

# CHALLENGES IN ADVANCED GI EDUCATION – STIMULATION TO SCIENTIFIC AND RESEARCH WORK: THEORY AND APPLICATION

A. Lisec

University of Ljubljana, Faculty of Civil and Geodetic Engineering, Department of Geodesy  
Jamova 2, SI-1000 Ljubljana, Slovenia, anka.lisec@fgg.uni-lj.si

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## ABSTRACT:

The fields, covered by the International Society for Photogrammetry and Remote Sensing (ISPRS), have been faced with new challenges in the last decades due to fast technological development and new methodological approaches in the GI sciences. The complexity of contemporary higher education in the fields related to the GI sciences demands that new modern technology is introduced to advanced students and young researchers in addition to the regular study programmes. In order to keep low costs for advanced and qualitative education in GI fields, the gain of knowledge has to be based on the international exchange of the knowledge and experiences as well, which can be supported by the international networking. In the paper, the idea on international networking is illustrated on the base of European experiences in geodetic, surveying and cartographic higher education firstly. Furthermore, the organisation and activities of the ISPRS WG VI/5 and Student Consortium are presented, where future prospects are given on the base of the international discussions in the framework of the ISPRS WG VI/5 and Student Consortium.

## 1. INTRODUCTION

The history of the remote observations and measurements of physical objects or phenomena, i.e. without physical contact with the objects of interest is linked with the history of photogrammetry. The term photogrammetry is derived from three Greek words, *photos* meaning light, *gram* meaning something drawn or written, and *metron* meaning to measure (Alspaugh, 2004). The nature of remote data acquisition about the shape and other characteristics of the physical objects have been changing because of new technologies, methodologies and growing demands of the society for data and information on physical objects and phenomena. Figure 1 shows the use of the photogrammetric product, orthophoto, in spatial planning.

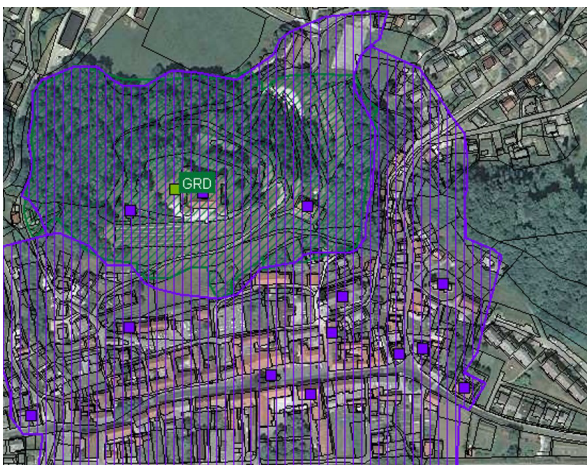


Figure 1. Orthophoto as the base layer for spatial planning, municipality of Sevnica, Slovenia (PISO, 2007).

International Society for Photogrammetry and Remote Sensing (ISPRS), since its creation in 1910, has created a scientific and

professional organisation in the field of imaging and image analysis. The successful story of the ISPRS activity would not occurred unless there was a massive practical demand for its services, often linked with geodesy, surveying and cartography (Konecny, 2002). As the consequence, photogrammetry, remote sensing and nowadays a series of GI subjects has become part of geodetic, surveying and cartographic curricula worldwide, especially in the higher education area. In the era of fast developing technology, especially IT, the extent of curricula of classic geodetic, surveying and cartographic study programmes has been broadened. In addition, there are several new specialized technologies which are coming into the practice. It is hard to handle all these topics in the contemporary study programmes.

The complexity of contemporary higher education in the fields related to the geomatics demands that the new, narrow oriented modern technology is introduced to advanced students and young researchers in addition to the regular study programs. There are several new techniques to improve learning by students and gain greater efficiencies in teaching, such as the provision of online study material and the introduction of multimedia delivery. However, the international student and research mobility will keep the importance in the education although the information flow is quick and remote communication is very fast. The main reason is that the expensive equipment, software, database etc. are not available at all universities. Furthermore, the social component in the international scientific and research areas is of big importance for the harmonized development of the profession as well as society.

International student and staff mobility is often connected with several obstacles such as financing, insufficiency of information on student and staff exchange programmes and grants in the international higher education area, lack of information on study programmes abroad, the extension of the study period because of the incongruity of study programmes etc. With the main aim to support the international student and staff mobility in the

fields covered by the ISPRS (photogrammetry, remote sensing, GI sciences and related fields) and to promote the profession among students, young researchers, the ISPRS WG VI/5 and the Student Consortium were established during the ISPRS Congress 2004 in Istanbul.

## 2. MATERIALS AND METHODS

In the article, the idea on networking is illustrated on the European experiences in the thematic networking in the higher education area, followed by the introduction to the ISPRS WG VI/5 and Student Consortium (SC). In addition to the short description of these ISPRS VI/5 and SC activities, the emphasis is given to the problems that appeared by establishing networking and how these problems were solved.

The main aim of the ISPRS WG VI/5 and SC is to promote profession to students and encourage young researchers to deepen their knowledge on the base of international networking. Understanding organisational structure is crucial in order to provide the base for effective communication. Therefore, the Unified Modelling Language (UML) is used for graphical presentation of the proposed organisational structure of the ISPRS WG VI/5 and SC. UML, which has been adopted as standard by The Object Management Group (OMG), is a general purpose visual modelling language that is used to specify, visualize, construct, browse, configure, maintain, and control information of different real systems or processes. The advantage of the UML models of a system (process) is in stability of the models that are not dependent on the technological environment which changed over time (Eriksson, 2004; Rumbaugh et al., 2005). The UML notation in the form of diagrams can be used to present and to explain the complex real or virtual systems (also organisational structure) in a simple and comprehensible way, which can provide the base for further discussion and control as well.

Thus, critical evaluation of different aspects will be given (organizational scheme, membership network, etc.). Considerations and suggestions, based on the gained experience, are given for the future work and development of the working group and the Student Consortium activities.

## 3. NETWORKING

Globalisation, as a process and a condition of the space for higher education, dictates the guidelines for study programmes in the higher education area all over the world. The new technologies and methodological approaches in the fields of photogrammetry, remote sensing and related fields are inevitably entering the everyday practice. The contemporary study programmes are not always able to follow the quick development of every segment of this wide professional area, also due to expensive equipment, data, specialized knowledge and teaching materials. The cooperation between educational institutions has become necessary, on the national as well as on the international level. It is widely recognised that the adequate management of information on study programs is crucial to the future of international mobility of students, researchers and teachers in every profession. The professions such as photogrammetry, remote sensing, GIS are not the exception.

There is not only development in technology but also social-economic conditions in higher education, research and science

are changing. The resources for education will very likely be reduced due to the shrinking number of students in such technical subjects like photogrammetry and remote sensing. This means that a stronger co-operation between educational institutions has to take place and, more educational networks have to be formed consequently (Höhle, 2006). The main idea is to support networking in order to provide information on international educational programmes, research, scientific projects – not only for higher educational level but also life-long.

As an example of good practice of higher educational institutions network, the EEGECS-project (European Education in Geodetic Engineering, Cartography and Surveying) is briefly introduced. The thematic network EEGECS aims to facilitate trans-national access to educational resources in Europe and to enable the mobility of students and graduates in geodetic engineering, cartography and surveying all over Europe.

Furthermore, there are several international organisations covering the fields of photogrammetry, remote sensing and other GI sciences (FIG, International Federation of Surveyors; ISPRS, International Society for Photogrammetry and Remote Sensing; ICA, International Cartographic Association, etc.). Their main aim is to support development and promotion of the profession, and to stimulate the international cooperation. Recognizing the potential of advanced young students and researchers, international organisations, such as the ISPRS, have already pioneered the promotion of the profession among the students and young researchers with the aim to include the young generation into the society and to encourage the research and scientific work among them. A special emphasize is given to the developing of the organizational structure of the new ISPRS working group VI/5, whose main aim is the promotion of profession to students, and Student Consortium.

## 4. EUROPEAN PROJECT ON HIGHER EDUCATION FOR MOBILITY OF STUDENTS AND TEACHERS

The past years have been a time for preparation and implementation for new curricula in the history of the European higher education. The main concern has been on the reformation of the structure of national higher education systems in a convergent way in accordance to the Bologna Declaration (Heine et al., 2006). The main goal of this declaration has been to create a European space for higher education in order to enhance the employability and mobility of citizens and to increase the international competitiveness of European higher education (European Council and Commission, 2006).

In the European higher education space, there are special mechanisms that give support to organisations, institutions or individuals to run or participate in projects all over the European Union and beyond. The European Community promotes inter-university cooperation as a means of improving the quality of education for the benefit of students and higher education institutions. The recognition of study programmes and diplomas is a prerequisite for the creation of an Open European area of education and training where students and teachers can move without obstacles. This is the main reason why the European Credit Transfer System (ECTS) was developed within the Erasmus programme as a means of improving academic recognition for study abroad. Erasmus programme of the European Community addresses the teaching and learning needs of all those in formal higher education, including trans-national stu-

dent placements in enterprise, and the institutions and organisations providing or facilitating such education and training.

#### 4.1. Thematic network EEGECS

One of the project relating to the fields of photogrammetry, remote sensing and other GI sciences, supported by the European Commission, is the thematic network EEGECS (European Education in Geodetic Engineering, Cartography and Surveying). The EEGECS, established in the framework of the Erasmus programme in 2002, is a project originally created by Geodetic Engineering, Cartography and Surveying institutions whose main objective was to enhance collaboration and co-operation between the higher education institutions which offers these studies and studies from related fields (Steinkellner and Heine, 2005).

Today, the network has a partnership of over 100 institutions from 27 different European countries. The institutions involved are trying to create a transparent higher education in the fields of the EEGECS in order to provide the base not only for the mobility of students and teachers in Europe but also worldwide. The general aim of the project is to make the achievements and essential results obtained by EEGECS available to the students, teachers and researchers, faculty managers, public and private sectors that are involved in professional activities related to Geomatics, through a number of permanently active and open Working Groups that use these results on everyday basis (EEGECS, 2007). The work is organised in six working groups as it is evident from Table 1.

Table 1. EEGECS organising structure (EEGECS, 2005).

EEGECS WG	Objectives
WG1	Undergraduate education
WG2	Research
WG3	Continuous education, e-learning and the European dimension of studies
WG4	Enterprises-Private sector
WG5	Mobility, Language, Culture, Citizenship, Social cohesion
WG6	Quality Assurance

#### 4.2. EEGECS research on student mobility

In order to support the mobility of student and teachers in Europe from the fields covered by the EEGECS, the WG 5 was established. The main objectives of the Working group 5 are to increase the mobility of undergraduate students, lecturers, researchers and administrative staff in Europe, to promote scientific studies among young people, particularly women, and to promote language learning among the whole academic community. Furthermore, the objectives of the working group include activities with the aims to enhance social cohesion, promote ethnics and respect for the diversity of cultures and races, equal opportunities and so on.

In the framework of the Working group 5 the motivation and interest of European students in international mobility was studied, and the student and staff mobility in the fields related to geomatics was discussed. The results of the research showed that students are aware of importance of international coopera-

tion, exchange and mobility. The main obstacles for student mobility are financing, insufficiency of information on exchange programmes and study programmes abroad, and the extension of the study period because of the incongruity of study programmes (EEGECS, 2005). Therefore, the idea on short-term educational programmes such as summer schools seems to be an adequate solution in order to provide the possibility to deepen the knowledge in the areas, not covered by contemporary study programmes, and of course in order to develop and strengthen the international cooperation among young professionals.

### 5. ISPRS WG VI/5 AND STUDENT CONSORTIUM

There is several information available on the world wide web and other media on international study programmes, student mobility, research work etc. The problem of today's society is flood of information and it is hard to extract the relevant information, especially for young people with less experience and less critical decision making (Figure 2). The fact is that young people think differently than adults, they are developing their professional directions and are open to different topics. They do not have much experience, and they need introduction and hints about many professional things consequently.

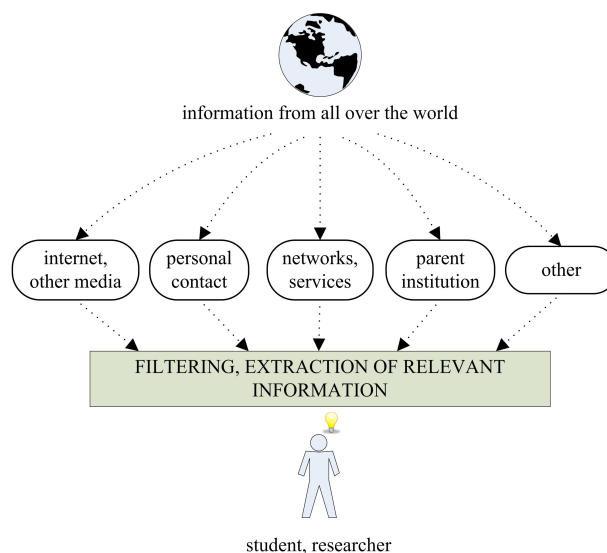


Figure 2. Flood of information in the international area of higher education, research demands filtering of information.

To cope with the problem of providing relevant information to students, the ISPRS WG VI/5 (Promotion of Profession to Students) and the Student Consortium were established, during the ISPRS Congress 2004 in Istanbul. The main purpose of the WG VI/5 is stimulation to scientific and research work, and promotion of the ISPRS profession to talented graduate, post-graduate students and young researchers. The idea behind is clear and reflects in the Terms of references (ISPRS WG VI/5, 2007):

- Promotion and support of international student activities including the ISPRS Student Consortium.
- Encouragement of active participation of students, especially undergraduate students, in ISPRS events and promotion of reduced fees and stipend for their participation.
- Collection and maintenance of a database on persons who are involved in the promotion of the profession to students, including the members of ISPRS Student Consortium and educators.

However, its realization is possible in different ways, where the strategic aims (terms of references) represent the top of the decision hierarchy (Figure 2).

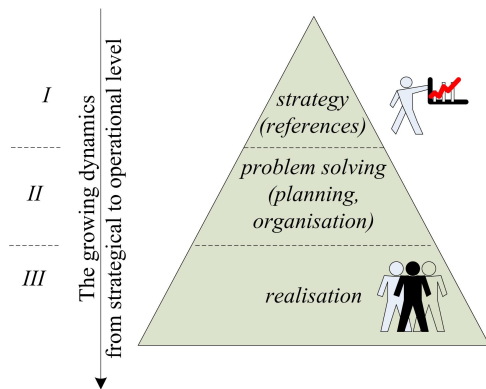


Figure 2. The hierarchy of decisions in the process of forming (changing) the organisation structure of the WG VI/5 and SC.

The initial period was mainly dedicated to find proper ways of communication with students and youth professionals interested in the activities in the framework of the ISPRS Student Consortium. The main framework of communication between students and the ISPRS officers was given with the establishment of the ISPRS WG VI/5 on one side (ISPRS officers) and the ISPRS SC on the other side (students, researchers, young professionals). This was the starting point for development of the organisational structure of the SC and ways of communications with the WG VI/5 officers and other representatives of the ISPRS (Figure 3).

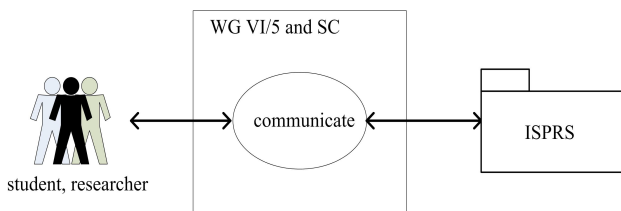


Figure 3. The initial idea on communication system between the ISPRS and students.

### 5.1. The proposed organisational structure

The ISPRS WG VI/5 presents the main link between students from different countries and the ISPRS. It offers support to the student coordinators of the Student Consortium, working very closely together. The structure and work of the WG VI/5 thus differs in some way from the usual ISPRS working groups (Kosmatin Fras, 2006). Figure 4 shows the main actors and groups (systems) in the proposed communication between students and the ISPRS – package class diagram in UML (Unified Modelling language).

As it is well known, the scientific and technical work of the ISPRS is accomplished by 8 Technical Commissions (TC), whose work is organized in several working groups (WG). The WG VI/5: Promotion of Profession to Students was established under the Technical Commission ISPRS TC VI: Education and Outreach. Under the WG VI/5 Student Consortium was established. The Student Consortium (SC) presents the main student group, who share the same interest in photogrammetry, remote sensing and spatial information sciences. SC provides a plat-

form for exchange of information and organise student-specific events either independently or within larger ISPRS events (Kosmatin Fras, 2006).

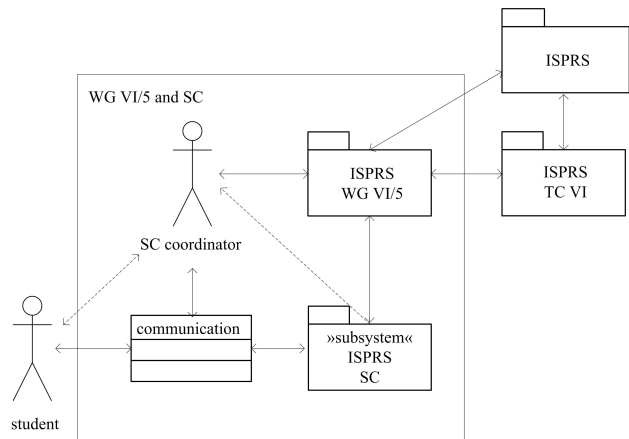


Figure 4. The proposed communication (information flow) between the ISPRS WG VI/5 and Student Consortium.

The four year period, in which the working group officers usually work, is too long for students. The structure of the Student Consortium has to be more flexible. It is proposed that the Student Consortium is led by Student Consortium board, consisted of student coordinators and the student coordinator-in-chief, who coordinates the work of the consortium and the coordinators and is a contact person for communication with the working group officers (Figure 5).

The student coordinators are supposed to be responsible for special tasks (SC newsletter, webpage, summer school organisation) and on the other side, there will be regional representatives at least for each continent. Therefore, regional coordinators should be appointed from different geographical areas (at least for each continent one), who search for new contacts (e.g. with different local student organisations), collect, update and mediate information, etc.).

### 5.2. Networking - SC Newsletter

One of important issue of the ISPRS Student Consortium and WG VI/5 is the SC Newsletter. The idea about the SC digital Newsletter has appeared during the summer school in Istanbul 2005. For the coordination of the work for publishing and distribution of the digital SC newsletter the editorial (and technical) board is proposed to be established (student coordinators for the newspaper). The SC Newsletter is supposed to be available from the SC and WG 5 web page and will be delivered to the SC members and other subscribed, interested in the topics of the Newsletter.

The main aim of the newspaper is the information flow, which is one of the most important things for the successful activity of an association. The newsletter will help to inform all interested students, researchers about the educational, research and scientific opportunities in the fields of the ISPRS, to encourage students and young researchers for the international work and to develop cultural cohesion in the science and professional work. In addition, the newsletter will present student activities in the framework of the SC to other interested. Other activities, such as further development of the membership network and the new SC webpage have contributed to the promotion of the profession to students and young researchers.

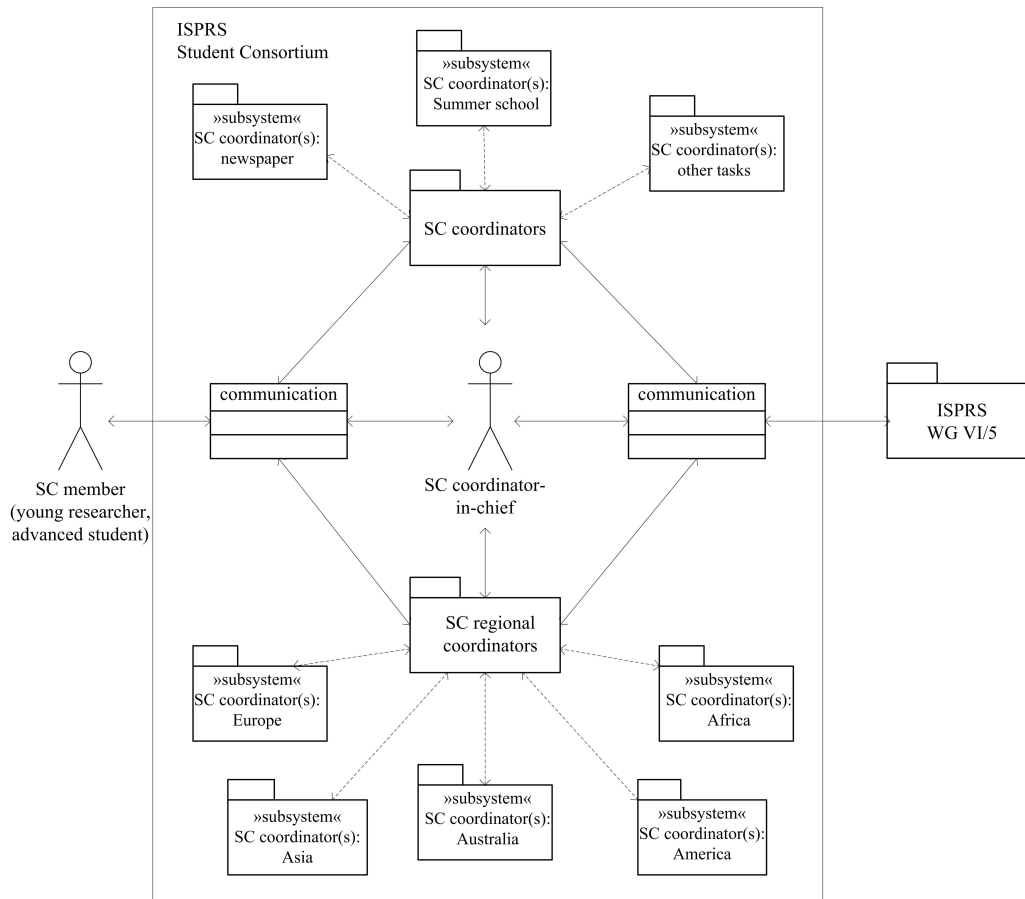


Figure 5. The proposed organisational structure of the ISPRS WG VI/5 and Student Consortium.

## 6. ISPRS SHORT-TERM EDUCATIONAL PROGRAMMES (SUMMER SCHOOLS)

Recognizing the potential of advanced young students and young researchers, the ISPRS have created the platform for the promotion of the profession among the students and young researchers in the last years with the aim to include the young generation into the society and to encourage the research and scientific work among them. In the era of fast developing technology, the regular study programmes could not cover all the topics related to the fields covered by the ISPRS as well as there are not equal opportunities for research due to expensive equipment and missing human resources. The supplementary short-term educational programmes such as summer schools for specific topics seem to play an important role in the future.

One of the most important activities for the promotion of the science among the young researchers of the ISPRS WG VI/5 and SC is organisation of summer schools. The initial idea on the ISPRS support to advanced student and young researchers, professionals, goes back to the year 2004, when the ISPRS world congress took place in Istanbul, Turkey. During the XX. Congress of the ISPRS in Istanbul some student activities were organised. These were Youth Technical Session, The Best Paper and Best Poster by Young Authors Awards, Youth Forum and Summer Camp. All the activities were really productive and encouraging for students. These Youth Forum and Summer Camp were regarded as the first in ISPRS history (Akkoca et al., 2006).

The main purpose of these short-term educational programmes is to provide an intensive and educational week with training activities for the students and young researchers in the ISPRS's work fields. Each summer school has scientific topics of its own, selected from the wide variety of the topics treated within ISPRS. Besides learning the theory through the lectures, the aim of summer schools is also to demonstrate the participants practical and laboratory works (the approach called also as "theory and application"). Not less important, such meetings have a special social meaning in order to exchange ideas and provide base for further international cooperation.

### 6.1. Summer School in Istanbul, 2005

The 1<sup>st</sup> ISPRS SC Summer School took place at Istanbul Technical University's Maslak campus, Turkey, June 19-26, 2005. The general topic of this Summer School was "Satellite Data Processing and Spatio-Temporal Analysis (for Resource and Disaster Mapping, Monitoring and Management)". Altogether 39 participants from 11 different countries attended the event (Figure 6). During the discussion on the future of the SC activities and ISPRS summer schools, the participants expressed wish for future short-term educational programmes where theory has to be illustrated in practical applications (exercise) in order to deepen theoretical as well as practical knowledge on specific topics and get better view into material taught in theory during the lectures (Erten et al., 2005).



Figure 6. Graduation from the ISPRS Summer School 2005 in Istanbul, Turkey (ISPRS Student Consortium ..., 2005).

### 6.2. Summer School in Ljubljana, 2007

The 2<sup>nd</sup> Summer School was held in Ljubljana, Slovenia, 1-7 of July 2007 with the topic "Theory and Application of Laser Scanning". The decision for the topic was due to the fact that the technology of laser scanning is inevitably entering the everyday surveying practice. Laser scanning is a successful technology that has evolved over the last decades across the industrialized world, incorporating a wide array of advances in science and engineering. The basic objective of laser scanning is the indirect determination of spatial measurements of objects using laser scanners. Laser scanner is in fact a digitizing system based on laser distance measurements meant for capturing the 3D shape of physical objects. The distance from scanner to object may range from very close to very far. In the practice, two main groups of laser scanners in regard to the distance from scanner to scanned object have appeared:

- terrestrial laser scanner and
- airborne laser scanners.



Figure 6. Terrestrial laser scanning of the Prešeren's Monument, the monument to the greatest Slovenian Poet France Prešeren, The Prešernov square, Ljubljana.

Both airborne scanning and terrestrial laser scanning (or lidar) are now well established methods for the acquisition of precise and reliable 3D geo-information as well as for the acquisition of several physical objects in the real world, for example monuments for the purpose of preservation and restoration (Figure 6). The needs from the practice are big and enterprises employing young professionals expect that they are well acquainted with latest development when finishing their study. On the

other hand, the faculty programs are not always able to follow the quick development of the profession, due to expensive equipment, data, specialized knowledge and teaching materials. The summer school was thus meant to upgrade and deepen the general knowledge in the technology, which students might receive at their faculties, and to practice the theory on real data.

The Summer School was hosted by University of Ljubljana, Faculty of Civil and Geodetic Engineering. The University of Ljubljana is an institution with a very rich tradition, established in 1917, and today with over 40.000 of regular students ranks among the biggest universities in the world scale. The organization of the Summer School was entrusted to the Faculty of Civil and Geodetic Engineering, Slovenian Geodetic Student Association (more than 20 students of geodesy were involved in the organization) and Association of Slovenian Surveyors – Section of Photogrammetry and Remote Sensing. The lecturers came from acknowledged international research and education institutions, having made the summer school a truly professional experience.

The success of the Summer School is already a great number of participants – 52 international participants from 20 countries (China, Malaysia, India, Iran, Egypt, Turkey and many European countries), and around 30 domestic participants (advanced students, PhD students, faculty teaching staff, young researchers). In addition to 32 lecturing hours of the program, technical visits and different social events were parts of the programme. Perhaps the most important and stimulative facts of the first ISPRS summer schools are the friendly atmosphere during the whole summer school period and active participation of advanced students, young researchers, researcher from the third world countries and countries in transitions, who worked as a group of old friends, as well as the high quality lectures.

It has been shown, that the approach, where the topic of summer school was selected by professionals on the base of students (researchers) needs, has to be kept also for the future short-term scientific educational programmes. The topic, interesting for students and researchers, are related to the fields, often not (or not deeply) covered by contemporary study programmes.

### 6.3. Summer School in Nanjing, 2008

The 3rd Summer School will take place in Nanjing, China, 27 June – 1 July 2008, proposed topic is »Acquisition, processing and representation of 3D geospatial information«, organized jointly with the biannual Chinese Doctoral Students' Forum in GIS.

### 6.4. Future prospects

The technical development requires new skills and methodological approaches to exploit new data sources on 3D physical objects and spatial information. Furthermore, the growing demand of the society for those data dictates the multi-disciplinary approach in the practical as well as scientific areas of profession. A supplementary short-term education such as Summer School can be an adequate opportunity to gain a specialized knowledge on selected topics for students and young researchers from different profession.

One of the basic conditions for promotion the profession to students and researchers, and for providing additional opportunities to gain new and deepen knowledge on specific

topics, is networking. In order to be active, such networks have to be transparent (clear defined structure of organisation and responsibilities of involved and assured human as well as financial resources). The proposed structure and activities of the ISPRS WG VI/5 and SC will have to be updated, but it presents the starting point for realisation of the main aims, formed by establishing the ISPRS WG VI/5 and SC.

We strongly believe that the achieved results in the framework of the ISPRS WG VI/5 and Student Consortium in such a short period (2004-2007) show a progress in communication with students and among the students, which has been reflected also in the involvement of youth in different ISPRS activities (Figure 7).



Figure 7. The international networking of students and profession under the ISPRS – participants of the 2<sup>nd</sup> Summer School in Ljubljana.

We see good future prospects in continuation of started activities (e.g. summer schools, SC Newsletter), whereas new ways for promotion of the profession will appear as well.

## 7. CONCLUSION

The only constant in the fields covered by the ISPRS is Change. We should not view these from an aspect of fear for the future, but should view them as opportunities for the profession to exploit and to find new challenges, in education as well. The fast developing technology demands the international mobility of students and staff in the higher educational area.

Unfortunately, there are several obstacles that prevent student and staff from the international exchange, often associated with financial problems and extension of study period. As it has been shown, the short-term educational programmes (such as summer schools) with theoretical lectures, practical demonstrations and laboratory work can contribute to deeply engagements of young researchers in the specialized topics, which are not included in the regular curricula at their parent educational institution. Therefore, the idea on the topic of such educational programmes has to be discussed and determined by young researchers and supported by professional advice (ISPRS WG VI/5). In the first place, the quality of the lectures is crucial for the success of the short-term educational programmes but not less important is a friendly atmosphere and social contacts.

Based on the results of the past activities of the EEGECS and the ISPRS WG VI/5, the future activities of the ISPRS working group and Student Consortium have further to be focused on collecting and mediating relevant information on financial support, study programmes and mobility opportunities worldwide for students as well as for researchers and teachers. Such information could contribute to the promotion of the profession among the young people, mobility of students in the fields related to the ISPRS, and provide the platform for the international cooperation of the academic institutions consequently. In addition, the young scientists are getting involved into the ISPRS activities and the future international professional network has been establishing indirectly.

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