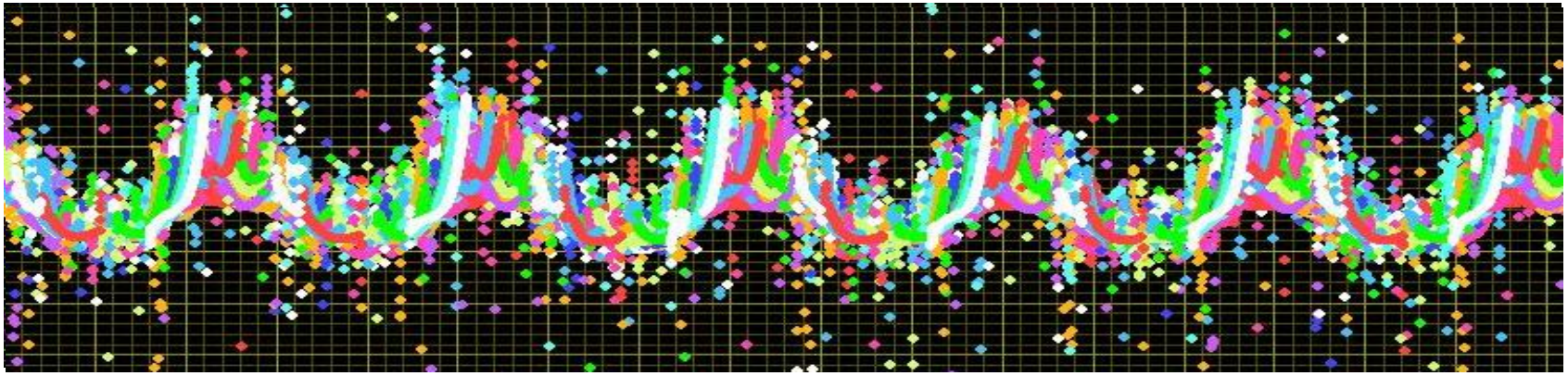


TEC monitorimg

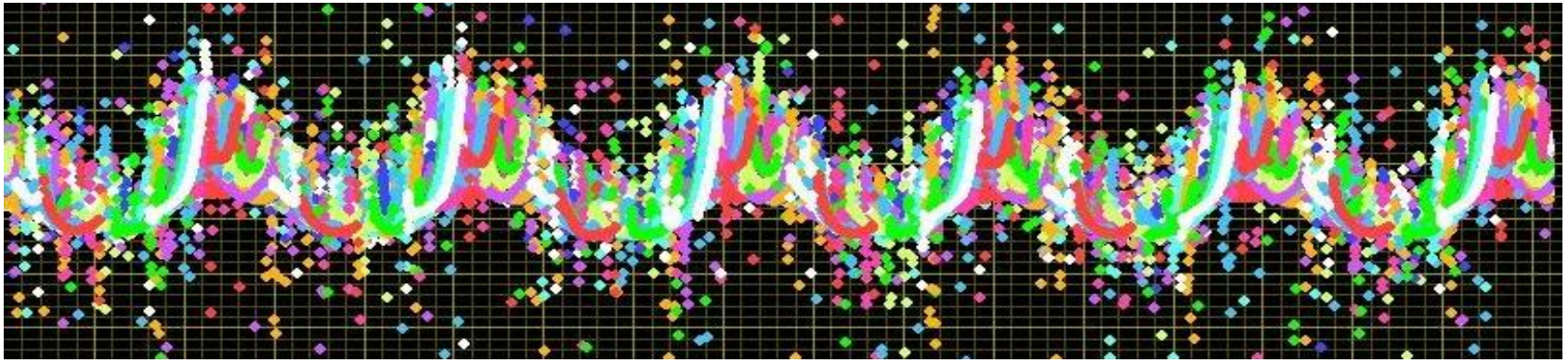
Staion 1



2Station 2



Station 3



High-Precision GNSS Kinematic Technology Researches

During the process of kinematic positioning (RTK,PPP, reference station networks), researches, special attention was paid to practical measurements..

They use inertial navigation systems (INS), ionospheric stations and the global navigation satellite systems (multi-GNSS - GLONASS, GPS, Galileo, Beidou) signals operating equipment.

Survey GNSS Equipment Laboratory and Field Testing With the Involvement of Students and Post-graduates

MIIGAiK conducts the full cycle of laboratory and field testing, as well as the comparative analysis of the of the equipment specification. are used during “Applied Survey“ and “Geodesy and Remote Sensing” students take regular courses of training with GNSS receivers.

MIIGAiK Educational Activity in High-Precision GNSS technology

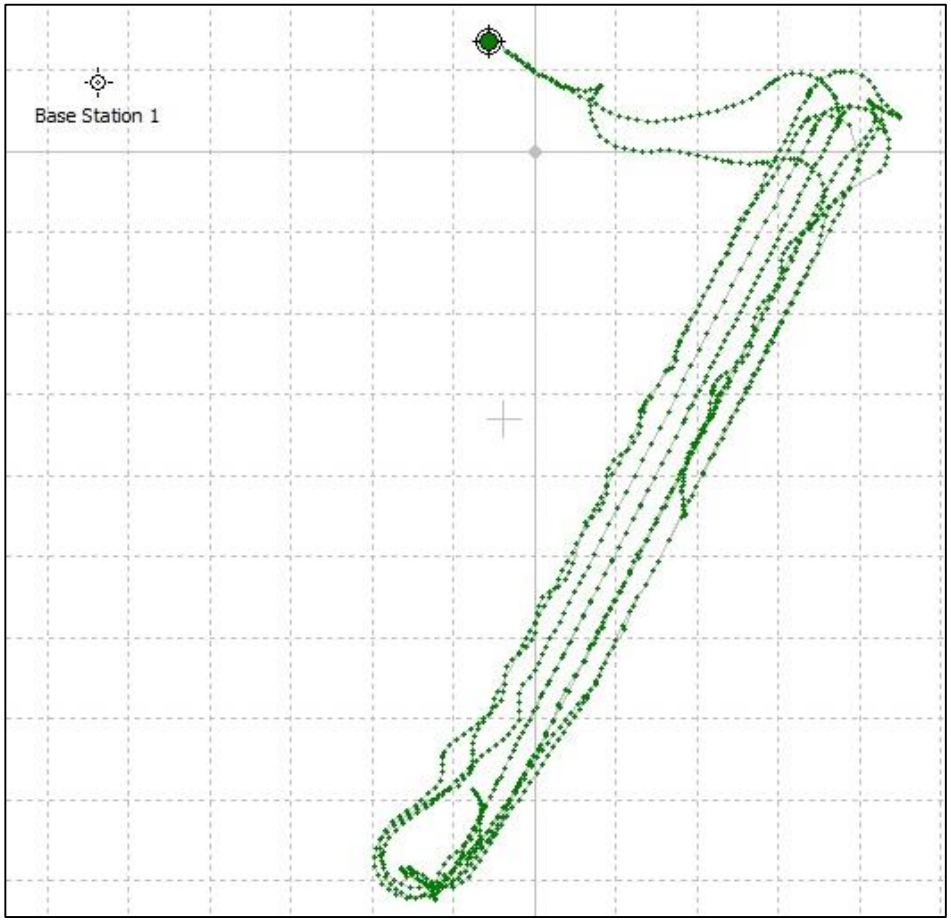
High-precision positioning is used not only for construction and survey purposes, but it also has wide variety of application areas, such as: agriculture, nature resources management, monitoring and forecasting of natural/technological phenomena, geodynamics sphere, fundamental geodesy. GNSS technology provides coordinate/time information of high quality for all of them.

Students master skills in basics of radio navigation, agricultural mechanization, logistics, electrical engineering, geophysics while becoming advanced specialists in the areas of programming and global navigation satellite systems technologies.

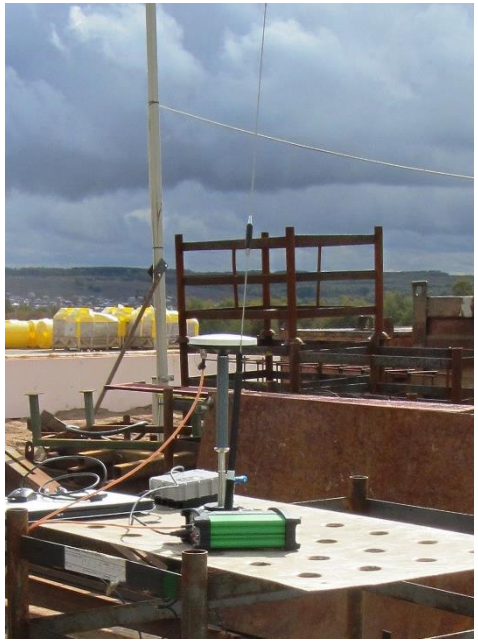
External Educational Activity of MIIGAIK
Republic Kyrgyzstan, Siberian and Ural regions

Precision Agriculture Applied Survey Technology

The primary goals of the applied GNSS technology in precision agriculture area are the development, installation and control of the equipment for the crops, fertilizers and water precise application. The equipment is the GNSS signals-based auto-pilot integrated system.



Precision Agriculture Equipment



Modern GNSS Scientific and Applied Survey Education Experience

Precision Agriculture Engineer is a skilled into following areas professional:

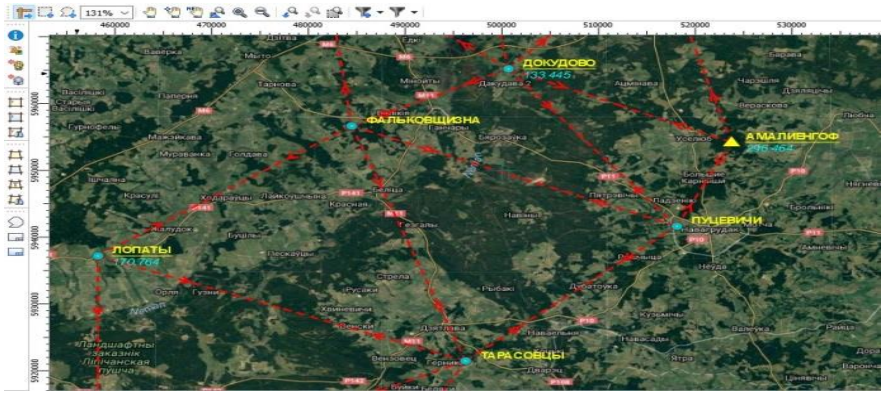
1. The basis of precision farming technology;
2. Satellite-based global positioning system;
3. Major principles of geographic information systems (GIS);
4. Yield monitoring understanding;
5. Variable application of materials technology ;
6. Soil samples analysis;
7. Data collection using precision farming equipment;
8. Collected data expert analysis and managing decisions taking based on its result;
9. Precision agriculture economy and the principles of key technology elements selecting for a particular job.

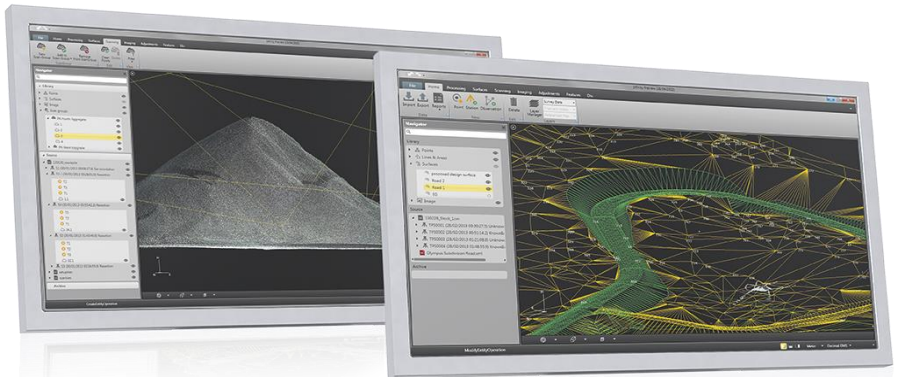
Modern GNSS Scientific and Applied Survey Education Experience

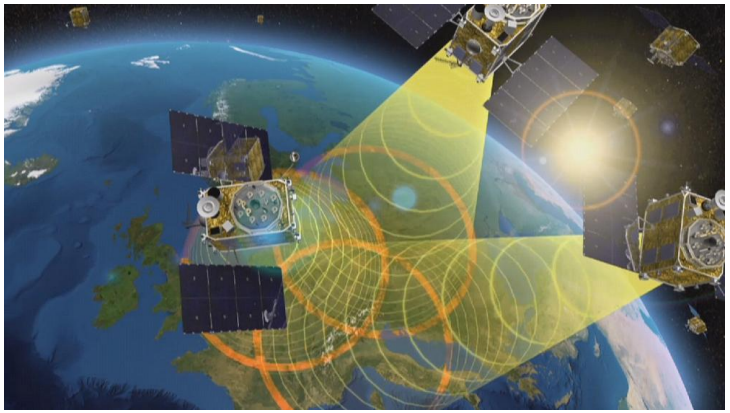
The **"Engineering and survey support for the construction and maintenance operation of nuclear power plants and unique facilities"** specialization is aimed at survey work performed during the construction of energy industry facilities (hydroelectric power stations, thermal power plants, nuclear power plants), as well as maintenance of unique world projects. The study focuses the detailed aspects of the construction of nuclear power plants and monitor their deformations using GLONASS / GNSS technologies.CORS technology advanced skills are also being received during this course.

Modern GNSS Scientific and Applied Survey Education Experience

The **“Applied Mathematics”** specialization aims at the process of the specialized software for field and office jobs design and development. The main goal of the training course is specialists trained in the area of GLONASS/GNSS technologies application with advanced skills in higher-level programming, capable to maintain and develop high-grade specialized software







Modern GNSS Scientific and Applied Survey Education Experience

The **"Engineering and geodetic support for the construction and operation of oil and gas facilities"** specialization targets the survey operations performed during the construction of oil and gas facilities using the GLONASS/GNSS technology. These objects are complex dynamic geotechnical systems. They constantly interact with the environment directly. Students study methods for observing deformations of such facilities, Earth's surface geophysics, and technological equipment related to wells.

International School on Satellite Navigation

RSS

56-72 hours of lectures and practical training

September 16-20, 2019
Moscow, Russia

Since 2011: > 450 students from Russia, Kazakhstan, Belarus, Ukraine, Moldova

НП "ГЛОНАСС"
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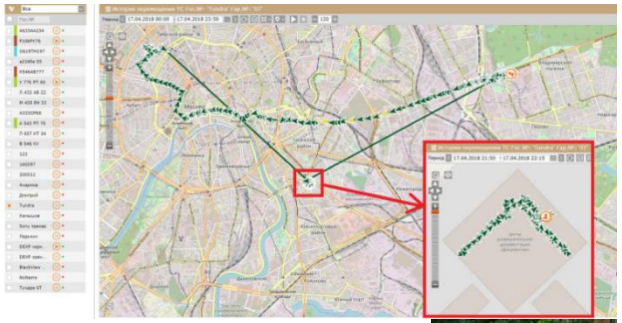
International School on Satellite Navigation: learning program updates

- *General GNSSS courses. RTK PPP Reference networks*
  Errors of Navigation Definitions
- *Systems of Outdoor and Indoor Navigation*
- *User GNSS Equipment in Topographic Monitoring*
- *GLONASS/GNSS High Precision Positioning in Arctic Latitudes*



School: 7-13 September 2020

www.gnss-school.com

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Thank you!

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