International Conference on Geomatics Education

10 - 12 May 2023

The Hong Kong Polytechnic University, Hong Kong

Conference Abstract Proceedings

Challenges and Prospects

THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學

DEPARTMENT OF LAND SURVEYING AND GEO-INFORMATICS
土地測量及地理資訊學系

Programme At-a-Glance

10 May 2023 (Wed)		
10:00 – 13:00	Registration	outside N002
14:00 – 14:20	Opening Ceremony	N003
14:20 – 14:50	Keynote Speech 1	
14:50 – 15:30	Session 1: Web-based Tools for Surveying Education	
15:30 – 16:00	*Tea Break*	
16:00 – 17:40	Session 2: Curricula Development	N003
18:30 – 20:30	*Banquet @ King Yat Hin, Harbour Plaza Metropolis, 7 Metropolis Dr, Hung Hom*	
11 May 2023 (Thu)		
9:00 – 9:30	Keynote Speech 2	N003
9:30 – 10:30	Session 3: Promotion of Young Professional	
10:30 – 10:50	*Tea Break*	
10:50 – 11:50	Session 4: Multi-level Education	N003
12:00 – 13:30	*Lunch @ Chinese Restaurant, 4/F, Communal Building*	
13:30 – 14:00	Keynote Speech 3	N003
14:00 – 16:00	Session 5/6: Promotion of Materials on Geomatics & Emerging Techniques in Surveying	
15:30 – 16:00	*Tea Break*	
16:00 – 18:20	Session 7/8: Multi-level Surveying Education & Cost-effective Surveying Education	N003
12 May 2023 (Fri)		
9:00 – 10:20	Session 9: Innovation for Asset Management	N003
10:20 – 10:40	*Tea Break*	
10:20 – 11:00	Session 9: Innovation for Asset Management	N003
11:20 – 11:30	Closing Ceremony	

https://www.polyu.edu.hk/lsgi/icge22/

Keynote Speech 1

Sailing Through Radical Changes in the Geomatics Education

Prof. Liqiu MENG

Technical University of Munich

Professor of Cartography at the Technical University of Munich (TUM), and Member of the German National Academy of Sciences. She was Senior Vice President of TUM (2008-2014), one of the TUM's Principal Investigators in the first round of the German Universities Excellence Initiative, member of the Senate of the German Helmholtz Federation, deputy chairperson of the German Space Agency, member of the International Advisory Board of the Humboldt Foundation, and is currently Vice President of the International Cartographic Association, and Board Member of the Hans-Rudolf Foundation. She initiated the international master's program "Cartography" in 2011, which is jointly run by TUM, Technical University of Vienna and Technical University of Dresden and University Twente. Her recent research interests include geodata integration, multimodal navigation algorithms, map-based open portal for climate events, and ethical issues in cartography.

Abstract

The speaker takes a cognitive walk through the major educational reforms in Europa over the last 25 years in an attempt to explain the radical changes in the geomatics education. For instance, the Bologna reform has greatly facilitated the mobility of students and teaching staff, which in turn has contributed to the internationalization of curriculum design and given rise to new Master's study courses. The competencies required of new geomatics graduates have also been expanded. In addition to professional skills (know-how) and critical thinking (know-why), social skills, communication skills and adaptability have become indispensable.

The developments of data science, social media and artificial intelligence (AI) in recent years are having an unprecedented global impact on the education community. During the several recurring peaks of the pandemic, universities have adapted to online or hybrid teaching with incredible efficiency. With the advent of the post-pandemic era, we generally believe that we have now developed the habit of being highly vigilant and resilient to daily eventualities and multiple uncertainties. Nonetheless, the release of chapGPT as a disruptive milestone in AI has once again left us feeling underprepared.

Facing this new situation, the speaker addresses the changing relationship between lecturer and student from knowledge provider and recipient to co-learner and co-creator of new knowledge. She also points out that regular academic degree programs as primary delivery units that are built upon each other are increasingly being flanked by flexible lifelong learning modules based on anytime, anywhere micro-learning and micro-credentials. Furthermore, she emphasizes the need to engage students in the loop of educational quality management. Approaches such as trusted learning analytics and gamification may help create an intrinsically motivated and happy learning process and are therefore as important as conventional means such as exams and post-exam assessments of teaching quality. Finally, using case studies, the speaker calls for the inclusion of AI and ethics in the curriculum of geomatics education to enhance the human capacity of deep learning, thus prepare future talent with not only analytical problem-solving skills, but also a systemic understanding of complex and wicked geospatial problems.

Keynote Speech 2

Integrating New and Emerging Concepts into a Geomatics Engineering Curriculum

Prof. Derek LICHTI

The University of Calgary

Prof. Lichti joined the Department of Geomatics Engineering in 2008. Following his promotion to Professor in 2013, he served a five-year term as Department Head. Prior to his time in Calgary, Dr Lichti worked as an academic in Perth, Australia starting in 1999 and has held visiting academic positions in Australia, Brazil, Malaysia and Switzerland. He was also a co-founder of Scanalyse Pty Ltd, a successful Perth, Australia based start-up company specialising in wear measurement solutions for the mining industry based on laser scanning technology. Since 2013, Dr Lichti has served as the Editor-in-Chief of the ISPRS Journal of Photogrammetry and Remote Sensing. Prior to that, he served two terms as Chair of the International Society for Photogrammetry and Remote Sensing (ISPRS) Working Group V/3 Terrestrial Laser Scanning.

Abstract

Geomatics education faces pressure to integrate new and emerging methods into undergraduate curricula. Examples include deep learning, simultaneous localization and mapping, structure from motion, building information models, digital twins, autonomous vehicles, and others. The pressure can be attributed to multiple sources: widespread use in closely-related disciplines; the increasing ubiquity of technology like smart phones; and the democratization of methods such as photogrammetry. Moreover, there exists industry demand

for graduates equipped with knowledge of the aforementioned methods as well as software development skills.

It is clear that in order to stay relevant, geomatics education must adapt to meet this challenge. Doing so will create new and exciting opportunities for graduating students. It is important, however, to prevent curriculum overload. The capacity to add new content to an already-packed undergraduate degree program may be very limited. Adding more content runs the risks of treating subjects in insufficient detail and overloading students. In practical terms, curriculum modification is required in order to add new material. That said, content revision cannot be at the expense of important fundamental material that comprises a student's knowledge base and may be required to meet accreditation requirements. Finding the right balance is a challenge.

This presentation will report on curriculum challenges faced by the Department of Geomatics Engineering at the University of Calgary. Some recent initiatives taken to integrate new and emerging methods into our undergraduate program will be described. The presentation will conclude with a case study of how students are engaged in both fundamental material and emerging concepts in a final-year photogrammetry course.

Keynote Speech 3

Experiences from several Erasmus + Education Projects

Prof. Georg GARTNER

Vienna University of Technology

Georg Gartner is a Professor for Cartography and Geo-Mediatechniques at the Research Group of Cartography at the Vienna University of Technology. He holds graduate qualifications in geography and cartography from the University of Vienna and the Vienna University of Technology, including a habilitation.

His main research interests lie in the role of modern cartography and applying LBS and interactivity to this role.

Abstract

Since the winter term 2011/2012 the International Master´s Program Cartography is offered (cartographymaster.eu). It lasts two years and is a cooperation between the Technical University Munich (TUM, Germany), the Technical University Vienna (TUM, Austria), the Technical University Dresden (TUD, Germany), and the University of Twente (UT, The Netherlands) (Cron et al 2014).
The aim of this Master´s Program is to educate specialists who are able to face the challenges of modern cartography and to help in forming the future of cartography. The full time study contains 120 ECTS. The students get 30 ECTS per term/at each university as well as 30 ECTS for the master thesis. The program is strongly structured.

The students remain as group during the whole studies and switch together to the next university after each term. The corporate feeling and collegiality are especially supported within this program. A

survey among the students showed that the students prefer this model. The studies last 4 terms and begin in each winter term at TUM. The students pass the second term at TUW and the third at TUD. They can choose at which of the four cooperating universities they want to complete their master thesis in the fourth term.

The development of a curriculum of an international master program needs to consider several constraints:

- Local Arrangements: many of the potential offered classes might need to be also part of the respective local curriculums
- Local Strengths and Directions: as a master curriculum should be researchoriented the respective research directions of the scientists and lecturers involved influence the content and focus of classes
- Global Scientific Directions and Developments: the curriculum should allow for alumnis which are trained in the recent and ongoing available technologies and methods as well as being able to contribute to their further development, thus fundamentals as well as new trends need to be included and offered
- Didactic and pedagogical concepts: the curriculum should reflect the ideas and concepts of the didactical aims involved, defining the mixture of practical, 2 theoretical classes as well as the pedagogical concepts and educational means involved

As part of the International MSc Cartography program the Research Division Cartography of the Technical University Vienna has developed specific answers to those constraints. The core part of these answers is the development of a so-called triangle of competences. This triangle defines the major cornerstones of competences a modern cartographer should achieve and is derived from the analysis of the domain research activities, the evolution of technologies, methods and applications, the job market and general considerations (Gartner 2014). If a Body of Knowledge (BoK) of a domain exist, this could be an excellent source for underpinning the definition of such a triangle of competences, however, in cartography such a BoK is not available yet (Huang et al 2018). Such a triangle allows then for placing potential classes and their objectives and aims in relation to each other and allow for a holistic view of the context being offered.

As a further specific answer to the constraints listed above the curriculum includes a rather “problem-based” learning style (PrBL). In a project-based learning environment tasks, assignments and action

steps are usually defined by the teacher. In contrast, PrBL is rather student-centered and provides self-paced learning modules for the students. Learners are gradually given more and more responsibility in order to become independent life-long learners. Unlike traditional pedagogy methods, which are teacher-centered and where teachers transfer knowledge directly to students, in PrBL, teachers are there to facilitate learning and educational materials to students.
Furthermore, it is based on real world problems, sometimes research-oriented, that stimulate learning, integrating and organizing learned information to ensure recall and future application (Retscher et al., 2022).

As part of the three-year Erasmus+ Capacity Building in Higher Education (CBHE) project called "LBS2ITS" (Curricula Enrichment for Sri Lankan Universities Delivered Through the Application of Location-based Services to Intelligent Transport Systems) so-called "Trainthe-Teacher Courses" are conducted. Generally speaking, Train-the-Teacher (TTT) workshops are designed to equip university teaching staff with the necessary skills and knowledge to deliver effective training sessions to other individuals or groups (Gabela et al 2022). Principles that should be incorporated into Train-the-Teacher workshops include understanding learning processes, practice effective communication, appropriate interaction strategies, develop clear learning objectives and goals, discuss feedback and evaluation options, and allow for practical experiences if appropriate.

A dedicated one-week TTT-workshop on Location-based Services and Multimedia Cartography was conducted from February 20-24, 2023 at General Sir John Kotelawala Defence University in Ratmalana, Sri Lanka, following several other TTT-workshops on topics related to the overall project context of LBS2ITS. The workshop was visited by 25 lecturers and academia staff of four Sri Lankan partner universities of several domains, including geodesy, urban planning, computer science and management. Two trainers from TU Wien - Vienna University of Technology have been the resource persons. The TTT-course was designed as a mix of theoretical, interactive and practical inputs, as the respective level of education in LBS in Sri Lanka is still in its infancy and cannot rapidly deliver the knowledge inputs required to change transport management decision-making in Intelligent Transport Systems (ITS).

The overall structure of the TTT-workshop introduced the idea of a "why-what-how" structure, thus WHY is educating students on the subject of Location-based Services and Multimedia cartography, relevant and in which context, followed by WHAT content can be taught and is aims for gaining particular skills and competences related to LBS2ITS, and finally HOW education in LBS and multimedia cartography can be pursued (Huang et al 2018), including the idea of how to introduce problem-based learning (PBL) approaches, active learning strategies, quality assessment options and curriculum development (Gartner 2022a).

While the workshop reached its objectives by offering a total of 15 sessions on the "WHY", "WHAT" and "HOW" topics, key interventions have also been on the interaction and discussion about experiences and best practices amongst the participants. The outcome of the workshop allows participants to reflect on key concepts needed to be considered when building or editing curriculas in the context of integrating innovative topics such as LBS2ITS (Gartner 2022b). Possible Syllabi's, course contents and learning environments as well as possible quality control measures have been analyzed and discussed. As a project in the context of "Erasmus+ Capacity Building in Higher Education (CBHE) program" aims for exposing project partners on understanding learning processes, practice effective communication and appropriate interaction strategies, develop clear learning objectives and goals, discuss feedback and evaluation options, and allow for practical experiences if appropriate, all these aspects have been offered and lead to follow-up activities and results, including:

- Sharing best practices of quality management of higher education;
- developing a follow-up research project on higher education in the context of digital transformation of teaching and education;
- developing a joined research project in the context of the SriLanka Transport Board's needs on LBS2ITS;
- establishing teacher and student exchange plans.

Train-the-teacher courses are designed to provide teachers with the knowledge, skills, and tools necessary to effectively teach and engage their students in a particular subject area. The results of these courses can be measured in several ways, including changes in teaching practices, improvements in student learning outcomes, and increased teacher confidence and motivation.

As one scientific approach to measuring the impact of Train-the-teacher courses is through the use of pre- and post-training assessments. These assessments can measure changes in teacher knowledge and skills, as well as changes in their attitudes and beliefs about teaching. For example, a pre-training assessment might include questions about the teacher's understanding of the subject matter, while a post-training assessment might measure their ability to apply that knowledge in the classroom. Such post-training assessment is applied and results will be reported.

Another way to measure the impact of Train-the-teacher courses is through observations of classroom practices. Researchers might use a standardized observation tool to assess changes in the quality of teacher-student interactions, the level of student engagement, and the use of effective teaching strategies. These observations can provide a more nuanced understanding of how the training has impacted teacher practices and student learning.

Finally, researchers might also measure the impact of Train-the-teacher courses on student learning outcomes. This could involve analyzing student performance on standardized tests or other assessments, as well as gathering feedback from students about their learning experiences. By measuring changes in student outcomes, researchers can assess the overall effectiveness of the training in improving teaching practices and enhancing student learning.

Abstracts of Presentations in ICGE

Session 1: Web-based Tools for Surveying Education

The Design of Scalable Web GIS Microservice Framework for Undergraduate Education

Dr Haiyang LYU

Nanjing University of Posts and Telecommunications, China

Abstract

Geographic Information Science (referred to as GIS) is a discipline on the theory and method of geographic data management, spatial analysis methods, visualization and mapping, etc., which is consisted of a bundle of GIS algorithms and tools. With the rapid development of internet technologies, the GIS is extended with wings of the Web and become the "Web GIS", which has dramatically prompted the socialized development of GIS, and makes it accessible from GIS experts to common users. Hence, how to help people using Web GIS to acquire the GIS capability and master the GIS skills to solve geographic problems in social lives, is becoming an urgent issue, especially in the undergraduate education. In the current GIS education system, it usually focuses on building the comprehensive GIS knowledge tree and training the GIS software mastering skills. However, it still remains a challenge for the student to understand and master the logical relations between each GIS course, and there is still a long distance to make them qualified from the GIS learning to GIS practice.

To address the issue, a scalable Web GIS microservice framework is designed for undergraduate education, which is aimed to instruct students in GIS practices of multi-courses, including Web GIS, GIS Software Development, GIS Principle, GIS Algorithm, and Spatial

GeoDatabase. The Scalable Web GIS microservice framework intends to conduct the GIS query and spatial analysis by mashup several different data sources, ranging from the private data source to public data provider (for example, the Open Street Map), and provide the visualization of the geographic dataset in the Web browser. Using the Service Oriented Architecture (referred to as SOA), the GIS algorithm is sealed as isolated GIS microservice, and the GIS dataset is taken as the resource according to the REpresentational State Transfer (referred to as REST) standard. The framework is composed of three modules:

(1) scalable Web GIS microservices using RESTful APIs.

The GIS spatial analysis algorithm is scalable imbedded in each microservices as an independent script. The Web GIS microservices is implemented using Python Django framework, along with API documents illustrating the specific usage. Then the GIS Web service is accessed via the RESTful APIs, and can be scalable assembled with different kinds of service demands. In addition, the Web GIS service can be scalable deployed at different physical machines.

(2) scalable spatial data source provider using PostGIS.

The data source for each Web GIS microservice is provided by the PostGIS, which is further connected to the PostgreSQL database. Hence, each data source provider is equipped with GIS extensions, and some spatial analysis operations can also be scalable implemented via the PostGIS. In addition, the spatial data source can also be deployed at different physical machines, using the feature of distributed spatial databases.

(3) scalable Web mapping and symbolization using JavaScript.

The geographic data acquired from Web GIS microservice is transported to the Web browser, and is further processed and visualized with JavaScript libraries, such as Leaflet, OpenLayers, and D3. With different kinds of JavaScript Libraries, some GIS spatial analysis operations can be conducted at the Web browser, which make is scalable to assemble varied GIS features on demands, for example, Web mapping and symbolization.

Based on the scalable Web GIS microservice framework, different courses are leveraged and the inter logical connections are built during the practice:

(1) Web GIS. As the background and main purpose of the experiment, Web GIS played a role of overall designer, which connect to each course and build the logical relation via the GIS practice. The specific technique, such RESTful API, Web Framework, Model-View-Controller (referred toas MVC), PostGIS, JavaScript libraries, are used to build the

scalable Web GIS microservice framework, with the related knowledge of Web architecture, Internet protocol, Spatial database, data visualization, in the course.

(2) GIS Software Development. As one of the basic skills for the GIS undergraduate, the language programming that using C, C++, Java, Python, etc., has already been required throughout the GIS courses. During the development practice, students are instructed to design the framework architecture, and finish the development document, including the background, demand analysis, user interface (referred to as UI) design, and usage manual. Hence, the GIS software development skills can be comprehensively trained and strengthened.

(3) GIS Principle. It's the fundamental course in the GIS undergraduate education system, and focuses on the basic concept in GIS, and instruct development of GIS capacity for each student, with the principle theory and a plenty of GIS applications. However, there is still a long distance for students to become an expert that using computer programming to solve GIS problems. With the GIS practice of designing the framework, GIS theories and methods of data management, spatial analysis, mapping and symbolization, etc., can be experimented.

(4) GIS Algorithm. It's the specific implementation of the theory in GIS principle, utilizing different kinds of computer programming languages that learned in the pretrained GIS courses. As the salability of Web GIS microservice framework, spatial analysis methods, data management methods, and some other GIS methods, can be applied at the section of spatial data process, RESTful GIS microservice, or Web GIS mapping and symbolization. In other words, the GIS algorithm can be embedded throughout the framework design practice.

(5) Spatial GeoDatabase. As the important technique and theory of GIS data management, it's not only the software to store and mange the GIS spatial database, but also the combination of distributed object technique, geographic data modeling, database technique. During the GIS practice of framework design, students are required to design the geographic data model and use it in the MVC framework, read and write the geographic information via the GeoDatabase, along with the design of spatial data constraints to guarantee data integrity and uniqueness.

To the improve GIS capability of undergraduate students, experiments are conducted and the scalable Web GIS microservice framework is designed in GIS practices. Students are required to design the Web GIS microservices using the Python Django framework and development

RESTful GIS APIs, visit the spatial data source using PostGIS, and visualize the geographic information by Web mapping and symbolization using JavaScript. Specific GIS trainings are conducted in the form of concentrated practice, open experiment, in-course experiment, innovation ability cultivation program, and different kinds of awards are achieved by students. Results show that the goal of GIS capability improvement is achieved for undergraduate education.

Geospatial Approach for Petrol Pumps Valuation with Urban Prediction Modelling by Cellular Automata in Creeds of Metropolitan Expanse

Mr Danish RAZA

Wuhan University, China

Abstract

This research demonstrated the spatial analysis of site suitability using physical parameters in the urban area of land use competition that requires environmental safety, sustainability and environment-sensitive development solutions. The aim of this research to provide a road map for decision maker and urban planner by using GIS based modelling approaches cities sustainability can be achieved and the future growth pattern of urbanization determined with realistic scenario. Due to the rapid growth of urban and rural parts there are many serious concerns has been raised on the urban sustainability (Wu, 1996). There a lot of vegetation land has also been converted in to the urban area. The rapid urban growth also causes of many challenges in form of urban infrastructure and urban utilities. Many questions raised and resembled but due to the lack of interest of urban planning criteria inducements the challenges increased rapidly with the growth of city. Therefore, in this research the some randomly selected petrol station locations identified and valuated with defined criteria. Also, the trend of past, present and future trend of temporal LULC changes especially increasing urbanized trend observed that need serious consideration for cities sustainability especially in the case of developing country where serious consideration much required. This research has been divided in to the three parts which are as following;

In the first part analytical hieratical process-based modelling approach has been used under the certain defined criteria. In the light of developed criteria, the suitability of urban petrol stations has been observed and valuated. To observe the current scenario of petrol stations and

its spatial existence and flaws among the randomly selected locations. Lahore is one of the most populous cities of Punjab because of the education, health and employment services (Waheed et al. 2020) and has immense pressure on the roads due to increased use of automobiles. There are many petrol pumps and service stations are operating in Lahore city including Caltex, Shell, Total Parco and the Pakistan State Oil (PSO). These four companies are spread all over in MC having different petrol pump stations in the remote as well as in the CBD areas of Lahore (Tabinda et al. 2019). The location of filling stations that are developed against the set standards is worrying. This research finds out the level of compliance of petrol pumps to set standards for distances and location in Lahore Metropolitan Corporation. 195 petrol pumps were sampled and Eight criteria were used to perform site suitability analysis under the certain criteria using Analytical Hierarchy Process technique. The results revealed that 88% of petrol pumps in the study area complied most of the standard criteria while 12 % did not meet the criteria due to improper planning of the management.

In the second part of the research the temporal LULC pattern has also been identified with supervised classification techniques for the year 2002, 2012 and 2022. The temporal satellite data of Landsat with zero cloud cover has been selected after the prepressing of the acquired satellite data random forest algorithm (Kavzoglu, T., & Bilucan, 2022) used to classify the satellite data to observed spatiotemporal pattern of land use and land cover of the area of interest. The main purpose of this work was to observed the dynamic temporal LULC trends how much changes has been occurred due to the urban expansion.

In the light of temporal satellite observations results and spatial variables the model accuracy of classified data has been checked in the third part using cellular automata modelling. As, the cellular automata models are more capable for complex modelling of urban areas (Santé et al., 2010). Therefore, the accuracy of model plaid on known dataset by prediction results of 2002 and 2012 data for the year 2022 that been compared with already classified dataset for the year 2022. The accuracy level of CA model has been observed and future prediction of the available data performed under the several spatial variables i.e. distance from roads, river, health facilities, public and religious building as well commercial areas facilities. Then, the trained CA model has been used in this research because of this competences and ability of integrated modeling with the spatiotemporal datasets for prediction of the LULC for the years 2032 and 2042. The simulated results of the CA model (Aburas et., 2016) have also been adopted in this research that will also be beneficent for the urban planners and decision makers to take some

necessary measure to words the sustainability of urban environment as a road map. The study showed that Geographical Information system is essential too that can assist regulatory authorities in siting the best location for a new development project to take appropriate measures under the consideration of rapid growth trends of urbanization that also been intimated in this research.

Session 2: Curricula Development

Urban Informatics - A Foundational Interdiscipline for Future Smart Cities

Prof. John SHI

The Hong Kong Polytechnic University, Hong Kong

Abstract

Urban informatics is a science and technology foundation for smart cities, and it is a transdisciplinary field by urban science, computer science, and geomatics. Urban informatics covers urban sensing, urban data infrastructure, urban computing, urban systems, and urban science. This presentation will firstly introduce urban problems urging the development of urban informatics, and how this field is fusing different disciplines into better urban solutions. The recent technology innovation in smart cities and urban informatics will be introduced. The talk will then provide the prospective for urban informatics, with the emphasis on the key enabling technologies for constructing future smart cities.

Multiple Pedagogical Approaches to Teaching GIS for Environmental Science

Prof. Zhiyong HU

University of West Florida, United States

Abstract

The paper presents multiple pedagogical approaches to teaching GIS for environmental science at University of West Florida. GIS has evolved from standalone desktop systems to mobile and cloud technology-based Web-GIS. Web-GIS maps, apps and spatial analytical tools can be accessed from any mobile devices anywhere and anytime. The technology has fostered "citizen science" – the general public can contribute to science by collecting volunteered information using GPS and internet enabled mobile devices. The technology advancement has had vast impact on education by building or expanding the capacity to engage students in problem-, project-, place-based experiential and inquiry-based learning.

The objective of our GIS curriculum design was to promote students' environmental data literacy and scientific inquiry by using a suite of a mobile and cloud-based Web GIS technology.

After take our GIS classes, students are expected to able to 1) collect and process environmental data; 2) turn environment data into information-knowledge-wisdom-actionable insight; 3) Think globally, spatially, critically, and scientifically, and 4) act locally: communicate effectively environmental information and knowledge to the public to raise public awareness of local environmental issues and help address these issues.

We have developed a GIS curriculum that adopts problem-, project-, place-based experiential and inquiry-based learning pedagogical approaches. Data literacy is achieved by data collection and synthesis activities. Students will collect, search, crowdsource, process, organize and integrate data, and input the data to the Web GIS in real time from anywhere. GIS data collection work is mainly a collaborative, public-participating, citizen-science based

project engaging students, parents, and the community. A student joins an interest group such as water/air/soil quality, seashore ecosystem, endangered or invasive species, biodiversity, freshwater wetland, and human dimensions. Students use using a GPS-enabled mobile device to collect locational and attribute data and synch the data to a cloud GIS.

Scientific literacy is fostered by unlocking scientific information and knowledge from the data through GIS cartographic visualization, analytical functions and spatial modeling to reveal patterns, identify problems, and explore human-nature interactions that may not be apparent in text or tables. The activities of working with data and scientific inquiry let students gain IT and geospatial skills, think spatially, and act wisely and actively on the environment issues.

Remote Sensing Related Practices for Geomatics Education in Undergraduate Curriculum at the IMNU

Prof. Bayaer WULIANGHA

Inner Mongolia Normal University, China

Abstract

Remote Sensing is the acquisition of information about an object or phenomenon without making physical contact with the object and thus in contrast to on site observation. Evelyn Lord Pruitt (1918-2000), a geographer with the U.S. Office of Naval Research, she first coined the term 'remote sensing' in 1960. Acquisition of the first aerial photograph has been generally credited to Gaspard-Félix Tournachon (1829-1910), known also by his pseudonym, Nadar. In 1858, he acquired an aerial photo from tethered balloon in France. If this was starting point of history of remote sensing, which has been in development for 165 years. In modern usage, the term generally refers to the use of aerial sensor technologies to detect and classify objects on Earth, and which also plays quite important role in today's geomatics education. This paper introduced how the remote sensing related practices were allocated in undergraduate curriculum for geomatics education at College of Geographical Science, Inner Mongolia Normal University (IMNU), and as the research purpose and final results, also discussed existing issues, breakthrough path and prospects etc.

Abwi Airborne Binocular Whiskbroom Imager: Camera Principles and the Workflow

Mr Jieke DONG
Wuhan University, China

Abstract

The imaging methods of common airborne cameras are linear array pushbroom and frame camera based on area arrays, and the sensors or lens of them cannot be rotated. With the development of oblique photogrammetry and UAV mapping, there are new advances in airborne whiskbroom sensors. Due to their unique imaging method, they can obtain the side texture information of features more efficiently. ABWI is a new generation of airborne sweeping sensors with the dual-lens area array whiskbroom imaging method. It has a maximum sweeping field of view of 120° and can also acquire spectral information in four bands of RGB and NIR. Additionally, the camera system is equipped with a laser ranger to assist with other measurement purposes. This paper introduces the camera structure and corresponding data processing system of ABWI, and summarizes its advantages and new application scenarios.

Four-In-One Scientific and Innovative Surveying and Mapping Postgraduates Talent Training System of "Ideological And Political - Curriculum - Platform - Team"

Ms Ying XU

Shandong University of Science and Technology, China

Abstract

With the rapid development of a new round of scientific and technological revolution and industrial transformation, the demand for surveying and mapping postgraduates with firm ideals and beliefs, solid professional knowledge, exquisite practical skills and outstanding scientific and technological innovation ability is becoming more and more urgent.

However, there are three problems in the area of surveying and mapping graduate students education: 1) There is a " two skins" problem between professional education and ideological and political education, that is, professional education and ideological and political education are completely separated. The main body of postgraduate ideological and political education is single, the education process is not coherent, the understanding of the important task of the times and the spirit of surveying and mapping is not deep. 2) The curriculum system is not suitable. The teaching of the course attaches importance to knowledge transfer, neglects the cultivation of scientific and technological innovation ability. The curriculum system should meet the needs of high-level space-time information service of natural resources. 3) The ability of scientific and technological innovation needs to be improved.

The scientific and technological achievements are less connected with the latest scientific and technological progress, the ability to serve the country and the region needs to be improved. In response to these problems, following the training idea of 'demand-oriented, innovation-oriented, reform-driven, science and education integration', connects with the orientation of the school, and relies on the national teaching and research platform, provincial and ministerial

education reform projects, provincial youth innovation team and provincial construction courses, the four-in-one scientific and innovative surveying and mapping postgraduates talent training system of "ideological and political -curriculum - platform - team" has been built in this paper: 1) Taking science and technology innovation serving the country as the initial intention, we build a high-standard ideological and political position of "cultivating the spirit of surveying and mapping in the new era with the connotation of great country craftsmen," and build a solid foundation for ideological and political education. 2) Focusing on the cultivation and training of scientific and innovative methods, we build a high-quality curriculum system with four levels of "general knowledge dimension, professional dimension, expansion dimension and promotion dimension", and consolidate the foundation of curriculum education. 3) Relying on the improvement and optimization of the scientific and technological innovation environment, we strengthen the high-level scientific research and teaching platform of " coordinated development of science and education, innovation demonstration leading", and build a solid foundation for platform education. 4) With the goal of improving the cultivation of scientific and technological innovation ability, we create a high-level team cultivation mechanism with the deep integration of "politics, production, learning, research and application", and build a solid foundation for mechanism education.

After 10 years of exploration and practice, the application of this system has achieved fruitful results: 1) The cultivation quality of postgraduates has been significantly improved: their professional knowledge has become more solid, practical ability and scientific research and innovation ability have been improved, and their sense of responsibility and mission have also been continuously enhanced. A large number of outstanding graduates have contributed their talents and made contributions to major projects such as the research and development of the Beidou satellite navigation system and the Chang'e orbit determination. 2) The teaching results are fruitful: for the curriculum, while imparting knowledge, we also pay more attention to the cultivation of scientific and technological innovation ability. The training system has promoted the construction of multiple high-level scientific research platforms, built 4 provincial and ministerial high-quality courses, built 1 provincial youth innovation team, and won more than10provincial and ministerial teaching achievement awards. 3) The team 's academic research and social service capabilities have been significantly improved: the ability of scientific and technological innovation has been greatly improved, and the results of scientific cand technological innovation have been directly connected with national and

regional development and industry needs. In recent years, more than 20 provincial and ministerial scientific research awards have been awarded.

This system has played an exemplary role in the cultivation of graduate students in the surveying and mapping, and provided a referential educational reform approach for the cultivation of scientific and innovative surveying and mapping talents in the surveying and mapping industry in the new era.

Session 3: Promotion of Young Professional

'Remote Sensing Plus' Training Mode of Innovation and Entrepreneurship Talent Nurturing through College Student Competitions

Prof. Xiaoliang MENG

Wuhan University, China

Abstract

Innovation leads the development of technology and society, so the position of innovation and entrepreneurship training to nurture innovative talents is very important. A large quantity of countries has successively implemented innovative education reform for colleges. Remote sensing science and technology, as a new interdisciplinary subject developed on the basis of the integration of surveying and mapping science, space science, electronic science, earth science, computer science and other disciplines, presents a good market expectation in the world. And the expectation promotes the demand for innovative and entrepreneurial talents.

The paper explores the 'trinity' innovation and entrepreneurship talent training model of 'promoting learning through competition, education through competition, and innovation through competition', focus on high level innovation and entrepreneurship competitions, enhance the stickiness among colleges, educators, students, and social enterprises, and enable students to participate in extracurricular academic activities that are highly consistent with the needs of the industrial market.

1. Promote learning through competition: cultivate new forces of innovation and entrepreneurship. It aims to stimulate the creativity of the college students, cultivate their

academic thinking ability and team cooperation ability, temper their willpower, expand their international vision, increase their wisdom and talents in innovation and entrepreneurship, and strive to grow into promising talents with both ability and integrity.

2. Promote education through competition: explore new ways of quality education. Take competition as an important starting point for deepening the reform of innovation and entrepreneurship education, guide students to actively serve the international strategy and regional development, deepen the comprehensive reform of talent training, comprehensively promote quality education, and effectively improve students' innovation spirit, entrepreneurship awareness and innovation and entrepreneurship ability. Promote the profound transformation of talent training paradigm, and form a new concept of talent quality, teaching quality and quality culture.
3. Promote innovation through competition: build a platform for the transformation of innovation and entrepreneurship achievements of teachers and students. Enhance the interaction between market enterprises and university teachers and students, respond to the market demand, promote the close combination of innovation and entrepreneurship with the transformation of competition results and the applications of research, serve the high-quality development of the social economy, and strive to form a new situation of high-quality entrepreneurship and employment for graduates of our college.

To achieve this goal, School of Remote Sensing and Information Engineering of Wuhan University puts forward a ‘remote sensing +’ training model (as Figure 1 shows).

1. Take the innovation and entrepreneurship competitions (such as China International College Students’ ‘Internet+’ Innovation and Entrepreneurship Competition, and etc.) as the starting point, and practice ‘promoting learning through competition’. How to cultivate innovative and entrepreneurial talents in line with the development of the times has become an important topic for universities to study. The traditional single professional talent quality evaluation method is no longer sufficient to meet the needs of the society for talents, especially in the current situation where emerging industries such as the Internet are rapidly driving the development of the social's economy, the new type of compound and innovative talents with both professional knowledge and comprehensive quality are needed. Higher education needs not only to enable students to master the textbook professional knowledge, but also to stimulate students' enthusiasm for innovative learning, so that students can effectively reflect the usefulness of learning. This new concept of talent quality, in addition to the training and evaluation of traditional academic and

theoretical abilities, also needs to strengthen the training and evaluation of students' general knowledge ability, innovation and entrepreneurship creation ability, cultural exchange ability, international exchange ability, hands-on practice ability and other dimensions of quality.

2. Continuously deepen the teaching method of ‘promoting education through competition’ to guide extracurricular student activities in innovation and entrepreneurship, give full play to the supporting role of teacher guidance in student innovation, and grasp the criterion that what students learn is determined by the social demand for talent cultivation. Teachers can form learning knowledge points by refining the industrialization technology key in innovation and entrepreneurship competition proposition. Teachers can allow undergraduate and graduate students to form teams in a mixed way, learn these knowledge points in the face of professional problems in the major disciplines of remote sensing, and in the face of competition projects. In addition to the traditional classroom teaching quality evaluation view based on "teaching", a new extracurricular practice teaching quality view based on "solving doubts" has been formed.
3. The number of teachers and students participating in various competitions and innovation and entrepreneurship activities in colleges are increasing, the forms are becoming more and more diverse, and the degree of internationalization is becoming higher, which poses a challenge to the teaching management of innovation and entrepreneurship for college students. Exploring ‘promoting innovation through competition’ and establishing a support platform for college students' innovation and entrepreneurship (college students' innovation and entrepreneurship center), on the one hand, is conducive to improving the quality and effect of talent training, on the other hand, is conducive to optimizing and integrating school-running resources. The innovation and entrepreneurship support platform for college students will involve the functions of undergraduate teaching management, graduate teaching management, and academic and industrial management departments. It is necessary to integrate and optimize the relevant functions, establish a new management quality view, and explore the construction and management methods of the international innovation and entrepreneurship support platform for college students, so as to better serve the goal of cultivating world-class innovation and entrepreneurship talents in remote sensing science and technology.

Through the two-year practice of this model, 136 students from different schools and majors participated in the training of the ‘Remote Sensing +’ Innovation and Entrepreneurship Center

in Wuhan University, and won three gold and three silver awards in the China International 'Internet plus' students Innovation and Entrepreneurship Competition (China's largest innovation and entrepreneurship competition). Due to the characteristics of cross-integration of remote sensing science and technology itself, it has played a supporting role in innovation education, integrating other multi-specialized knowledge, and providing more entrepreneurial and employment opportunities for students of related majors.

Figure 1. 'Remote Sensing Plus' Training Mode Structure.

Faculty of Geomatics as the Focal Point in Geomatics Education in Sri Lanka

Dr Herath Prasanna

Sabaragamuwa University of Sri Lanka, Sri Lanka

Abstract

The Faculty of Geomatics (FOG) is one of the eight faculties of the Sabaragamuwa University of Sri Lanka (SUSL) and was established in the year 2004. It is the successor to the Department of Surveying Sciences, which introduced the Bachelor of Science in Surveying Sciences degree Programme in 1997. This was the first time in the history of the university system in Sri Lanka, that a degree programme in this scientific discipline was introduced by a university, fulfilling a much felt need of the country. The Degree Programme is a four-year course leading to an honours degree in Surveying Sciences, subsequently becoming the first such degree awarded in Sri Lanka. Presently, the Faculty consists of two departments; (i) Department of Surveying and Geodesy (DSUGEO), and (ii) Department of Remote Sensing and GIS (DRSGIS). The two departments jointly conduct the first five semesters of the degree programme as a Foundation Course (FC), and during the last three semesters, offer five areas of specialization as (i) Surveying and Geodesy, (ii) Hydrographic Surveying, (iii) Land Management, (iv) Remote Sensing, and (v) Geographic Information System.

A Teaching-Learning and Storytelling Platform: Students' Perspectives on Applying Story Map in Education in Geo-Informatics Subjects

Ms Fangyi CAI

The Hong Kong Polytechnic University, Hong Kong

Abstract

Storytelling has been demonstrated as an effective way to improve teaching outcomes in science and social science education (Burnett et al., 2006; Butler et al., 2013). These works point to the possibilities of combining maps into geography education with respect to the visual nature of maps as the appropriate media for narrating spatial stories and as analytical tools to study the spatial elements of stories (Mukherjee, 2019). The geography education has witnessed a series of rapid changes over the years with the introduction of digital technologies (e.g., web-based mapping) into geospatial learning. Such trend makes it possible to combine the digital technologies with maps so as to bring a new dimension to conventional mapping practices, which currently allow not only exhibitions of locations but also geospatial narratives problem-solving.

Story Map, as one of the most versatile web-mapping platforms, has been employed into experimental education across disciplines (e.g., Berendsen et al., 2018; Strachan & Mitchell, 2014). These works have acknowledged the benefits of Story Map as an interactive platform encouraging students' engagement in their learning process. Its capacity to interactively organize and present multimedia information (e.g., texts, photographs, videos) and its intuitive design (Cope et al., 2018) serve as a conduit for students to experience 'learning by

doing' outside the textbooks (Mukherjee, 2019), and transfer abstractive geospatial theories into practical and understandable stories and maps.

Students' responses to Story Map in existing studies is related to Story Map as a platform aiding students to learn geospatial knowledge (Egiebor & Foster, 2019; Groshans et al., 2019). Yet, little emphasis has been paid to the perspectives of students on how Story Map works when they use the geospatial knowledge, they acquire to create their own geospatial stories. In addition, a thorough investigation of how students from various academic backgrounds respond to Story Map is also required so as to verify whether it is feasible for 'non-specialists' to create their story maps (Mukherjee, 2019), despite the fact that studies on using Story Map in varied disciplines (Groshans et al., 2019; Hoesen et al., 2019) have shown its potential in assisting students in a variety of academic contexts.

With all this taken into account, the following study hypotheses were established:

- H1 – Students' academic backgrounds do not significantly affect how they respond to Story Map as an education platform.

- H2 – Students from various academic contexts exhibit similar attitudes on the use of Story Map as a platform for both teaching-learning and storytelling platform. For storytelling.

Session 4: Multi-level Education

Cesium-MRS: A Cesium-based Platform for Visualizing Multi-source Remote Sensing Data Remote Sensing Data

Mr Chuanbin LIU

ShanDong University of Science and Technology, China

Abstract

A Cesium-based Platform for Visualizing Multi-source Remote Sensing Data Remote sensing data is a major method for obtaining information on the Earth's surface, which is widely applied in various fields such as geographic information, natural resource management, urban planning, environmental monitoring and disaster prevention and mitigation. In the past few decades, remote sensing technology has developed rapidly, and the emergence of devices such as satellites and drones has made it easier and more efficient to acquire remote sensing data. However, due to the large volume and high complexity of remote sensing image data obtained by satellites, drones and other devices, how to efficiently process these data and visualize the results has become an important issue.

To address this issue, this paper proposes a Cesium-based platform for visualizing multi-source remote sensing data that aims to make remote sensing services more commercialized and popularized. This platform visualizes remote sensing data in three dimensions, enabling users to intuitively understand the spatial distribution and dynamic changes of remote sensing data. Cesium is an open-source JavaScript library released by AGI company for displaying 3D Earth and maps. It is a 3D Earth visualization engine based on WebGL technology. In the three-layer framework of data, service and application, it belongs to the client-side application layer of 3D development framework. Developers can use this framework to create high-performance and realistic Earth and space scenes in WebGL-supported PC-side and mobile-side browsers. Its core technology is a high-performance 3D rendering engine that can achieve

smooth browsing of various large-, medium- and small-scale 3D scenes. At the same time, it supports multiple data sources including but not limited to satellite imagery, terrain data, urban-level 3D models, vector data, etc.

The platform built based on Cesium can not only integrate these different types of remote sensing data into a unified 3D scene, but also enable users to interact with the data according to their needs, such as performing data management, big data visualization, spatial analysis and other interactive functions, or tracking a specific POI in real time, as well as simulating weather conditions in the scene and supporting virtual reality and so on. In terms of visualization, developers can add various animations, particle effects and other features to further enhance the intuitiveness and attractiveness of 3D presentation of data, allowing users to understand various kinds of remote sensing information conveyed by the platform in a "watching" state.

In addition to data visualization, the platform's spatial analysis and data processing functions are also highlights, such as urban traffic management, regional statistics, route analysis, coverage area and illegal construction monitoring and other GIS functions implementation, or fire point monitoring, hydrological monitoring, post-disaster analysis and other RS applications that enable users to better understand and judge specific situations occurring in real scenarios while making more accurate decisions and planning that provide more precise services for real scenarios.

The Cesium-based platform for visualizing remote sensing data can overcome the disadvantage of traditional two-dimensional visualization methods that cannot fully display spatial information and characteristics of remote sensing data, and provide new ideas and approaches for commercialization and popularization of remote sensing applications. Real-time streaming transmission also opens up new doors for information circulation under traditional management methods. By continuously adding user-level requirements to improve the functionality of the platform, the value of remote sensing itself can be effectively enhanced and expanded,to achieve a leapfrogging effect of 1+1>2.

PyRS - Python Package for Remotely Sensed Data Processing

Mr Xichen MENG

ShanDong University of Science and Technology, China

Abstract

PyRS (Python package for Remotely Sensed data processing) is a Python package designed handling remote sensing data to assisst teaching and research. PyRS encapsulates the current mainstream remote sensing algorithms, greatly enhancing the scientific research efficiency of researchers in the remote sensing field, and providing user-friendly interfaces to handle various remote sensing tasks, including data reading, radiometric correction, image enhancement, image denoising, image segmentation, land cover classification, change detection, construction of remote sensing indices, quantitative inversion, and accuracy verification.

PyRS is an open-source project continuously updated and maintained by the author of this article to meet teaching and research needs. It is designed to be modular and extensible, allowing users to add new algorithms and functionalities to the package. PyRS is widely used in the remote sensing field and has been applied to various applications, such as land cover mapping, crop monitoring, and disaster response. PyRS is based on GDAL for raster image reading, a matrix class provided by Python's NumPy library as the basic data structure and integrated with C++ for collaborative development. PyRS can read various types of data, including GeoTIFF, NetCDF, HDF, and ENVI, and create the core Image class of PyRS, which implements functions such as constructing multidimensional arrays, image resampling, statistical calculation of maximum and minimum values of specified bands, data type conversion, color synthesis, and image saving.

Radiometric correction includes radiometric calibration, atmospheric correction, and correction for solar zenith angle and terrain, where the atmospheric correction models include a physical model based on 6S and a statistical model, which can be freely selected by the user according to their needs. Image enhancement mainly includes three parts: spatial domain,

transform domain, and data fusion. The spatial domain corresponds to enhancement methods such as gray transformation, histogram equalization and matching, first- and second-order differential operators, and morphological gradient operation. The transform domain includes methods such as Fourier transform, high-pass filtering, principal component analysis, and homomorphic filtering. Data fusion mainly focuses on datalevel fusion, including color space transformation and PCA-based data fusion, to obtain images with stronger visual effects and richer information.

Image segmentation includes thresholding and region-based segmentation algorithms, which extract regions of interest from the background. Land cover classification is mainly divided into supervised and unsupervised classification, where supervised classification includes methods such as minimum distance, maximum likelihood, support vector machine, and random forest, and unsupervised classification includes methods such as K-Means and ISODATA, and the accuracy validation module can be used by users to validate classification results. Change detection includes pre-classification detection and post-classification detection, and users can choose the appropriate method for the current data.

The remote sensing index module integrates multiple mature remote sensing indices, including NDVI, RVI, DVI, SAVI, GVI, PVI, LAI, TVDI, NDBI, and NDWI, which are suitable for different remote sensing application scenarios. The quantitative inversion module includes the inversion of physical parameters such as surface temperature, soil moisture content, and vegetation net primary productivity, using the current mainstream inversion algorithms.

The biggest feature of PyRS is that all the functionalities are presented in the form of API calls, and the corresponding code is open source, allowing users to view the algorithm implementation process and freely modify the code according to their own needs, avoiding the "black box" operation of current commercial remote sensing image processing software and providing a transparent and repeatable workflow. The functionalities implemented by PyRS are the most basic and commonly used functionalities in the remote sensing field, which can greatly improve the efficiency of teaching, research, and development personnel in the remote sensing field and provide a foundation for them to achieve unique and innovative functionalities.

Study and Application of Flood Control Risk Trend Analysis Model

Ms Min ZHANG

Yangtze University, China

Abstract

In order to analyze the comprehensive risks of natural disasters quantitatively and improve the accuracy of natural disaster management and control, this paper expands the F indicator, Forecast, which is about real-time monitoring and early warning data of natural disasters, and forms the flood control risk trend analysis model framework based on PSR. The framework is named FPSR, i.e. Forecast-Pressure-State-Response, composed of static data and dynamic data. The dynamic data is F, and the static data contains Pressure indicator, i.e. P, State indicator, i.e. S, and Response indicator, i.e. R. In FPSR, P is composed of information such as disaster-causing factors, historical natural disasters and major hidden dangers, and S is about disaster-bearing bodies, and R is about disaster reduction resources (capacities). By establishing the four-level index system of flood control risk trend analysis in Fangshan District of Beijing, screening factors, and using analytic hierarchy process, AHP, and experts scoring to determine the weights of each factor, it constructs the flood control risk trend analysis model, FCRTAM. At last, using the real-time monitoring and early warning data of natural disasters in Beijing and the information such as disaster-causing factors, historical natural disasters, major hidden dangers, disaster-bearing bodies, disaster reduction resources (capacities), etc., from National Natural Disaster Comprehensive Risk Census in Fangshan, it analyzes the flood control situation of each town in Fangshan. The results show that the results flood control risk index calculated according to FCRTAM is basically consistent with the actual flood control situation of the towns in Fangshan, and can provide theoretical basis for flood control comprehensive risk trend analysis and the decision-making of disaster prevention and reduction in Fangshan District, which has high use value.

Session 5/6: Promotion of Materials on Geomatics & Emerging Techniques in Surveying

Design and Implementation of the Integrated Practicum of Geomatics According to Engineering Education Accreditation

Prof. Ling ZHU

Beijing University of Civil Engineering and Architecture, China

Abstract

Engineering education accreditation is a new engineering education model promoted by the Ministry of Education in China, which aims to cultivate the ability of students to solve complex engineering problems. A course named “integrated practicum of Geomatics” (IPG) was designed for the undergraduate specialty of Geomatics. This course involves in the current advanced technologies to lay a solid foundation for students to engage in Geomatics through aerial photography technology design, unmanned aerial vehicle photography, control point selection, GNSS-RTK control point survey, photo interpretation and sketch, 3D (DEM, DOM, and DLG) product production, inputting 3D products into the Geodatabase, and GIS application software development. This paper expounds on the objectives, contents, evaluation methods, and continuous improvement of IPG.

Designing Blinded Experiments for Bias Mitigation in Geophysical Surveying Subject

Dr Wallace LAI
The Hong Kong Polytechnic University, Hong Kong

Abstract

Cognitive biases and team decision-making are two major, yet often overlooked, factors of geophysical imaging. These factors are measured and evaluated through a 12-hour ground penetrating radar (GPR) blind test of void hunting in utility lab and a 1-hour electromagnetic locating (EML) of watermains in Q-Leak Training Centre. During the blinded experiments, teams are required to experience an 'identify, decide, eliminate, and agree' (IDEA) process. In IDEA, the teams are required to 'identify' the varieties of geophysical information through data collection, processing and imaging. Then the teams 'decide' and 'eliminate' false information and interfered signals until the target signals of voids and watermains is 'agreed' among team members. The 'I' and 'D' in IDEA are subject to technical competence and subject knowledge, while 'E' and 'A' are subject to a range of individual and team's cognitive biases. For 'I' and 'D', outcomes were evaluated based on a accuracy- and precision-based marking scheme devised in LSGI. For 'E' and 'A', individual and team's cognitive biases were regularly observed by a team of PolyU's researchers. Over confidence, anchoring and adjustment, information bias and confirmation bias contributed to most of the biases in IDEA process. Some examples are 'I really want to believe even evidence is somehow ambiguous', 'No-void answer is not possible', 'I just want to follow the leader and do whatever he/she would like me to do'. After the blinded experiments, de-briefing sessions were organized for students to understand, recognize and mitigate their biases in their future works. For students, the blinded experiments are important for students to reckon that biases are unavoidable but better understanding of their own biases will be helpful in problem-solving tasks in real world. For lecturers, design of the blinded experiments and marking schemes are also applicable in

other geophysical and geomatics problems, where targets of different kinds are required to be located within certain tolerances.

Measure Up: A Serious Game for Topographic Education

Mr Jelle VERMANDERE

KU Leuven, Belgium

Abstract

The process of learning topographic practices involves familiarizing themselves with a wide range of equipment and techniques. While most techniques can be taught in the classroom, the more practical exercises require field experience. Providing these students with proper equipment is an expensive endeavor, both because of the high cost and risks of damage.

Serious gaming, or the use of games with a specific educational or training purpose, has been gaining popularity as a method for engaging and educating students in recent years. The use of serious games in education has been shown to have numerous advantages over traditional teaching methods, including increased motivation and engagement, improved learning outcomes, and the ability to simulate real-world scenarios (Robson et al., 2015).

While existing serious games like (Bontchev et al., 2022) and (Hart et al., 2020) provide a great learning platform and great value to their specific fields, they, like many others, are designed as static experiences. They lack a clear and simple way to expand or adapt the software after release, something which is crucial in an ever changing field like education. (Dankov et al., 2021) proposes a framework that allows educators to easily expand the game past release. By storing large portions of the game's data in online databases, the game can dynamically generate new content. While this method works great for simple games where the core gameplay remains the same throughout the experience, this method will prove to be insufficient for more complex expansions needed to accommodate the wide variety of surveying problems.

Our goal is to develop a serious game to help the students better understand the principles of surveying and other geomatic concepts to better prepare them for the on-site labs. Furthermore, the game should be constructed with easy and extensive expandability and accessibility in mind.

Building3D: A Urban-Scale Dataset and Benchmarks for Learning Roof Structures from Point Clouds

Prof. Ruisheng WANG

University of Calgary, Canada

Abstract

Urban modeling from LiDAR point clouds is an important topic in computer vision, computer graphics, photogrammetry and remote sensing. 3D city models have found a wide range of applications in navigation, urban planning and mapping etc. However, existing datasets for 3D modeling mainly focus on common objects such as furniture or cars. Lack of building datasets has become a major obstacle for applying deep learning technology to specific domains such as urban modeling. In this talk, we present a urban-scale dataset consisting of more than 160 thousands buildings along with corresponding point clouds, mesh and wire-frame models, covering 16 cities in Estonia about 998 Km2. We also provide two new baselines for the benchmark test: a supervised and a self-supervised learning method. To our knowledge, the self-supervised learning pipeline based on a novel linear self-attention mechanism is the first attempt in this regard. Furthermore, we perform several baseline experiments including handcrafted and deep feature-based methods. Experimental results indicate that Building3D has challenges of high intra-class variance, data imbalance and large-scale noises. The Building3D is the first and largest urban-scale building modeling benchmark, allowing a comparison of supervised and self-supervised learning methods. We believe that our Building3D will facilitate future research on urban modeling, aerial path planning, mesh simplification, and imbalanced learning etc. The benchmark will be publicly available soon.

Nurturing Talents of Geomatics Surveyors to Meet the Challenges of Land Supply, Works Projects and Smart City of Hong Kong

Mr Ben Siu-bun CHAN

The Hong Kong Polytechnic University, Hong Kong

Abstract

The challenge of a growing number of large-scale land development projects (e.g., Northern Metropolis, Lantau Tomorrow and related infrastructures) must be met by innovative land acquisition planning and processes. A recent quick win solution to land supply for works projects has been in trial commissioning of the preliminary draft land resumption plan preparations and related survey works from the government to consultants, specifically the Authorized Land Surveyor (ALS) in the private sector. The industry therefore must consider the necessary and diverse sources of expertise available, and the existing land survey technical resources that will render support to such new initiatives. Collaboration is called for between the spheres of public sector, education, and works industry to successfully move forwards to the smart city development of Hong Kong. In this paper, the previous learning from the past mega land resumption project, "The Hong Kong section of the Guangzhou-Shenzhen-Hong Kong Express Rail Link" will be referred to for rapid land supply for works projects. Insights are shared from members of the government, education, and industry sectors to give an interactive perspective on reviewing the current working processes of land development.

Local statistics and knowledge will be used to examine the new approach of professional survey input from the private practice ALS, and why is the number of ALS and engineering surveyors in the constructions industry growing so slowly. However, there will also be international comparison between Hong Kong's practice and Singapore Land Authority and Ordnance Survey to grasp any global learning points. The ways ALS talent and technical

expertise can be further developed will be explored. The possibility of a shared platform holding cadastral survey and land boundary records will be considered with necessary funding support from different sectors, thus leading to better knowledge management. The evolution of the traditional land survey profession into the geomatics services has become an international trend that is growing in popularity in the survey profession. Combining the geo-spatial data from the planning and design stage, with the standardised surveyed geo-spatial data processing used in project implementation and asset management would encourage data sharing and avoid duplicate efforts. Widening access to common spatial data infrastructure research and extending the data sharing platform to industry and public would furthermore facilitate multi-disciplinary development in areas outside of the traditional boundaries of land survey and help the economic activities of a modern city. Both nurturing the talents of geomatics surveyors and utilising the capability of geo-spatial data technology are essential for the development of smart works and smart city. Future work on building collaboration and identifying a project site for pilot implementation of the new practice, introducing a paradigm shift in land development and works projects would be proposed.

Development of AI-Hardware Related Curriculum for Universities in Brandenburg and Bavaria: Visions and Experiences from BB-KI Chips

Ms Zhouyi XIONG

Technical University of Munich, Germany

Abstract

In recent years, artificial intelligence (AI) has become an increasingly important topic not only in computer science, but also in many natural sciences. It is an important research field of digitization and has the potential to sustain growth and prosperity in a disruptive way. The role of special hardware for AI is still underdeveloped: while corporations such as Xilinx, NVIDIA, ARM and Intel are integrating more and more AI elements into their platforms, AI hardware aspects are hardly covered in university teaching. Dedicated AI-capable hardware is of particular relevance in Germany, since, in contrast to the cloud processing, it does not depend on the collection of data in the cloud. It provides an alternative solution which is less problematic from a data protection point of view. Edge applications is also a key driver for special hardware development due to their power and performance limitations. Respective hardware platform forms the basis for further AI developments in order to allow effective (high performance) and efficient (low energy consumption) processing. AI is often based on deep learning and requires enormous hardware support if it wants to keep up with rapid international development. This can only be achieved with an innovative hardware architecture specially designed and optimized for AI tasks. However, current university education often neglects the design, development and evaluation of new AI architectures and rather emphasizes theoretical foundations and optimal algorithmic implementations.

In order to connect emerging values such as the right to privacy, informational self-determination and data federalism with data-driven innovations (Industry 4.0, 6G, smart cities,

autonomous driving, IoT, monitoring using remote sensing and geodata), the "Edge computing" has become an ever-important research and teaching area. However, the focus of current programs and AI training in Germany is rather on software development and the application of technologies. On the other hand, training in the field of AI hardware development and its diverse areas of application is only rudimentary.

Technical University of Munich (TUM) and University of Potsdam (UP) offer a wide range of courses that focus on AI basics, AI algorithmic development, general computer architectures and chip design. Both universities also focus strongly on natural sciences in teaching, in which many applied areas (e.g. computer vision, geodata and natural hazards) benefit from AI technology. However, hardware aspects currently play an increasing role in teaching, which mostly deals with the development and application of algorithms. Therefore, in the context of BB-KI Chips, we aim to jointly develop an AI-hardware related curriculum in the state of Brandenburg and Bavaria. The vision of BB-KI Chips is to develop a series of hardware-oriented courses with real-world AI applications. In a longer term, we aim to facilitate the connection between AI specification and the implementation of the hardware that meets the complex requirements for performance, safety and reliability in the university teaching of both TUM and UP.

Current university teaching only minimally touches this AI hardware topic due to separate sub-disciplines. This is why the BB-KI Chip is unique. We will address a multidisciplinary target group (e.g., made up of hardware, AI and applications) in an integrative (through open courses, practice-oriented teaching and teamwork) and realistic (i.e., chip production in Germany, also as part of courses by students) with an attractive range of courses. Specifically, we are planning a hybrid, cross-university educational offer that bundles theoretical foundations, design and exemplary application. The BB-KI Chips consortium (with the affiliated Leibniz Institute IHP in Frankfurt/O.) has the unique opportunity for chip production in Germany, which allows students to implement AI hardware in practice during their studies.

At the end of the winter semester 2022, the Big Geospatial Data Management (BGD) group from TUM has already held a seminar course that allows students to directly work with remote sensing data from unmanned aerial vehicle (UAV). Master students come from different backgrounds including: cartography, satellite engineering, geodesy etc. Now they all have hands-on experience on simple convolutional neural networks (CNN) model training from

scratch. Specifically, interpretation with real-world data collected from post disaster UAV campaign. Images are taken after a landslide caused rock/ice avalanche on the river, a lot of deadwood debris can be seen piling up and blocking the stream. Based on this background, interactive lectures about the importance of AI in geohazard application are given by the Natural Hazards group of UP. This provided motivation for the debris detection topic. Then students worked with Jupyter notebook workflow for training data preparation and model inference in real-world UAV data for debris detection.

In the coming summer semester, a course combining CNN and hardware design would be given by Chair of Computer Architecture and Parallel Systems(CAPS) .This would allow students to understand the advantages and disadvantages of implementing specific workloads in Programmable Logic compared to software, learn about Programmable Logic (PL) and Processing System (PS) and codesign of software and hardware. In the future, the student can take the trained model of debris detection from the seminar course into this hardware design course to work out a dedicated hardware solution for potential on-board model inferencing. In the later stage, more courses like AI in Ethics (started in winter semester 2022 UP) and Field Programmable Gate Arrays (FPGAs) design will be regularly offered by TUM and UP together.

Session 7/8: Multi-level Surveying Education & Cost-effective Surveying Education

Monitoring Work Progress of Dam Construction based on Photogrammetric Point Clouds and BIM Building Elements

Prof. Pratama Arliandy

Jakarta State Polytechnic, Indonesia

Abstract

Industry 4.0 encompasses a range of ideas, technologies, and procedures that impact engineering education and other fields. Building information modeling (BIM) has become a widely adopted practice in Indonesia's construction industry, prompting polytechnic universities to incorporate BIM skills and concepts into their construction engineering and management degree programs. Nowdays, more than 50 dam construction works occurred in Indonesia from 2014-2024. Monitoring progress regularly is crucial to ensure a construction project's successful completion. This can be done by visually tracking the project's advancement, which enables the identification of any changes or deviations that occur. Accurate measurement data is essential for reliable progress management, as it allows for the prediction of future project success or failure. Image-based object detection is highly beneficial for retrieving site information and monitoring construction progress. To monitor the progress of a construction project, the as-planned state of the building at a specific time must be compared to the as-built state. The as-planned state is obtained from a building information model (BIM) that contains information about the geometry of the building and the construction schedule. In this study, we introduce a novel technique for generating an as-built point cloud using photogrammetry in the dam construction project. Due to the fact that

images cannot be captured from every angle on a construction site, we utilize a combination of structure from motion and control points to create a scaled point cloud in a consistent coordinate system. This point cloud is then used to compare the as-built and as-planned states of the building. Dense point clouds are generated by fusing disparity maps created with Structure from Motion (SfM) and are subsequently matched against the target state for updating 4D Building Information Model (BIM). This enables the identification of non-existing building parts. A second test based on the points in front of and behind the as-planned model planes is performed to verify the existence of building parts. The study presents experimental results from a real case study and discusses future perspectives.

Environment Monitoring along China-Europe Railway Express with Remote Sensing and Artificial Intelligent Technology: A Regional Collaboration Project between China and Serbia

Dr Xian GUO

Beijing University of Civil Engineering and Architecture, China

Abstract

The operation of the China-Europe railways has facilitated economic development and improved regional connectivity along the route, while impacting on the ecological environment. Effective monitoring the ecological environment status along the railway is necessary to promote the sustainable development of the Belt and Road Initiative (BRI). Existing ecological remote sensing monitoring methods depend on local priori knowledge and model selections, resulting in insufficient specificity when applying to the China-Europe railways, which have large spatial extent and complex surface variability across nations. Finance by the 2020 China-CEEC Joint Education Project of Institutions of Higher Education, we combine the preponderant research fields of BUCEA and UNS, and established an artificial-intelligence based environmental monitoring process with remote sensing techniques. More specifically, an online annotating platform and deep learning based classification procedure is established, followed by environmental analysis conducted with comprehensive indicators and difference-in-difference method. Our results provide 10 years of monitoring data on the environmental status of the China-Europe Railway Express, based on which, the impacts of the economic corridors on the local ecological environment before & after the establishment were evaluated specifically. This collaborative project supports the BRI initiative and highlights the potential for international collaboration in large-scale environmental monitoring.

Using Indoor Positioning Technology to Evaluate Students' Academic Performance with Their Classroom Performance

Dr Keru LU

The Hong Kong Polytechnic University, Hong Kong

Abstract

This study aims to explore the application of indoor positioning technology in evaluating students' academic performance with their classroom behaviour. 373 students from 4 STEM subjects of The Hong Kong Polytechnic University were participants in this study. During the class, students using their smartphones that could record their location. The indoor positioning technology is based on the fingerprint method of iBeacon technology with an accuracy of 2m. Students' location and attendance with their academic performance were compared. The results showed a significant correlation between the student's location and their academic performance. These research findings provide useful information and insights for education administrators and teachers to better understand students' learning behaviours and classroom performance. The paper also discusses the potential applications and benefits of indoor positioning technology for enhancing students' academic performance.

Interdisciplinary Approach to Curricula Development in Geomatics Education: Erasmus+ LBS2ITS Project

Dr Guenther RETSCHER

Vienna University of Technology (TUW), Austria

Abstract

Curricula Enrichment delivered through the Application of Location-based Services to Intelligent Transport Systems (LBS2ITS) is an Erasmus+ Capacity Building in higher education project delivered for four Sri Lankan universities. The key action of the project is cooperation for the purpose of innovation and the exchange of good practices in higher education of geomatics, transport engineering, urban planning and computer science. The project activities started in 2021 and will continue until the end of 2024.

At the time of writing the proposal in 2019/2020, Sri Lanka stood in the middle-income category. The country was focusing on long-term strategic and structural development challenges for the transition to an upper-middle income country. This has changed firstly due to Covid-19 and secondly due to the worst economic and political crisis in 70 years that started in Apr 2022. During the last decade, the immediate priority of national physical development has raised pressing mobility issues in the western region of Sri Lanka (27% of the SL population and >50% of GDP). This issue is now more important when Sri Lanka faced fuel shortages that immobilised the country (in addition to food/medicine shortages).

To ensure a sustainable transport system and mobility, good Intelligent Transport System (ITS) and Location Based Services (LBS) are necessary. More than ever, good engineers with up-to-date knowledge and experience working on good technology are crucial in Sri Lanka's recovery and development to previous goals. This is in line with the "National Physical Development Policy and the Plan 2050" of Sri Lanka which is to "update the workforce of the country by disseminating knowledge to maintain the ongoing developments to the state-of-the-art smart transportation standards as practised by developed and well-organised cities".

LBS2ITS project focuses on regional cooperation for capacity building in Sri Lanka as well as international cooperation. The project partners are (1) the Department of Geodesy and Geoinformation, Vienna University of Technology (TUW), (2) the Faculty of Transport and Traffic, Dresden University of Technology (TUD), (3) the School of Rural and Surveying Engineering, National Technical University of Athens (NTUA), (4) the Faculty Of Geomatics, Sabaragamuwa University of Sri Lanka (SUSL), (5) Departments of Town & Country Planning and Civil Engineering, University of Moratuwa (UoM), (6) the Faculty of Technology, University of Sri Jayawardhanapura (USJ), and (7) Faculty of Computing, General Sir John Kotelawala Defence University (KDU).

Our approach to curricula development is executed in two phases: training and development. The training phase does not only focus on the materials and teaching but also introduces the teachers to a new pedagogic method, e-learning and quality assurance in teaching. The development phase focuses on the material development and holding the pilot courses before the end of the project's lifetime.

In this paper, we will detail both phases of curriculum development and the educational and theoretical reasoning for introducing certain methods. We will also introduce Problem Based (e-)Learning (PBeL), a pedagogic method we first published in Retscher et al. (2022). Lastly, we will provide an explanation of our comprehensive and integrated approach to the curricula development that, in addition to cooperation between diverse project partners, includes consultations with various Sri Lankan government, education and private stakeholders.

Reflections on the State of Geomatics Engineering Curricula in Spanish Higher Education

Prof. Angel COLLADO

University of Castilla-La Mancha (UCLM), Spain

Abstract

The adaptation to the European system of university studies of Technical Engineering in Surveying, arising from the Bologna Plan in 2010, shaped the current Degree in Geomatics Engineering which, under the Order CIN/353/2009, is qualifying for the exercise of the regulated profession in Spain. After a decade, it is pertinent to carry out an analysis of the current situation of university education in our country (Polo et al., 2021; Collado, 2022).

The aim of this article is to make an in-depth study of the current situation of the Degree in Geomatics Engineering in our country, showing the most relevant data and considering the universities that offer the degree. Likewise, it will indicate those degrees that, without having a department of the Cartographic, Geodetic and Photogrammetric Engineering Area, develop their activity, to a greater or lesser extent, in the geomatics field. A study of the different curricula is essential to understand the evolution of the concept of geomatics, its sub-disciplines and how it is taught.

A Comparative Study on Multi-source Remote Sensing Image Registration Algorithms

Ms Yiyao WANG

Shandong University of Science and Technology, China

Abstract

Remote sensing image registration is a basic task in remote sensing image processing, which refers to the process of mapping one image to another image or multiple images of the same scene obtained under different conditions such as different time phases, angles, illumination, etc., and establishing spatial correspondence between them. Remote sensing image registration is the core foundation of remote sensing image stitching, fusion, change detection and target localization and other visual processing and understanding tasks, and plays an important role in natural disaster emergency response, damage assessment and other fields. With the development of remote sensing technology, obtaining information from remote sensing images has become a very important means of information acquisition. Different satellite sensors can provide multi-spectral, multi-temporal and multi-resolution multisource remote sensing images for the same area, such as optical, infrared, Synthetic Aperture Radar, Light Detection and Ranging and raster maps. The accurate registration of multi-source remote sensing images is a basic pre-processing step for many remote sensing applications such as image fusion, change detection and image mosaic. Its registration accuracy has an important impact on subsequent analysis applications. Most multi-source remote sensing image registration methods can be divided into two categories: feature-based registration methods and area-based registration methods. Feature-based registration methods first extract salient features from the considered images and then match them according to their similarity to achieve registration. Area-based methods usually use predefined size template windows to detect homologous points between two images. Although automatic image registration technology has made significant progress in the past few decades, accurate registration of multi-source remote sensing images is still very challenging due to significant geometric

distortion and nonlinear radiometric differences between these images. Therefore, research on this topic has certain practical significance.

This paper compares several multi-source remote sensing image registration methods: structure similarity based multi-source remote sensing image registration method (SSM), fast accurate structure similarity based multi-source remote sensing image registration method (FASM) and anisotropic weighted moment with absolute phase congruency gradient histogram based multi-source remote sensing image registration method (AWM-APCGH). The SSM method is based on matching homologous points between images using structural features. This method uses a phase congruency model with illumination and contrast invariance to construct a new feature descriptor called histogram of phase congruency (HOPC). This method can realize automatic registration of various types of multisource remote sensing images such as visible light, infrared, SAR, LiDAR and raster maps, but this method has low computational efficiency and cannot meet the needs of real-time processing well. Therefore, an improved algorithm called FASM is proposed. This algorithm proposes a pixel-level feature representation method using oriented gradient channels (CFOG), which mainly characterizes the structural features of images by each pixel and accelerates matching by Fourier transform, improving the accuracy and efficiency of image matching. It mainly solves the nonlinear intensity difference problem of multisource remote sensing image registration and greatly improves the computational efficiency. The third method is AWM-APCGH, which first uses anisotropic filtering for nonlinear diffusion of images, then calculates the maximum moment and minimum moment of phase congruency on this basis and constructs anisotropic weighted moment equation to obtain anisotropic weighted moment map. After that, the phase congruency model is extended to establish absolute phase congruency orientation gradient and combined with logpolar coordinate description template to establish an absolute phase orientation gradient histogram (HAPCG). Finally, Euclidean distance is used as matching measure for homologous point recognition. This method can achieve high matching accuracy and realize accurate registration of multisource remote sensing images.

By comparing experiments on several methods above, the results show that HOPC method takes 16.355 seconds with root mean square error 0.3599, CFOG method takes 2.878 seconds with root mean square error 0.3599，HAPCG takes 133.244 seconds with root mean square error 1.8597，It can be found that the HOPC method has good registration accuracy, but it takes much longer, the matching performance and computational efficiency of CFOG method

are significantly higher than those of the other two methods, and the same name points that meet the error requirements can be identified faster, HAPCG can match the largest number of points with the same name compared with the other two methods, but its registration accuracy is slightly insufficient compared with the other two methods, and it needs to be improved, and the experimental results obtained also verify the effectiveness of the three methods in multi-source remote sensing image registration.

Virtual Reality Traverse:

A Novel Way to Teach Traverse Surveying

Dr Lawrence LAU

The Hong Kong Polytechnic University, Hong Kong

Abstract

With the advancement of technology, lowered cost in hardware and widely available development tools, more and more educators across different disciplines have used virtual reality as a mean to enhance their teaching. The hit of the pandemic has also speeded up the adoption of virtual reality in education where face-to-face classes and practicals are suspended/cancelled. Virtual Reality as a tool to facilitate teaching and learning has created a new way for learners to experience the materials instead of receiving information passively through books and videos. Traverse survey is one of the main topics in surveying, it is a method used for control survey through establishing a series of points that are linked together by straight lines to form a framework. Traversing involves setting a total station and prism targets at points along the traverse line to do observations. Measurements of angles and distances are taken for the calculation of the points' coordinates using trigonometry.

This paper illustrates using freely available tools to develop a virtual reality program for doing traverse survey, the program is used in an assignment as a virtual fieldwork tool for students to learn traverse surveying at home and anywhere with a computer.

Session 9: Innovation for Asset Management

Establishment and Practice of Undergraduate Education System for Marine Surveying and Mapping in the New Stage

Prof. Fanlin YANG

Shandong University of Science and Technology, China

Abstract

In 2012, China announced its national strategy of building maritime power. With the booming of marinetime development activity, the demand for marine surveying and mapping has increased sharply. However, education for the discipline lagged far behind the growth in demand. In contrast, for a long time, education in the marine surveying and mapping discipline has faced two problems. First, the education content is mainly for military purposes, and there is little content about civilian use. Second, the education content is outdated and is far from the frontier science and engineering practice. To address these problems, Shandong University of Science and Technology has been working on the education reformation of the marine surveying and mapping discipline for more than a decade. By cooperating with our education partners from the military college, the universities, and the enterprises in maritime industries, we deeply analyzed the booming need in the marine survey and mapping field, and make clear the connotation and characteristics of the discipline in the new era. The discipline roots in the geodesy discipline, but is also deeply connected with oceanography, electromagnetics, and underwater acoustic. Meanwhile, it serves the national marine strategy and the coastal economic development. Thus, it is an interdisciplinary emphasizing practicality and innovation. To this end, under the framework of military-civilian cooperation and industry-education integration, we establish an education alliance with participants from marine institutes, universities, industries, and users. Based on the close collaboration within the

alliance, we built a new education model for undergraduate students in the marine surveying and mapping discipline. During the last decade, more than 3000 undergraduate students have been educated to fill the needs of employers relative to the marine economy. Moreover, more than 500 students obtained the qualifications as “international hydrographic surveyor and cartographer”, and they make worthwhile contributions to the national marine strategy and marine economic development.

The "Integration of Science and Education, International Cooperation" Mode of Training Talents in Geomatics

Prof. Chaoying ZHAO

Chang'an University, China

Abstract

With the rapid development of GNSS, high-resolution remote sensing, InSAR, LiDAR and other earth observation technologies, advanced technical conditions are provided for the training of talents in the field of geomatics. The surveying and mapping discipline in Chang'an University has been combined with engineering geology, geohazards over decades, forming one of the special research directions, that is development of earth observation techniques and the application in geological disasters. Therefore, we have formed the "integration of science and education, international cooperation" characteristic talent training mode. The specific initiatives include six aspects, namely, concentrating disciplinary characteristics, building scientific research platforms and teams, recruiting and developing outstanding talents, undertaking major projects, strengthening the integration of science and education, and expanding international cooperation, which ultimately serves the goal of improving the quality of personnel training in geomatics.

(1) Concentrating disciplinary characteristics. We have undertaken the construction of China Beidou Analysis and Service Center since 2012, developed Beidou geological disaster monitoring equipment and Drone-throwing BeiDou monitoring equipment, developed GACOS Atmospheric Correction Service System and cloud platform for the geohazards identification, monitoring and early warning with multi-source remote sensing such as InSAR, high-resolution optical imagery and LiDAR. Therefore, we have formed one of the special directions of geomatics, namely, development of earth observation techniques and the application in geological disasters.

(2) Building scientific research platforms and teams. We have participated in the construction of eight scientific research platforms, including National Key Laboratory of Loess Science (to be built), Key Laboratory of Western Mineral Resources and Geological Engineering, Ministry of Education, Key Laboratory of Ecological Geology and Disaster Prevention and Control, Ministry of Natural Resources, Shaanxi Yellow River Scientific Research Institute. Besides, we were approved two Shaanxi Provincial Research and Innovation Teams related to geological disaster monitoring and early warning and prevention and control and two Shaanxi Provincial Teaching Teams of Surveying engineering, Remote sensing science and technology.

(3) Recruiting and developing outstanding talents. In the past ten years, the department has introduced more than 10 outstanding talents and PhD graduates from the United States, the United Kingdom, Germany, Belgium, and Hong Kong. Besides, we also developed the "Chang'an Scholars" talent support program implementation methods to nurture young teachers. Currently, the talent echelon has taken shape, where 10 teachers are selected for national or provincial talent programs.

(4) Undertaking major projects. We have been awarded more than 30 projects by the Ministry of Science and Technology, including key R&D projects, the National Natural Science Foundation of China, including major project, instrument major project, key project, Hong Kong, Macau and overseas scholars programs, where we have served in the construction of major national projects such as the Sichuan-Tibet Railway, ecological protection and high quality development in the Yellow River Basin, and intelligent transportation.

(5) Strengthening the integration of science and education. We integrate the scientific research results into the development of professional courses, where we have applied for approval of five first-class courses and online courses in Shaanxi Province, such as "Modern Surveying and Mapping: Technological Innovation and Major Engineering Applications", and have guided students to participate in "Internet+" and "Challenge Cup" to win more than 20 provincial-level competitions.

(6) Expanding international cooperation. We have expanded international cooperation in various fields. Firstly, we have hosted two "111" Innovation and Intelligence Base Projects from Ministry of Education, China Scholarship Council, and Shaanxi Province, that is, “Western Department of Geological Hazards and Geological Engineering” and “Geological disaster high-precision monitoring and early warning and prevention”. Secondly, we are

granted 5 foreign expert programs, including International Cooperation Training Program for Innovative Talents, which can send around 8 students to study overseas each years based on our assessment. Thirdly, we have Signed Chang'an University-Spanish University of Alicante Joint Doctoral Training Agreement. Fourthly, we have developed over 5 international full English courses, including earth observation from Aristotle University of Greece, Land use and land cover from University of Leuven, Belgium. Lastly, we have applied several international cooperative projects granted by Dragon projects and National Natural Science Foundation of China etc.

Through the practices in above six aspects over 10 years, students' innovation ability has been strengthened, and the scientific research they participated in has successfully early-warned landslide disasters five times, which was widely reported by the media such as Spain Informacion, China Daily and CCTV News. The discipline has trained dozens of special talents represented by national young top talents, Shaanxi outstanding youth, etc. They are engaged in scientific research and teaching of surveying and mapping in Ministry of Natural Resources, Ministry of Emergency Management or universities, and become the backbone of employing units.

From Tectonic Geodesy to Natural Disasters:

Video, Science and Response

Dr Ting CHEN

Wuhan University, China

Abstract

This is an ongoing education innovation project on Geomatics for 13 years. It will been presented in four stages.

Firstly, Tectonic Geodesy, an interdisciplinary of Geomatics and Geophysics, has been Geodetic and Geophysical undergraduate's key course in School of Geodesy & Geomatics of Wuhan University for many years. Its research content and purpose are: to use modern space geodetic and geophysical observation technologies to accurately determine the geometric position of the earth's surface points, the earth's gravitational field elements, the position and direction of the earth's rotation axis in space, and the change of the above parameters with time. It also studies the physical mechanisms of global dynamic change from the perspective of dynamics, and provides services for the study of environmental change and sea level change, and the prediction of natural disasters such as earthquakes and so on.

Secondly, Tectonic Geodesy was developed into a school-wide general education course as Natural Disasters: Video, Science and Response, which integrated natural disasters related part of science, movie art and liberal arts into one course in 2019. All aspects of how graduate students do scientific research will be taught throughout the course. Undergraduate students from different schools and majors of Wuhan University can study cooperatively in small groups, and carry out interdisciplinary study and research around the theme of natural disasters.

Thirdly, Undergraduate students who finished their study of Natural Disasters: Video, Science and Response established an student associations and can continue their natural disasters related research or carry out a wholly different research far beyond natural disasters related.

Lastly, We will start to modify all of what we have learned in previous stages to meet the needs of students from high school, middle school and elementary school. We hope Geomatics could draw more attentions of our young generation and we will have more Geomatics students and practitioners.

A Comparison Study on Feature Extraction and Matching using Manually Designed and Deep Learning-based Methods

Mr Zhanquan LIU

Shandong University of Science and Technology, China

Abstract

In recent years, understanding the differences and connections between multiple visual targets and processing perceptual information accordingly based on specific needs has become one of the hot topics in the field of computer vision. Feature matching, as a fundamental and critical process connecting two image targets with similar attributes, is the link between low-level vision and highlevel vision, and an effective way to achieve information recognition, integration, and recover high-dimensional structures from lowdimensional images. The definition and task objectives of feature matching are extremely simple and clear, it is a low-level image processing technology that directly extracts and matches features from images and is the primary step in many specific large-scale tasks.

Feature matching is an important prerequisite for high-precision bundle adjustment of high-resolution optical satellite stereo images. However, with the advent of the era of satellite big data, a massive amount of high-resolution optical satellite images has accumulated in the same area, including many high-resolution optical satellite images with multiple temporal phases, multiple imaging perspectives, and large radiation differences, which pose a challenge for high-precision feature matching. Meanwhile, historical images provide a valuable source of information for urban and territorial monitoring, reconstruction of destroyed buildings, and other applications, and are increasingly being used for application sharing through virtual or augmented reality and cultural propaganda projects. Finding reliable and accurate matches between historical and current images is a fundamental step in these projects because they need to match the current 3D scene with the past 3D scene. Therefore, high-resolution optical satellite image feature matching and historical and current image feature matching have

practical significance. The study presented in this paper serves as a detailed comparison between the traditional Scale-Invariant Feature Transform (SIFT) algorithm and the Super Points-Super Glue Fusing deep learning feature matching algorithm in the context of feature matching in difficult conditions for high-resolution satellite imagery and historical images. The SIFT algorithm is a local feature descriptor algorithm in the field of image processing that provides not only scale invariance but also robustness to changes in image rotation, brightness, and camera position. The Super Points-Super Glue Fusing algorithm, on the other hand, is primarily based on the Super Points feature extraction algorithm and the Super Glue feature matching algorithm. Super Point algorithm consists of two deep learning networks, one being the Base Detector used for detecting candidate feature points, and the other being the Super Point network used for outputting feature points and descriptors. The Super Glue algorithm, on the other hand, is a graph neural networkbased algorithm used for local feature matching with an attention mechanism.

The study utilizes a training dataset consisting of close-range and indoor images, and a testing dataset consisting of high-resolution satellite image pairs and historical image pairs. The accuracy of the matching points is compared between the SIFT algorithm and the Super Points-Super Glue Fusing algorithm for both difficult and normal conditions. The results indicate that the traditional algorithm exhibits poor stability and robustness under difficult conditions, and suffers from limited application, whereas the Super Points-Super Glue Fusing algorithm demonstrates superior performance in high-resolution satellite imagery. Furthermore, the Super Points-Super Glue Fusing algorithm is tested in different scenarios such as normal conditions, multiple time phases, multiple imaging perspectives, and large differences in radiation. The algorithm performs well across all scenarios, with particularly excellent results in the difficult conditions. Therefore, the proposed approach has great potential in practical applications, such as urban and territorial monitoring, damaged building reconstruction, and cultural heritage projects, among others.

In conclusion, the study highlights the importance of feature matching in the field of computer vision and its practical applications. The proposed Super Points-Super Glue Fusing algorithm exhibits superior performance in difficult conditions compared to the traditional SIFT algorithm, making it a promising approach for feature matching in high-resolution satellite imagery and historical images.

Technical Approach A 2d GNSS Cadastral Survey on Prismatic Compass Lot

Mr Abdul Khaliq BUJANG

Brunei Survey Department, Brunei Darussalam

Abstract

Beginning in 1909, the Torren System was used to register land in Brunei Darussalam. "Where only grant registration is used and the land is not registered, the owner should obtain a court order if a claim exists".

Brunei's cadastral systems are based on Torren systems and use lot numbers as identifiers. Cadastre involves two departments: Survey Departments, which provide technical aspects such as surveys and mapping, and Lands Departments, which would provide registration and transfers. Brunei Cadastral system was designed for registration, transfer of ownership, any land development, sub division and consolidation, and other purposes (Country Report-Cadastral Template 2.0, 2023). As per Brunei Survey Department Cadastral System data, the Tutong district currently has 1530 prismatic compass lots. Unfortunately, the existing lots are unsuitable for representing land in 2D situations for rapid increases for development and technical purposes. As a result, effective 2D GNSS cadastral survey is use in particularly for found land boundaries, is directly related to old field survey data and old survey plan as considerations.

This paper gives an overview of the Brunei Survey Department Cadastral System for 2D purposes, as well as the prismatic compass lot technical situation in Tutong, Brunei Darussalam. We explain the current practice of cadastral and GNSS surveying in Brunei and go over the surveying technique in full depth. Throughout the paper, it is hoped that this new approach will contribute to Brunei Survey Department on land surveying sustainability.

Comprehensive Analysis of UNet Backbone and Decoder for Deep Learning-based Building Segmentation

Dr Jian YANG

University of Tsukuba, Japan

Abstract

Accurate building footprints are of significantly high demand in many aspects of urban planning. Over the past few years, semantic segmentation of building rooftops has attracted growing attention from both computer vision and remote sensing researchers. However, most of the existing studies advanced the methodology with the focus on specific and detailed improvements, while ignoring the basic elements of UNet networks, including backbone and decoder. Therefore, this study conducts a comprehensive analysis of UNet backbone and decoder for building rooftop segmentation

THE END