

## Contemporary Education and Quality Assurance in the Geodesy and Geoinformation Programs at the Vienna University of Technology



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### Abstract

This paper provides some general remarks on the education programs in the domain of Geodesy and Geoinformation at the Vienna University of Technology. Currently one bachelor and three master programs are offered. A special focus point will be attempts for quality assurance.

### 1. Education and Teaching at the Vienna University of Technology

The education offered by the Vienna University of Technology is rewarded by high international and domestic recognition. The chances of graduates for getting an attractive employment are very prosperous. The high demand on graduates of the Vienna University of Technology from economy and industry, governmental as well as research institutions is evidence for this.

The content of the provided courses is actualized continuously and adjusted to the requirements by industry and economy. Students of the Vienna University of Technology are very flexible because of their solid know-how in technical and natural science. This knowledge is complemented by an offer of courses covering the areas personality development and the so-called "soft skills" (e.g. foreign languages, management know-how, etc.). They receive a solid basic knowledge accompanied with individual tasks to be chosen by each student subject to their personal interests. Great emphasis is also put on the participation of students in current research projects.

Students of the Vienna University of Technology can choose between several curricula. They are offered without one exception (teacher training programme) as bachelor and master programmes. Bachelor programmes last for 6 semesters. Master programmes can be completed within further 3 or 4 semesters following a bachelor programme or equivalent postgraduate degree.

According to its status, the Vienna University of Technology offers postgraduate doctoral programmes as a follow up to all master programmes. Besides the already well established doctoral programmes of Technical Sciences and Natural Sciences the new doctoral programme of Science of Social and Economic Affairs has been introduced in 2004.

More emphasis is at the moment and will in the future be put on at the following three important accents: internationalization of education, e-learning and continuing education. These tasks are fulfilled by the approved Department for International Relations, the E-Learning and the Continuing Education Center.

### 2. The Geodesy and Geoinformation Departments of Vienna University of Technology

The aim of the research and education programs of the Geodesy and Geoinformation departments is based on international leading programs. This is visible in the acceptance and attractiveness of the education programs to students from beyond the region of Vienna and surrounding areas. It is also visible by the fact, that the research groups of Geodesy and Geoinformation are heavily linked to leading international institutions.

The research activities of the research groups in Geodesy and Geoinformation are noticed all over the world, which is documented in invited presentations and proceedings of international conferences, awards for scientific contributions but also by elections in executive committees of

international scientific organisations, editorial boards and program committees.

The area of Geodesy and Geoinformation is administratively represented by three departments, which are divided into seven research groups:

- Institute of Photogrammetry and Remote Sensing
  - Research Group on Photogrammetry and Laser Scanning
  - Research Group on Remote Sensing and Data Assimilation
- Institute of Geoinformation and Cartography
  - Research Group on Geoinformation
  - Research Group on Cartography
- Institute of Geodesy and Geophysics
  - Research Group on Advanced Geodesy
  - Research Group on Applied Geodesy
  - Research Group on Geophysics

Within the focus of the Institute of Photogrammetry and Remote Sensing the main areas of expertise and research include especially issues of deriving Spatial Data from Laser Scanning and Remote Sensing. The research group “Photogrammetry and Laser Scanning” mainly deals with geometrical aspects of object reconstruction, whereas the research group “Remote Sensing and Data Assimilation” focuses on physical problems of remote sensing as well as on advanced methods of data interpretation.

The Research Group Geoinformation of the Institute of Geoinformation and Cartography traditionally deals with fundamental research within the scope of spatial data handling. Ontological approaches for the acquisition and representation of the importance of spatial data are the main focus of information system research. Activities include the utilisation of functional aspects and new mathematical modelling of spatio-temporal processes. Among social and physical geo data especially data which describe properties (or other rights) are in the focus of research.

The Research Group Cartography focuses in their research especially on new ways of communicating spatial information by cartographic means. In this context the role of new media, especially within the domain of mobile systems, is a main area of research. Special fields of fundamental and applied research are situated in the domain of Location Based Services and Ubiquitous Cartography, where fundamental

questions of efficient cartographic communication processes are tackled and proved by applied developments.

The three research groups of the Institute of Geodesy and Geophysics cover a wide area of expertise. The research can be generally related to the research focus “Integrated Geodesy and Geodynamics”. Main research activities cover the domains of Navigation and Positioning by means of satellite geodesy (GPS, Glonass, Galileo, SLR), the implementation of radio-interferometry on long basic lines for geodesy and astrometry (VLBI), the integration of geodetic space processes and combination of geodetic parameters in the frame of Global Geodetic Observing Systems (GGOS), the analysis of interactions of the system earth by means of variations of the earth rotation parameters and the gravity field, the observation of global changes on the earth by means of Global Monitoring Earth Observing Systems (GMES), the analysis of geodynamic processes at regional and local scale by means of geophysical methods of exploration, monitoring and modelling, for example in the alpine area (geodynamics of Eastern Alps, structure and genesis of alpine valleys, stability of valley edges).

### 3. Education Programs in Geodesy and Geoinformation

As mentioned above the Vienna University of Technology offers within the branch of Surveying and Geoinformation (Faculty of Mathematics and Geoinformation) one bachelor program (since 2005) and three master programs (since 2008). Major goal of the courses is provision of key competences in engineering geodesy as well as in administration and visualization of spatial data. There is in addition a broad offer of courses dealing with topics like satellite navigation, Earth observation, geophysical exploration and monitoring of hazardous regions. This broad basis of competences opens successful students a wide range of job opportunities.

The programs are in detail

- Bachelor program “Geodesy and Geoinformation”
- Master program “Surveying and Cadastre”
- Master program “Geodesy and Geophysics”
- Master program “Geoinformation and Cartography”

The bachelor program provides within the first semesters basic knowledge in mathematics, physics, informatics as well as geodetic coordi-

nate systems and coordinate transformations. Introductory lectures in engineering geodesy, photogrammetry, airborne and terrestrial laser-scanning, cartography, geophysics, and satellite navigation are accompanied by a number field courses to practice. Starting with semester three one out of two modules (30 ECTS-points each) has to be selected to locate the students main focus. One module concentrates on modern geodesy, the other one on informatics and handling of spatial data. Nevertheless an overlap of at least 30% of the courses still ensures that students of both modules graduate with the same Bachelor degree and may switch later between the fields. Both modules cover, for example, lectures in legal rights, land administration and economics. Bachelor graduates usually proceed in one of the offered master courses but a small percentage also looks for immediate employment.

Since the start of the bachelor program the number of new students per year has increased from approximately 25 to about 50. A first evaluation end of 2008 shows that out of around 35 of them still in the program at the begin of the second year about 70% are able to receive their bachelor degree within 7 semester.

All master programs are intended for native and foreign students who have achieved a bachelor's degree and aim working as decision makers or leading scientists in geoinformatics, geodesy and navigation, engineering surveying, data adjustment, computer vision or remote sensing. Students are confronted with 'state of the art' science and instructed how to provide high quality and efficient solutions in a permanently changing environment. Consequently, besides the technical skills, a number of courses deal with presentation techniques and communication in foreign languages.

The master program "Surveying and Cadastre" focuses on engineering geodesy and land management. This includes for example courses on precise surveying techniques, machine guidance and control, indoor- and outdoor navigation, monitoring of potentially hazardous motions of artificial monuments or natural objects like land slides. Besides, special attention is paid to legal and economic competences which are indispensable skills to become a successful civil engineer.

The master program "Geodesy and Geophysics" deals primarily with Earth observation, Global Change monitoring and exploration techniques. Focal points are Reference Systems, observation and modelling of the Earth Rotation

and Earth Gravity Field, satellite based Earth Observing Systems as well as seismic and gravimetric exploration techniques. Closely linked are the tasks of precise positioning techniques by means of satellite navigation systems like GPS.

The master program "Geoinformation and Cartography" consists of theoretical and applied coursed to contemporary topics of Geoinformation and Cartography. In detail the master program deals with the acquisition, modelling, analysis, visualization and communication of geodata. Specific tasks include the combination of data from different sources, the integration into spatial information systems, and the establishing of user-adequate visualization techniques.

Based on a master degree the admission to a program of Doctoral Studies can be achieved as well. International students of many countries have already joined the Geodesy and Geoinformation institutes to successfully gain a Doctoral degree from Vienna University of Technology.

#### 4. Quality Assurance

The quality assurance within all education programs of Vienna University of Technology basically focuses on three main points:

- Selection of teachers with professional competence and adequate didactic qualification
- Continuous evaluation of courses by students
- Obligatory reporting to the Dean of Academic Affairs in case of remarkable evaluation results

For further developing an effective system of monitoring and assuring the quality of education programs a couple of activities are necessary that should complement one another. Therefore the Geodesy and Geoinformation programs develop further steps of quality assurance, based on the fundamental goals of the whole university. An indispensable basic element of quality assurance is hereby the evaluation of courses. Furthermore, accompanying methods are necessary like incentive systems, mentoring strategies, institutionalized offers for improving teaching skills and an institutionalized monitoring and comparison of international developments.

##### 4.1 Evaluation of courses

The instrument of evaluation of courses is a key element of quality assurance in education at the faculty of mathematics and geoinformation. A general increase in the acceptance of this elements by all participating parties (students, teachers) is a key goal, as it is a precondition for a

more precise and qualitative implementation of this instrument. Such an increase is aspired by

- optimisation of processes in evaluation of courses by means of optional usage of internet-based questionnaires resp. printed questionnaires
- improvement of questionnaires for students by means of stronger individualisation concerning course type
- implementation of modul parts of questionnaires which allow quicker answering by those students who do not want to expand on detailed statements
- the increase of communication between the involved groups in evaluation of courses (students, teachers, dean for study affairs) by means of increased and partly more transparent reactions. As further progression it is planned to confront students with the instrument "evaluation of courses" and its processes within the first semester
- more transparent publication of relevant results of evaluations of courses in various adequate panels
- Optional possibilities of comprehension of collegiate critiques like Wikis, Blogs should be proved concerning their applicability

#### 4.2 Incentive systems

Geoinformation education programs have adopted an incentive system for test purposes. As a direct result of evaluation of courses a "Best-of-education Award" has been tested. Based on the positive experiences this will be developed iteratively by defining a mix of quantitative and qualitative measures. Based on those measures a selection of classes being evaluated remarkably positive will be discussed and finally decided by a board consisting of student union members and the dean of academic affairs and the chair of the commission of academic affairs. For the time being this concept of a two-stage method (quantitative and qualitative ranking based on evaluation results resp. a jury) is used for various categories (compulsory lectures, applied classes, seminars, special courses).

#### 4.3 Mentoring concepts

Within the Vienna University of Technology tutoring and mentoring programs are offered and available. A special focus has to be given to dedicated information about offered courses via up-to-date communication media. A dedicated system of help, consultation and guidance

through the very first steps of beginners is offered currently and is monitored permanently with the goal of further improvement. Finally, dedicated information to those students starting their study not in a regular way (Summer Semester instead of Winter Semester; Foreign and Exchange Students) are offered and are also further developed, if necessary.

#### 4.4 Teaching competence and e-learning

As a key element of quality assurance within education programs of Geodesy and Geoinformation the Vienna University of Technology offers courses to improve teaching and didactical skills. Currently there are a few offers on dedicated workshops dealing with teaching competence, which are available to all members of the University. As a matter of fact more offers focused on the needs of specific teaching situations will have to be given. The final goal is to have more precise instruments for helping teachers to be able to make excellent classes and courses.

Under the acronym 'E-learning' a special electronic tool supplementing the regular lectures has been introduced at TU-Vienna recently. E-Learning is a web-based new concept to prepare the subject contents for interactive use. One advantage of e-learning is of course the possibility to provide additional material and tests which allow the students to jointly study and control their understanding of the lecture content. This is predominately impossible in large classes of a few hundred students. There are of course a number of still unresolved problems linked with E-learning like quality-assurance of the provided material, how to improve the acceptance by the teaching staff and last but not least how to motivate students to watch the lectures even if the subject matter is already provided in digital form. In summary e-learning is clearly not a perfect substitute of the lecturer but it may have advantages in case of huge classes which prohibit keeping contact with the lecturer. It helps students to check steadily their knowledge by running automated tests and answering provided questionnaires and of course these platforms are indispensable tools in remote education and postgraduate programs.

#### 4.5 Further instruments for quality assurance

Beside the described key elements of quality assurance further instruments apply. Those include

- assignment of international reviewers/examiners
- conducting of complementary time tables and examination schedules to ensure concise study process
- additional questionnaires for all graduates at the end of their study and approx. 3 – 5 years after final degree in order to gain additional insights on the evaluation of the study program
- monitoring and matching with course schemes of comparable foreign universities

## 5. Further Developments

The further development of the profile of the Geodesy and Geoinformation group at Vienna University of Technology is based on the fundamental goal of scientific excellence in research and education applied to the offered education programs. One consequence is that all courses and classes should aim at including aspects and results of recent research processes.

A permanent system of quality evaluation and assurance, consisting of a mix of instruments, is offered and applied in order to follow the main goal of Vienna University of Technology on ensuring high quality programs instead of mass education programs and aiming on producing students which are able to “compete” on an international level.

### References

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