

Geodesy as a Modern Science Forming Spatially Based Information Society

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Key words: geodata provision, geospace, geospatial data bases, geodetic metrology, satellite navigation systems

SUMMARY

Understanding the role and position of today's geoscience in the information society development is considered. A new postgraduate program in Geodesy based on the achievements of scientific-and-technological progress was elaborated and offered.

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Рассмотрено современное понимание роли и места геодезической науки в развитии информационного общества, разработан и предложен новый паспорт научной специальности «Геодезия» с учетом достижений научно-технического прогресса.

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Geodesy is one of the most ancient sciences integrating a number of related sciences and sectors of the national economy on a spatial basis. There are several concepts of geodesy's place and role. On the one hand this is the science of the terrestrial objects positioning, sizes, figure and gravitational field of the Earth and other planets. On the other hand it is a branch of the applied mathematics that is closely connected with geometry, mathematical analysis, classical potential theory, mathematical statistics and numerical analysis. At the same time this is the science of precise measurements developing methods for determination of distances angles and gravity by means of different instruments. Geodesy is also considered in geometrical and physical aspects. Geodesy appearance ascends to antiquity and it was supported by the advance of natural and exact sciences. The contemporary level of civilization development specifies geodesy's new tasks and role. First of all it can be explained by significant changes in the development of hardware, software and computer engineering, as well as by the contemporary public demand for geodata. That is why a new understanding of geodesy as the science of geospace /1/ that forms a mobile spatial basis for the implementation of a lot of projects is being developed dynamically. The projects are as follows: the digital Earth, e-government, e-geospace /2/ etc. To satisfy new requirements for the public and economy data support, the following tasks of geodata provision play an important role:

- Simultaneous analysis of the geospatial data for the certain territory by all the branches through integrating diverse subject information on a unified spatial basis;
- Determination of changes in georeferenced objects specified by the man-made and natural factors through data capture and spatial data base management containing information on the former territorial conditions and their changes;
- Assessment and forecasting of the future territories' spatial state under the influence of human activities through simulation of the territory spatial component, processing of huge volumes of spatial data from various sources and temporal states using powerful computers. In this regard the spatial information for territories must be represented, stored and compared with the information for the previous and forecasted territorial conditions in digital form by a computer.

It goes without saying that at the current development of spatially based information society the balance moves from the territory acquisition data to the data processing, interpretation, analysis and presentation. According to the world sources not less than 70% of all the managerial decisions of the authorities and territorial administration are of spatial origin and based on georeferenced data. New economy and social requirements as well as complication of the environment because of the man-induced component resulted in the expansion of geodata provision borders and changed its content. As a consequence at present there is a discrepancy between engineering and technological achievements of geodesy, social

requirements for spatial data and its content that forms the current postgraduate program of Geodesy.

A draft of a new postgraduate program in Geodesy has been developed and sent to the Higher Attestation Commission of the Russian Federation by a group of scientists from the Moscow State University of Geodesy and Cartography and the Siberian State Academy of Geodesy consisting of Doctors of Science Yambayev B.N, Gulyayev Y.P., Lisitskiy D.V., Mazurov V.T., Kalinitskiy A.I., Ustavich G.A. The draft program is presented below.

Field of science: 25.00.00 the Earth Sciences

Major code: 25.00.32 Geodesy

Major content: the determination of the Earth's figure and size, its gravitation field, spatial characteristics of natural and man-made objects, phenomena and processes on its surface, the creation of a geoinformation space as the basic product of geodetic support for territories, as well as defining the regularities of their spatio-temporal changes.

Area of research:

1. The determination of parameters of the Earth's ellipsoid, geoid and Earth's field of gravity and their spatio-temporal changes.
2. The creation of spatio-temporal reference system for different purposes using geodetic, gravimetric and other (space, terrestrial and underground) measurement procedures, assessment of their stability and behaviour, issues of their design and optimization. Geodetic reference frames.
3. Geodetic (global) navigation satellite systems (GNSS) and technologies. The formation of active positional and temporary space on the basis of GLONASS navigation infrastructure, etc. Terrestrial, marine and space-based geodetic systems for positioning and navigation of mobile objects, including transport, military equipment, people and animals.
4. The development of new principles, techniques, hardware and technologies of geodetic measurements to define geometric and physical parameters of the Earth, its surface, objects, phenomena and processes, including ones for terrestrial topographic surveys.
5. Techniques, hardware and technologies of geodata provision for construction-assembly, cadastral, land management, design and surveying, mine-surveying, prospecting and forest management works; offshore development, installation, adjustment and maintenance of major equipment.
6. Geodetic support for prospecting, design, construction and maintenance of large engineering complexes, including hydro technical constructions, nuclear, heat and power stations, industrial enterprises, and line structures. Geodetic control for maintenance supervision at the construction and maintenance of oil and gas extraction facilities.

7. Geodetic support for geodynamic environmental monitoring, primarily concerning dangerous processes and phenomena leading to the occurrence of crisis situations.
8. Geodetic monitoring of stress-deformed behaviour of the Earth's crust and its surface, buildings and structures, as a result of man-made and natural factors in order to control their stability, decreasing the risk and consequences of natural and man-made disasters, including earthquakes.
9. Geodata provision for sustainable territorial development using GIS technologies. Formation principles, content and structure of geoinformation space displaying total spatial characteristics of territories.
10. The development of principles and technologies for multi-purpose GIS design using geodetic data.
11. The theory and practice of mathematical processing of geodetic observations and geodata provision. The automated technologies for 3D digital model creation of engineering objects, processes and phenomena using geodata.
12. Advanced systems of geodata acquisition, processing, storage, transferring and usage, including geodata formats, infrastructures and territorial georeferenced databases, cyber geospaces, geodetic knowledge databases, geoservices, geoportals and other Internet-based geodetic systems.
13. Geodetic metrology. The development of methods, aids and regulations for metrological support of surveying instruments. The creation and maintenance of reference geodetic fields, baselines and comparators for verification, calibration and certification of surveying instruments.
14. Planning and marketing of surveying works. The development of procedures and technologies for the governmental supervision over geodetic activities. The development of IT methods and automation facilities for the State Geodetic Surveillance bodies. Geodetic support for the creation and maintenance of the Russian spatial data infrastructure especially for the following programs: *e-Russia*, *e-Government*, *e-Document Flow*, etc.
15. The development of scientific methods and principles of geodetic education and training.

The implementation of the new postgraduate program in Geodesy will provide for elimination of the discrepancy between contemporary achievements of scientific-and-technological progress in the field of geodesy and current state of the public geodata provision. This is an opportune and important step in the development of fundamental and applied scientific investigations of geoscience. Therefore, the Moscow State University of Geodesy and Cartography and the Siberian State Academy of Geodesy are to be the centres for fundamental geoscientific research. The similar experience is being observed in the leading world-powers and produces tangible accomplishment.

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