

# STUDIES OF GEOMATICS AT THE UNIVERSITY OF WEST BOHEMIA

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### **Abstract**

*The aim of this paper is to present the trend of both teaching and scientific activities of the Department of Mathematics – Section of Geomatics at the University of West Bohemia at the beginning of 21st century.*

*Studies of Geomatics have been founded in 1995 at the Faculty of Applied Sciences, but teaching of geo-related sciences has longer history at our university. It was Czech cartographer Jiří Pyšek, who had founded studies of mathematical cartography at the Faculty of Education in 1991. Presently there are three main specializations at the Section of geomatics: surveying and cadastre of real estates, geographic information systems and mathematical cartography.*

*Surveying focuses mainly on cadastral data collection, their storage and maintenance, but courses of physical geodesy, geodetical astronomy and global positioning systems are also very important. The GIS specialization insist on remote sensing and photogrammetry for data collection, spatial database structures for data management and analysis tools for area oriented decision support. The third specialization has added thematic and digital cartography to classical original mathematical cartography these days.*

*Whole studies are based on strong mathematical and IT (such as databases, programming and networking) knowledge. This fundament provides an optimum environment for research activities of our academic staff, PhD and master students. Main project activities of our section are:*

- *Cooperation at the research plan: Continuous and Discrete Mathematical Structures and Development of Corresponding Methods of their Study (MŠM 4977751301),*
- *Collecting, referencing and online distributing of old and historical maps,*
- *GPS Networking.*

**Keywords:** *Geomatics, University of West Bohemia, education.*

## **INTRODUCTION**

The University of West Bohemia is located in Pilsen (about 78 km southwest of Prague), the largest city in West Bohemia and the fourth largest city in the Czech Republic.

The University of West Bohemia was established by the decree of the Czech National Council in 1991 when the Institute of Technology in Pilsen (founded in 1949 as a branch of the Czech Technical University in Prague, in 1960 divided into the Faculty of Mechanical Engineering and the Faculty of Electrical Engineering) and the College of Education (founded in 1948 as a part of the Faculty of Education of the Charles University, Prague) were merged.

Nowadays the University of West Bohemia is composed of nine faculties and university institutes:

- Faculty of Applied Sciences
- Faculty of Economics
- Faculty of Electrical Engineering
- Faculty of Philosophy and Arts
- Faculty of Education
- Faculty of Law
- Faculty of Mechanical Engineering
- New Technologies – Research Centre in the West Bohemian Region
- Institute of Art and Design

The following table shows some basic data (from November 2006) to describe the University of West Bohemia in more detail.

|                     |   |
|---------------------|---|
| Number of faculties | 7 |
|---------------------|---|

|                                |        |
|--------------------------------|--------|
| Number of departments          | 61     |
| Number of institutes           | 2      |
| Number of students             | 17 270 |
| Number of Ph.D. students       | 996    |
| Number of academic staff       | 907    |
| Number of administrative staff | 723    |

Table 1. Short statistic of the University of West Bohemia.

The Faculty of Applied Sciences (founded in 1990) has five departments: Computer Science and Engineering, Mathematics, Cybernetics, Physics and Mechanics. Section of Geomatics belongs to the Department of Mathematics. [UWB2005], [FAS2007], [DMa2007]

## GEOMATICS AT THE UNIVERSITY OF WEST BOHEMIA

For better understanding of the term "geomatics" there are some definitions:

- International organization for normalization (ISO) defines geomatics as "scientific and technical interdisciplinary branch focused on collecting, distributing, storing, analyzing, processing and presenting of geographical data or geographical information". [Geo2007], [Sim2007]
- The Oxford English Dictionary defines Geomatics as "the mathematics of the earth; specifically the science of the collection, analysis, and interpretation of data, especially instrumental data, relating to the earth's surface". [GUG2007]
- GIM International, the global magazine for geomatics, defines 'geomatics' as encompassing all activities relating to the acquisition, processing, querying, analysis, presentation, dissemination, management and use of geo-data and geo-information.
- The Division of Geomatics at the University of Gävle defines Geomatics as "an integration of the sciences: geodesy, photogrammetry, remote sensing, cartography and geographical information technology in order to collect, process, understand, analyse, store and present geographical information". [GUG2007]

Interdisciplinary scientific branch Geomatics deals with collecting, distribution, storing, analyzing, processing and representation of geographical (geospatial) data and geographical (geospatial) information. It is nowadays developed worldwide and influences in a distinctive way traditional fields of science. Geomatics as a scientific branch rises from integrated approach of collecting, storing, transfer (distribution), analysis and offer of geospatial data. Those data comes from many sources and are collected by various methods of surveying, mapping, cartography, remote sensing and photogrammetry. GIS information technology is used for their processing, administration and analyzing. [Geo2007]

Geomatics consists of many branches which may be combined to produce detailed, but understandable image of physical world and our role on it. Those branches are: surveying (geodesy and cartography), remote sensing (together with photogrammetry), global positioning systems and GIS. [Sim2007]

The history of Geomatics at the University of West Bohemia is not very long. The study programme Geomatics has been existed since 1995. The predecessor of it was the study programme Mathematical cartography offered by the Faculty of Education founded by the Czech cartographer Jiří Pyšek.

Presently there are six specializations of different types and forms of study programme Geomatics:

| Type of study programme                      | Attendance form of study   | Combined form of study |
|--|--|------------------------|
| Bachelor study programme                     | Geodesy and cadastre (another specialization Geoinformatics is under consideration)  | Geodesy and cadastre   |
| Master of Science study programme            | <ol style="list-style-type: none"> <li>1. Geodesy and Geographic Information Systems (GIS)</li> <li>2. Cartography</li> <li>3. Cadastre and civil law</li> </ol> | Geodesy and cadastre   |
| Doctoral (postgradual, PhD.) study programme | Geomatics  | Geomatics              |

Table 2. Types and forms of study programme Geomatics.

The accent in specialization Geodesy and cadastre is put on practical aspects of acquisition, processing, management and actualization of base geospatial data. These data must be provided with required accuracy and recency.

The specialization Geodesy and Geographic Information Systems (GIS) is focused on methods of spatial data acquisition, processing, analysis and visualization in computer environment. It is technologically connected to the creation and management of geospatial databases. This specialization leads up of both usage and customizing GIS environment for purposes of geospatial project designs for commercial sphere, regional government and municipalities. Graduates of specialization Cartography should be focused on modern technologies of creation of different type of maps and geospatial data visualization. They used the methods of mathematical cartography, thematic cartography, computer cartography, photogrammetry and Global Positioning System (GPS). Graduates can solve complex tasks of territorial development and cartographic production.

The specialization Cadastre and civil law is focused on a technical aspect of cadastre and respective legal knowledges. The accent is put on the methods of creation and management of modern cadastre as a fundamental land information system of state and the usage of cadastre as a multipurpose data source for creation of maps and other information systems.

The specialization Geodesy and cadastre is designed above all for education of people with some other type of university education). Therefore this specialization is teaching just in combined form. The study is focused on technical aspects of cadastre, modern methods of geospatial data acquisition, data processing, data management and updating. [FAS2007]

Doctoral study programme Geomatics was accredited in 2006 as the first in the Czech Republic in the conjunction with the Research Institute of Geodesy, Topography and Cartography. Doctoral study programme responds to the rising requirements of modern progressive methods of mass-collection of geodata by conventional surveying methods (by electronic tachymeter, combined GPS units), as well as by non-conventional methods like terrestrial and aerial laser scan systems (LSS), aerial photogrammetry or remote sensing. [Geo2007]

|                                   |   |
|-----------------------------------|---|
| Bachelor study programme          | Geodesy, Application of information technologies in geodesy, Mapping, Cadastre, Introduction to GIS, Mathematical cartography, Thematic Cartography, Photogrammetry, etc.   |
| Master of Science study programme | Spatial databases, Computer cartography, Algorithms and applications of GIS, GIS theory, Databases systems for GIS, Algorithms of spatial analyses, Global Positioning Systems, etc.  |
| Doctoral study programme          | Geometry in geomatics, Theoretical and computation geodesy, Methods of spatial data collection, Geospatial and data modelling, Methods of image recognition, Selected chapters of theoretical geodesy, Geoinformation technologies, Methods of applied geomatics. |

Table 3. Examples of courses taught in Geomatics study programmes.

The Section of Geomatics disposes of large technical background. Students keep at one's disposal computer laboratories, mobile computer laboratory, laboratory of photogrammetry, measurement hardware (e.g. total, GPS and combined stations, level instruments etc.). Field measurements are realized round the surveying base located in the mansion areal Nečtiny (about 35 km north of Pilsen).

Software used in Section of Geomatics could be divided into two groups:

1. Commercial software (e.g. ArcGIS CampusPack2 – ArcInfo, ArcEditor, ArcView, ArcIMS, ArcSDE; Atlas DMT; ERDAS LPS – OrthoBase, OrthoBase Pro, VirtualGIS, StereoAnalyst; Kokeš, including MISYS; Matlab; Microsoft Visio etc.).

Note: The University of West Bohemia has completed the contract of cooperation in the scientific and research field with company ARCDATA Praha (the official distributor of companies ESRI and Leica Geosystems in the Czech Republic).

2. Software distributed under some non-commercial licence (e.g. GRASS; OpenJUMP; OpenOffice.org, QGIS, uDig, Thuban, Geoserver etc. Researchers from Geomatics department cooperate on the development of some parts of open-source geospatial software (e.g. uDig, GeoTools) and even develop their own projects (see <http://git.zcu.cz>). [Geo2007]

The Section of Geomatics cooperates with many organizations and institutions:

- Privat companies and corporations (e.g. ARCDATA Praha s.r.o., GEOREAL s.r.o., GEPRO s.r.o., T-MAPY s.r.o., Help service – remote sensing spol. s.r.o., CCSS – Czech Center for Science and Society, Czech Living Lab),
- research institutions (e.g. European Spatial Data Research, Research Institute of Geodesy, Topography and

- Cartography),
- academic institutes and universities.

Examples of projects solved by the Section of Geomatics

- Continuous and discrete mathematical structures and development of corresponding methods of their research,
- Verification, accuracy evaluation and interpretation of current models of the field of gravity derived from satellite data,
- Analyses of very models of geoid and kvazigeoid for Central Europe,
- GPS station PLZE,
- Geomorphological information system as a base for environmental applications,
- Progressive geospatial data collection and their processing,
- Georeferencing and cartographic analyses of historical maps of Bohemia, Moravia and Silesia,
- Atlas of International Relations,
- Multifunctional laboratory of computer modelling and GIS,
- Multimedia support of combined form of study programme Geomatics,
- Dictionary of terms of geodetic control,
- GIS Days. [DMa2007]

Some projects of students led by members of the Section of Geomatics were successfully presented on national and international student competitions. In last years there were presented projects on these topics:

- Maps for handicapped,
- Geodata and XML native databases,
- Flood GIS,
- Usage of XML in cartography,
- Physical geodesy,
- Geospatial data modelling.

## **CONCLUSION: THE FUTURE OF GEOMATICS IN THE UNIVERSITY OF WEST BOHEMIA**

Presently the Section of Geomatics has fifteen members (eight employees and seven internal postgradual students). All members participate in newly prepared projects. These projects are focused on the connection of fundamental geomatics processes (geospatial data collection, management, sharing and visualization), modern information technologies (e.g. sensors, laser scanning, etc.) and standards (e.g. INSPIRE, markup languages, web services, etc.). The following list contains some examples of new or prepared projects:

- Open Cadastre,
- Geoinformation technologies for cultural monuments preservation,
- Visualization of health data in supporting of interdisciplinary education and public relations,
- EnviroKnowledge Services – New concept of environmental spatial data management and integration with in situ data collection,
- GRISI Plus (establishing better ICT connections between regions),
- Middleware for spatial data harmonisation in accordance with INSPIRE rules,
- Historical Town's Atlas of the City of Pilsen.

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