Data, Knowledge, Information and Geospatial System

Wuhan University, Wuhan, China | MAY 19-31, 2014 | 2014 SUMMER SCHOOL
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1. Introduction

GPS in the cars and cabs, use of Google maps have become common for all of us. We are learning environmental modeling, disaster management, impact of climate change, telecommunications, location planning, architecture, archaeological reconstruction and many more. But do we have any idea of better use of Google images and maps or do we think of use of GPS for tracking or photography? Do we question from where Google images are coming from? Do we know what the other uses of these images are? The Summer school on Geoinformatics was offered in order to answer all these questions. The School aimed to cover fundamental concepts, methodologies, and technologies in regard to Data, Information and Knowledge Sharing for Geoinformatics. It was in combination with the increasing importance of geospatial data for the use of decision making processes and planning efforts.

The Geoinformatics summer school was held at State Key Lab of Information Engineering in Surveying, Mapping and Remote Sensing at Wuhan University, China. Summer schools present one of the most important activities of the Working Group (WG) VI and Student Consortium (SC) of International Society for Photogrammetry and Remote Sensing (ISPRS) for the promotion of the science among the young researchers. The main purpose is to provide an educational week with practical training for the students and young researchers in the ISPRS's work fields. The 1st ISPRS Summer School took place at Istanbul Technical University’s Maslak campus, Turkey, 19 – 26 June 2005 with the topic "Satellite Data Processing and Spatio-Temporal Analysis for Resource and Disaster Mapping, Monitoring and Management". The 3rd Summer School took place in Nanjing, China, 27 June – 1 July 2008, with the topic “Acquisition, processing and representation of 3D geospatial information”, organized jointly with the biannual Chinese Doctoral Students' Forum in GIS. The Summer School was preceded by Mid-Term ISPRS commission VI symposium on “Data, Information, and Knowledge Sharing for Geo-Education” held in Wuhan, China from from May 19th to 21st, 2014. It was followed by the Summer School from 23rd to 27th May, 2014.

1.1 Background

Wuhan, China

Wuhan is the capital of Hubei province, People's Republic of China, and is the most populous city in Central China. It lies in the eastern Jianghan Plain at the intersection of the middle reaches of the Yangtze and Han rivers. Arising out of the conglomeration of three cities, Wuchang, Hankou, and Hanyang, Wuhan is known as "the nine provinces' leading thoroughfare"; it is a major transportation hub, with dozens of railways, roads and expressways passing through the city. Because of its key role in domestic transportation, Wuhan was sometimes referred to as
the "Chicago of China." Holding sub-provincial status, Wuhan is recognized as the political, economic, financial, cultural, educational and transportation center of central China.

The metropolitan area comprises three parts—Wuchang, Hankou, and Hanyang—commonly called the "Three Towns of Wuhan" (hence the name "Wuhan", combining "Wu" from the first city and "Han" from the other two). The consolidation of these cities occurred in 1927 and Wuhan was thereby established. The parts face each other across the rivers and are linked by bridges, including one of the first modern bridges in China, known as the "First Bridge". It is simple in terrain—low and flat in the middle and hilly in the south, with the Yangtze and Han rivers winding through the city.

Wuhan is one of the three scientific and education centers of China, along with Beijing and Shanghai. It had the largest number of enrolled college students in the world in 2011. The city of Wuhan has 85 higher education institutions such as Wuhan University and Huazhong University of Science and Technology. Wuhan ranks third in China in scientific and education strength: It contains three national development zones and four scientific and technology development parks, as well as numerous enterprise incubators, over 350 research institutes, 1470 hi-tech enterprises, and over 400,000 experts and technicians.

**Wuhan University & LIESMARS**

Wuhan University is located on the southern shore of East Lake, the largest lake in China, and is surrounded by over 10 mountains and hills such as Mt. Luojia and Mt. Shizi. Enveloped by lakes and mountains and surrounded with natural beauty, Wuhan University’s elegant palatial architecture that blends perfectly eastern and western architectural styles has awarded it the description of “one of the beautiful universities in China”. Since the 1928 decision to build the campus at the Luojia location, countless great figures have contributed their wisdom, passion, and hard work to fill the Luojia campus with charm and beauty. Furthermore, Wuhan University's centennial humanistic accumulation boils down to its succinct motto, that is, "Improve Oneself, Promote Perseverance, Seek Truth and Make Innovations."

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**Figure 1: Guide Map of Wuhan University**
The University dates back to the Ziqiang Institute, which was founded in 1893 by Zhang Zhidong, governor of Hubei and Hunan Provinces in the late Qing Dynasty. Later, it changed its name several times before it was named National Wuhan University in July 1928, and was among the first group of national universities in modern China. In February, 1929, the jurist Wang Shijie became the first president of Wuhan University. During the War of Resistance against Japan, Wuhan University moved to Leshan, Sichuan Province and returned to Luojia Hill after the war. On August 2, 2000, with the approval of the State Council of the People's Republic of China, the new Wuhan University was established as a combination of four major universities close together ---- the former Wuhan University, the former Wuhan University of Hydraulic and Electrical Engineering (WUHEE), the former Wuhan Technical University of Surveying and Mapping (WTUSM) and the former Hubei Medical University (HBMU).

Currently the university has 6 different faculties with different schools and department within it. The faculties are **Faculty of Humanities, Faculty of Social Sciences, Faculty of Sciences, Faculty of Engineering, Faculty of Information Sciences** and **Faculty of Medical Sciences**.

In face of new opportunities and challenges, Wuhan University, under the guidance of the “Scientific outlook on Development”, set the objective of constructing a “Chinese-style, World-class” high-level university, and is exhibiting rapid progress. Wuhan University ‘Improved Oneself’ in 19th century, ‘Promoted Perseverance’ in 20th century, and ‘Made Innovations’ in 21st century. In face of new opportunities and challenges, Wuhan University has set the new goal of ‘Chinese style, World Class’ and the new strategy of ‘Head in clouds, Feet on Earth’, and laid out a new blueprint for development under their guidance. By 2015, the University aims to steadily increase the status of WHU in China’s higher education to achieve leading international level in some fields.

The State Key Laboratory of Information Engineering in Surveying, Mapping and Remote Sensing (LIESMARS), a part of Wuhan University is the only national key laboratory in the field of surveying and mapping in China. It was founded in 1989 with the approval of State Planning Commission for promoting the theoretical and technological research on photogrammetry, remote sensing, mapping and geodesy. Since its foundation, LIESMARS has made outstanding achievements in scientific research, technology development, education and international communication. In the evaluations conducted by the National Natural Science Foundation of China (NSFC), LIESMARS was ranked as the 5th laboratory of excellence out of the 14 state key laboratories in geo-sciences in 1996 and as the 4th laboratory of excellence out of the 28 state key laboratories and open laboratories in geo-sciences 2000. LIESMARS was entitled as “Team of Excellence” and granted with “Golden Bull Award” in 2004 by the Ministry of Science and Technology (MoST). In 2005, LIESMARS was evaluated as “laboratory of excellence” again by MOST.

LIESMARS devotes to the research of airborne and space borne photogrammetry, remote sensing image processing, geospatial information system, precise global positioning system, multimedia communications technology, 3S integration, and spatial information service. At present, LIESMARS has 75 full-time faculty and staff, including four academicians of the Chinese Academy of Sciences (CAS) and the Chinese Academy of Engineering (CAE), and 44 professors and 18 associate professors (87% of the total members). Prof. Gong Jianya is the Dean of LIESMARS and Prof. Li Deren is the Chairman of the current Academic Committee.
1.2 ISPRS & its objectives

The International Society for Photogrammetry and Remote Sensing is a non-governmental organization devoted to the development of international cooperation for the advancement of photogrammetry and remote sensing and their applications. The Society operates without any discrimination on grounds of race, religion, nationality, or political philosophy. The official languages are English, French and German.

Objectives and Activities

The Society's scientific interests include photogrammetry, remote sensing, spatial information systems and related disciplines, as well as applications in cartography, geodesy, surveying, natural, earth and engineering sciences, and environmental monitoring and protection. Further applications include industrial design and manufacturing, architecture and monument preservation, medicine and others.

The principal activities of the Society are:

1. Stimulating the formation of national or regional Societies of Photogrammetry and Remote Sensing.
2. Initiating and coordinating research in photogrammetry and remote sensing.
3. Holding international Symposia and Congresses at regular intervals.
4. Ensuring worldwide circulation of the records of discussion and the results of research by publication of the International Archives of Photogrammetry and Remote Sensing.
5. Encouraging the publication and exchange of scientific papers and journals dealing with photogrammetry and remote sensing.
6. Promoting cooperation and coordination with related international scientific organizations.


Goals of Technical Commission VI
The goal of the work in Technical Commission VI is to support, promote, and stimulate education and training, technology transfer, development and provision of computer-assisted teaching training and distance learning methods and materials, joint activities with regional organizations, ISPRS students consortium activities and regional capacity development activities.

- Support, promote, and stimulate education and training at fundamental, advanced and professional levels;
- Support, promote, and stimulate technology transfer, considering regional needs and resources;
- Support, promote, stimulate, and initiate development and provision of computer-assisted teaching training and distance learning methods and materials;
- Promote, support, and stimulate the ISPRS students consortium activities;
- Initiate, promote, and support regional capacity development activities;
- Develop and support joint activities with regional organizations;
- Stimulate and support regional and local initiatives for summer schools, courses, and workshops;
- Provide tutors and educational material and support;

Organize, initiate, promote, support, and stimulate regional and international summer schools or seminars, workshops and tutorials.
2. 2014 Mid-Term Symposium ISPRS Commission

The summer camp/school/seminar was started by the ISPRS Student Consortium in 2004 and ISPRS 3S – Summer Students Seminar started in 2010. 2014 Summer School on Geoinformatics was co-organized by ISPRS TC VI, Student Consortium, WG VI/4, VI/5, VI/6, LIESMARS and Wuhan University. It was held in conjunction with 2014 Mid-Term Symposium ISPRS Commission VI - “Data, Information, and Knowledge Sharing for Geo-Education”. The summer school gave an opportunity to meet academia and young students and strengthen ones network, covered fundamental concepts, methodologies, and technologies in Geoinformatics. The 2014 International Conference on Data, Information, and Knowledge Sharing for Geo-Education was held in May 19-21, 2014 at Wuhan, China. The conference was to encourage diverse topics related to methodologies and technologies to support education and training, stimulate technology and knowledge transfer, and promote regional capacity development.

On 19th May the opening ceremony of the symposium was conducted. The President of Wuhan University, the Deputy Director General of National Administration of Surveying, Mapping and Geoinformation, the Secretary General of ISPRS, the Vice President of ICA and the President of ISPRS honoured the occasion by their presence. Over three hundred attendees from 22 countries, including more than 60 conference representatives and over 200 students have participated in the conference.

The presentations of the Conference included many topics related to Remote Sensing and Photogrammetry. Large number of scientists and professors across the world participated in the conference. Following is a brief description of the presentations.
Day 1

1. PROF. DEREN LI of Wuhan University gave a presentation on Geoinformatics education in China. Professor started with the founders of geoinformatics in China. In China more than 200 universities have academic programs on GeoInformatics. About 15,000 students graduate each year with degrees in GeoInformatics: 12,000 undergraduate students, 2,500 post graduate students, 500 doctoral students. He briefed on the requirements for graduate students. He also talked about doctoral forums, summer schools and geoinformatics in Wuhan University. He gave brief on the “education infrastructure” which includes “hardware” and “software”.

2. PROF. UWE STILLA from Technical University of Munich, Germany gave a presentation of photogrammetry and remote sensing in the ESPACE MSc program at the Technische Universität München. Professor explained about ESPACE -Earth Oriented Space Science and Technology, Photogrammetry, Remote Sensing, and Geoinformation and Double Master’s Programme between TUM and WHU.

3. PROF. PENGDE LI Deputy Director General of NASG gave a presentation on “Capacity Development of surveying, mapping and geoinformation in China”. He talked about GIT progress in China, UN-GGIM and Calling for Global Cooperation of GGIM training.

4. PROF. JUN CHEN President of ISPRS presented on global land cover information service: past, present and future. He “Early development”, “Current ”Dynamic SOC for GLC”. He talked computer classification and expert handle the spectral confusion and the globe. Thus SOC approach and enabled more efficient image data current static information has shifted

5. PROF. MARGUERITE MADDEN, second vice president of ISPRS, talked on “NASA development program” at the University of Georgia. She presented a few examples of the projects developed by the students. One of which was on the impacts of African elephants on vegetation at Kruger National Park. And on the effects of exotic hemlock wooly adelgid on vegetation in Great Smoky

Mountains national park.
6. **PROF. LENA HALOUNOVA**, Congress Director of ISPRS gave a presentation on “European Inventory of Disaster Resilience Education”. She discussed about how the occurrence of flood frequency changed in Prague in the last few years. Hence the increasing frequency of floods realized them to invent Disaster Resilience Education. She has invited all the participants to visit Prague during the Congress in 2016.

7. **ARMIN GRUEN** from Zurich, Switzerland has delivered on White Elephant Club. A white elephant is a valuable possession which its owner cannot dispose of and whose cost exceeds its usefulness. The White elephant club is a group of senior officers of ISPRS dedicated to serving the society. The various activities performed are:

   - Transfer of Technology by Seminars, Tutorials, Workshops etc. He shared valuable thoughts on Thesis writing along with many tips, advices and suggestions regarding the same.

8. **PROF. IAN DOWMAN** from University college, London UK gave a presentation on development of Geospatial training and education in North Africa. He gave presentations on ‘How to write a journal paper’ and ‘How to give presentations’. Though the topics are extremely simple these presentations were highly beneficial to the students.

9. **PROF. JOHN TRINDER** Emeritus Professor University of NSW, Australia briefed us about ‘How to write a research proposal’. He talked about all the aspects related to a research proposal on an expert level with a list of TO-DOS and NOT TO-DOS. The topics included definition, purpose, various types, content and the evaluation process.

The same evening all the students, the university and commission members celebrated the 70th Birthday of Armin Gruen. This was followed by a conference dinner. The first day ended with delicious food and cultural events.
Day 2

1. Jie Jiang, President of ISPRS Commission IV presented a paper on the Platform for Common Geospatial Information Services. He talked about the surveying and mapping agencies of China, Problems encountered in data sharing and integration, requirements from the public, solutions to the requirements, the operations pattern, rules and regulations etc.

2. David Fairbarn, Chair of ICA commission on Education and Training presented on ‘The role of education and training in International Map Year 2015/16’. He explained what the International Map Year is about, the administrative structure, the activities held and educational aspects of IMY.

3. Wolfgang Kainz from University of Vienna, Austria talked on the University of Vienna, the course offered and related eligibility required for the Bachelors degree, Masters Degree and Doctoral Programs.

Post-tea break the parallel sessions were conducted. The following are the experts have made the presentations:

4. Ammatzia Peled from University of Haifa gave a description on MA programs offered in the University at the time budget crisis. He presented a very innovative idea of “not so hot” chocolate drinks which one can prepare 2 cups out of one and a half. Similarly, the University came up with 2 separate but related MA programmes.

5. Ian Dowman presented regarding the Geospatial Education & Training in North Africa. He briefed on the current status of the Geospatial Education in Africa. He showed how ISPRS is successfully engaging with organizations in North Africa to develop a curriculum which is appropriate for the purpose.

6. John Trinder of University of New South Wales brought forward the status of shortage of graduates in Geospatial profession and how the profession was publicized through website development, providing training to the secondary school teachers, by the process of mentoring and internships with the help of professional bodies.

7. Sheryl Rose C. Reyes presented about the historical overview of the student consortium of ISPRS. She showed that from the beginning the efforts and actions aimed at attracting new fellows are a key component for the development of the ISPRS.
The presentations that were held in the other parallel session were:

8. **Prof. Bert Veenendaal** of Curtin University, Perth, Australia presented that because of invisible career paths and funding opportunities there were adverse effects on GIS education. He also showed to meet these challenges how the GIS higher education curriculum framework was developed.

9. **David Fairburn** the Chair of the ICA and the professor of the Newcastle University presented about the manpower planning in the field of Geomatics. He raised several issues like filling skills gaps, profile of workforce, salaries and remuneration and role of immigration.

10. **Wei Song** of North China University of Water Resources and Electric Power presented the spatio-temporal relationships between land parcels and explained that it may be used to validate spatio-temporal relationships if they are explicitly stored in the database.

11. **Shen Yuanchun** of Wuhan University presented the status of higher education of GIS in China. He also focused on the efforts which are to make better plans in accordance with the professional orientation and training objectives, and constantly revise the curriculum, enhance the teaching power, strengthen international cooperation and exchanges.

During post lunch parallel sessions were organized and research papers were presented. **Prof. Anjana Vyas** has chaired one of the sessions. **Prof. Gerhard König** remained as co-Chair.

12. **Gerhard König** of Technische Universität Berlin, Germany presented the status of online teaching in remote sensing and Geomatics and how it has influenced the role of both the teachers and the students. He also introduced the massive open online courses (MOOC) offered by many renowned universities. This paper is co-authored by **Prof. Anjana Vyas**.

13. **Jianya Gong** presented a background for the course Geospatial Service Platform for Education and Research which was offered in the summer school. He gave a brief description that the course would share cutting-edge achievements of a geospatial service platform with students. The content of the course included the basic knowledge introduction and exercises. He described that the students would be able to learn how to use online service platforms for geospatial resource sharing and problem-solving.

14. **Justyna Jeziorska** presented regarding the Unmanned Aerial Vehicle, a newly implemented course in University of Wrocław, Poland. She showed how the Geography and Cartography students master the skills of acquiring spatial data using an innovative tool – an Unmanned Aerial Vehicle.

15. **Lixin Wu** of China University of Mining & Technology, Xuzhou, China presented that the big data brought by Integrated Earth Observations is not possible to share because of the big gap in unified spatial reference. He showed that how the Earth System Spatial Grid would act as a common SRF. He finally introduced the GASE system for big data sharing.
16. **Prof. FuanTsai** presented an overview of smart phone app in Geomatics education. He also presented his views regarding employing a smart phone in geomatics for hands-on education.

17. **Jing Qi** presented the ideas of student centered teaching and practical course. He said that these ideas mainly revolve around 4 steps - Building a group, Indoor work, Field surveying and Submitting reports.

18. **Jinyan Tian** of University at Buffalo, firstly introduced the concept (Sub-footprint analyses) to GLAS data processing. He proposed a new RLM method, which was employed to decompose raw GLAS waveform into multiple Gaussian signals. He had developed a model between each Gaussian signal and the three parameters. His studies revealed that large footprint GLAS data has the potentials for obtaining detailed forest height variation.

19. **Xiaoyan Mu** gave a comprehensive presentation on making spatial statistics service accessible on cloud platform. According to him, Eigen function based spatial filtering method can eliminate the spatial autocorrelation to some extent and improve the accuracy of the regression model. Supported by cloud computing, the ESF service can cut down the process-time effectively. By deploying Eigenvector-based spatial filtering service on the cloud platform (Windows Azure), the availability and accessibility of these services have been significantly improved.

The session after a tea break was mostly based on the GIS education and its opportunities in Industry. The presentations that took place were

20. **FuanTsai** discussed about the challenges of spatial education in a fast developing industry. He also gave an overview of Blue Ocean strategy by enhancing the values of 3S and geospatial technologies. He talked about the internationalization in both the industry and education sectors. He recommended for more effective technology transfer to meet the demands.

21. **Dr. Jim Griffiths** of University of Nottingham presented on the teaching of Digital Earth module in environmental sciences. He said that there should be clear learning objectives and pathway to help students identify range of skills acquired and what they can do with them. The programs should be such designed that at under-graduate level, lectures provide a solid foundation supported by practical classes linked to theory but designed to engage.

22. **Xi Zhai** talked about the Ruby on Rails, often simply Rails, which is an open source web application framework which runs via the Ruby programming language.

23. **Rakesh Malhotra** suggested for creating inter-disciplinary opportunities for the students in the field of GIS. He said to improve future opportunities for Geography and Intelligence Studies students through geo-computation. He also recommended to improve educational and employment opportunities for Computer Science students through real world applications of geospatial data.

24. **Amin Mobasheri** presented a case study of Iran regarding web-based GIS teaching in Developing countries. The components as well as the free and open source services and software packages that could be used in this framework for a specific case study was the Web GIS course. He concluded that for future work, the country has aimed to consider implementing the education system for the Web GIS course as a test bed, and try it in action by offering an online education course for teaching Web GIS to students in Iran.

25. **Mohd. R. Bualhaman** of UAE University presented an assessment of GIS education in developing countries. He concluded that the field of Geoinformatics is multidisciplinary and the variety of educational and research needs, ranging from simple training in the use of Geoinformatics software to advance research at theoretical level. The UAE will need to
develop a vision in the Geoinformatics field for future, in terms of education programs and disciplines. It will be necessary to plan for Geoinformatics education schools, colleges and universities in the UAE.

26. **Yaoguo Yi** explained how to exercise and improve the students ‘practical ability based on the basic principle of procedural teaching theory. He concluded that this method not only improved teachers’ efficiency to control the students, but also strengthened the students' ability to understand what they have learnt through the gradual process of practice of the GIS spatial analysis theory.

**Day 3**

The day begun with welcome remarks by Ian Dowman and followed by the student lecture session. Sheryl Rose Reyes and Hengqian Zhao gave presentations on ISPRS-SC and ASG respectively. The students from CEPT University wore their traditional attire on the final day of the conference. The following students have given a brief presentation on their respective Universities and the education system.

Justyna Jeziorska, University of Wroclaw, Poland
John Paul Genciana, University of Philippines, Philippines
Shahdadpuri Harshita Bhagwan, CEPT University, India
Mohammad Muqeet Khan, Aligarh Muslim University, India
Ailin Liang, Wuhan University, China
Shahdadpuri Harshita Bhagwan, CEPT University, India
John Paul Genciana, University of Philippines, Philippines
Justyna Jeziorska, University of Wroclaw, Poland

The students were given time for presenting their research projects through poster presentation. This was reviewed by the experts Ian Dowman, Songnian Li and Wolfgang Kainz.

Post lunch **Daniel A Griffith** from University of Texas at Dallas, USA gave a talk on ‘Reflections on the current state of Spatial Statistics Education in the United States. He described on the following questions:

- What is a modern introductory spatial statistics course?
- What educational training and experience are necessary to teach spatial statistics?
- What are important differences between spatial statistical thinking and mathematical thinking?

He narrated about the colleges offering Spatial Statistics course in US.

The lecture was followed by the presentations of the three sponsor companies - GeoStar, Leader Spatial and Geoway.

During the closing ceremony, the summary report of the Mid Term Symposium of ISPRS Commission VI was presented by **Marguerite Madden**. She ended her presentation with a genial welcome to the 23rd ISPRS Congress at Prague, in the Czech Republic, 2016.

The day programme ended with a visit to a company, namely GeoStar, a GIS-based company. The company offered delicious Chinese dinner in one of the most famous hotel of the city of Wuhan.
3. 2014 Geoinformatics Summer School

The ISPRS GeoInformatics Summer Camp was organised by State Key Lab of Information Engineering in Surveying, Mapping and Remote Sensing (LIESMARS) between 23rd to 27th May 2014 at Wuhan University, China. The School, which was held in conjunction with the Mid-Term Symposium ISPRS Commission VI - Data, Information, and Knowledge Sharing for Geo-Education, was an opportunity to meet lecturers and young people and strengthen your network. It covered fundamental concepts, methodologies, and technologies in GeoInformatics. During the Summer School, lectures were delivered by the distinguish expert guests including Armin Gruen, Orhan Atlan, Shunji Mural, and Deren Li. Around 300 young students and researchers registered. The School offered free registration and accommodation for all students and researchers. The University has provided a Debit Card to the registered students for daily expenses on food, beverages, laundry, etc.

There were four courses offered for the duration of five days each. The students of the CEPT University has grouped in 2-3 and participated in all the courses.

Course 1: Geospatial Service Platform for Education and Research:
Lecturer: Dr. Huayi Wu, Dr. Peng Yue, Dr. Wanshou Jiang, Dr. Wei Guo, Wuhan University

The course shared cutting-edge achievements of a geospatial service platform with students. The content of the course included the basic knowledge introduction and related lab exercises. Students also learnt how to use online service platforms for geospatial resource sharing and problem-solving.

Course 2: Spatial Statistics
Lecturer: Dr. Daniel A. Griffith, The University of Texas at Dallas; Dr. Bin Li, Central Michigan University

The course introduced the basic methods for analyzing spatial data. Students studied how to utilize spatial statistics methods appropriately and effectively to solve spatial problems. Appropriate lab exercises were carried out using R and GeoDa software.

Course 3: Mobile Laser Scanning and Mapping
Lecturer: Dr. Harri Kaartinen, Dr. Xinlian Liang and Dr. Antero Kukko, Finnish Geodetic Institute

The course introduced the principles of MLS (Mobile Laser Scanning), MLS systems, MLS data processing, MLS performance, case studies and emerging technologies. After this course, students could master basic knowledge of MLS for data acquisition and modeling.

Course 4: Open Source Mapmaking Technologies
Lecturers: Dr. Jorge Gustavo Rocha, University of Minho; Dr. Zhijie Zhang, Fudan University

This course introduced several open source technologies to handle maps and geographic information in a very flexible and powerful way. The details on the course is explained as below.
3.1 Spatial Statistics

Data Exploration (Faculty: - Dr. Bin Li)

Data exploration deals with exploring the statistics of the given data. Statistics in terms of mean, median, mode, standard deviation and so on comes under data exploration. Some of the explained data exploration parameters are as under:-

Mean – The average of all the samples.

Median – The value that splits the ranked list in halves, with half of the samples greater than it and half smaller than it.

Mode – The most frequently occurring value.

Range – The difference between the maximum and minimum values.

Interquartile Range (IQR) – The difference between the 25th and 75th percentile, where the 25th percentile is represented by observation \((n+1)/4\), and the 75th is represented by observation \(3(n+1)/4\).

Variance \((\sigma^2, s^2)\) – The average squared deviation of the observation from the (expected) mean.

Standard Deviation \((\sigma, s)\) – The square root of the variance.

Coefficient of variation – The ratio between the standard deviation and the mean.

For practice in R and GeoDa software, crime dataset of Columbus, USA was provided.

There were 49 observations with attribute table arranged as shown in the picture.

Following are the description of various variables shown in the attribute table of crime dataset of Columbus, USA:-

AREA - Neighborhood area (computed by ArcView).

PERIMETER - Neighborhood perimeter (computed by ArcView).

COLUMBUS_ - Internal polygon ID (generated by ArcView).

COLUMBUS_1 - Internal polygon ID (generated by ArcView).

POLYID - Neighborhood ID, used in GeoDa User's Guide and tutorials.

NEIG - Neighborhood ID, used in Spatial Econometrics examples.
HOVAL - Housing value (in $1,000).

INC - Household income (in $1,000).

CRIME - Residential burglaries and vehicle thefts per 1000 households.

PLUMB - Percent housing units without plumbing.

X - Centroid x coordinate (in arbitrary digitizing units).

Y - Centroid y coordinate (in arbitrary digitizing units).

NSA - North-south indicator variable (North = 1).

NSB - Other north-south indicator variable (North = 1).

EW - East-west indicator variable (East = 1).

CP - Core-periphery indicator variable (Core = 1).

NEIGNO - Another neighborhood ID variable (NEIG + 1000).

After analyzing and calculation various statistical parameters summary graphs are plotted. Various summary graphs with their figures are shown below:-

**Histogram**

**Stem and Leaf**
The most important step to be performed before studying any spatial statistics is to check the normality of the data. Following graph shows the normality of the crime data of Columbus, USA used for practicing in R and GeoDa software.

In order to produce user friendly and readable maps and to normalize the given sample of data it is very important to represent the sample dataset in forms of cartographic maps like choropleth maps which are used to represent the crime data of Columbus, USA over here. Choropleth maps can be classified on the basis of range of sample you select to cluster it in a single class. Basic classification can be termed as: - Equal Interval, Quantile Interval, Standard Deviation, Natural Breaks.

When the given sample of data is very large “Big Data”, it is advisable and very useful to go for Regional Focusing. In regional focusing whole study area, is divided into grids of x and y coordinates.

Conditional map of crime data of Columbus, USA is shown beside:-
For assessment of spatial trends, first order and second order trend surface equations are used:-

\[
\begin{align*}
 z(x, y) &= \beta_0 + \beta_1 x + \beta_2 y + \epsilon \\
 \text{Dependent variable: CRIME} \\
 \text{Explanatory variables: } x, y, x^2, y^2, xy \\
 CRIME &= -487 + 12.89 x + 17.67 y - 0.17 x^2 - 0.28 y^2 + 0.01 xy
\end{align*}
\]

The results of these equations are then turned into graphics by producing quadratic trend surface map to assess the spatial sprawl of the sample data.

For more understanding of data, comparison maps as well as scatter plots to get the statistical summary.

In order to measure the degree of association between two variables \(x\) and \(y\) Co-variance is a good indicator. The standard deviation of \(x\) and \(y\) (\(s_x, s_y\)) are used to standardize the covariance so that its value has a range from -1 to +1. +1 indicates a perfect negative linear association which is termed as Pearson’s Correlation Coefficient or Pearson’s \(r\).

\[
 r = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{(n-1)s_x s_y}
\]

Several techniques can be used to improve the effectiveness of the scatterplot. The first revision is to standardize the variables to the \(z\)-scores in order to compare data from different scales and different measurement units. For the variable \(x\), the \(Z\) score for each geographic unit is calculated by:-

\[
 z_i = \frac{x_i - \bar{x}}{s_x}
\]

A \(z\) score represents the number of standard deviations from the mean. After the transformation, the data set will have a mean of 0 and a standard deviation equal to 1. The resulting scatterplot is also easier to interpret. The slope of the regression line has the same value as the correlation coefficient.
• Where \( z_{xi} \) and \( z_{yi} \) are the z scores for variable \( x \) and \( y \). \( n \) is the number of observations.

• The domain for \( r \) is \((-1, 1)\). Negative \( r \) indicates the association of dissimilar (high-low) values, while a positive \( r \) reveals a dominant relationship between high-high or low-low values. When \( r=0 \), the two variables have no linear association.

On the basis of this a correlation matrix and a scatterplot matrix is prepared in R software.

Thus spatial statistics is a combination of GIS Statistical graphs and thematic maps which are combined to gather to produce different representative for the same data set which are linked. This is a basic method is Exploratory Data Analysis. Exploratory data analysis (EDA) is an approach to analyzing data for the purpose of formulating hypotheses worth testing, complementing the tools of conventional statistics for testing hypotheses. It was so named by John Tukey to contrast with Confirmatory Data Analysis, the term used for the set of ideas about hypothesis testing, \( p \)-values, confidence intervals etc. which formed the key tools in the arsenal of practicing statisticians. Objectives of EDA are:-

Suggest hypothesis about the causes of observed phenomena.

Assess assumptions on which statistical inference will be based.

Support the selection of appropriate statistical tools and techniques.

Provide a basis for further data collection through survey or experiments.

A more simplified view of relationship between variables can be established by using regression analysis. A linear regression line is established which is fitted in order to derive to a relationship between two variables. Various different regression studied where Ordinary least square and Moran’s I. This where studied on the basis of autocorrelation in terms of spatial lag and spatial error. Since OLS is not suitable to estimate both spatial regression models, Maximum Likelihood Estimation is used.

All the above process were tried out in R and GeoDa software as a part of our assignment lab work.

*Eigen Vector Spatial Filtering (Faculty: - Dr. Daniel A Griffith)*
Eigen Vector Spatial Filtering uses a set of synthetic proxy variables, which are extracted as eigenvectors from a spatial connectivity matrix $C$ that ties geographic objects together in space, and then adds these vectors as control variables to a model specification. These control variables identify and isolate the stochastic spatial dependencies among the georeferenced observations, thus allowing model building to proceed as if the observations are independent.

The first eigenvector is the set of real numbers that has the largest MC achievable by any set for the geographic arrangement defined by the spatial connectivity matrix $C$, the second eigenvector is the set of real numbers that has the largest achievable MC by any set that is orthogonal and uncorrelated with the 1st eigenvector so on through the $n$th eigenvector, which is the set of real numbers that has the largest negative MC achievable by any set that is orthogonal and uncorrelated with the preceding $(n-1)$ eigenvectors.

**Simultaneous Autoregressive Model (SAR)**

ASpatial Lag and Spatial Error models deal with the situation where the dependent variable or the OLS regression residuals have significant spatial autocorrelation.

$$Y = \rho W Y + X \beta + \epsilon$$

$$Y = X \beta + \rho W \epsilon$$

The SAR, on the other hand, accounts for spatial autocorrelation with the following model,

$$Y - \rho W Y = X \beta - \rho W X \beta + \epsilon$$

Or

$$Y = X \beta + \rho W (Y - X \beta) + \epsilon$$

where $W$ is the (row-standardized) spatial weights matrix, $\rho$ is the spatial autoregressive coefficient, $X$ is a set of covariates, $I$ is an identity matrix, and $\epsilon$ is a vector of the corresponding regression coefficient. Therefore, in addition to the linear relationship $X \beta$, spatial information is added by $\rho W (Y - X \beta)$.

The parameter $\rho$ and $\beta$ can be estimated through the maximum likelihood method with a weighted function, $\exp(\Sigma_{i=1}^{n} (1 - \rho \lambda_i))$

$$Y \exp(\Sigma_{i=1}^{n} (1 - \rho \lambda_i)) = \frac{\rho W Y \exp(\Sigma_{i=1}^{n} (1 - \rho \lambda_i))}{\exp(\Sigma_{i=1}^{n} (1 - \rho \lambda_i))} - \frac{\rho W X \beta \exp(\Sigma_{i=1}^{n} (1 - \rho \lambda_i))}{\exp(\Sigma_{i=1}^{n} (1 - \rho \lambda_i))} + \frac{X \beta \exp(\Sigma_{i=1}^{n} (1 - \rho \lambda_i))}{\exp(\Sigma_{i=1}^{n} (1 - \rho \lambda_i))} + \frac{\epsilon \exp(\Sigma_{i=1}^{n} (1 - \rho \lambda_i))}{\exp(\Sigma_{i=1}^{n} (1 - \rho \lambda_i))}$$

Which involves calculating the Jacobian, $\prod_{i=1}^{n} (1 - \rho \lambda_i)$, with $\lambda_i$ being the $i$th eigenvalue of matrix $W$.

In the R package, both “errorsarlm” and “spautolm” perform the SAR estimations.

**Eigenvector Spatial Filtering (ESF)**

Along the same line of thinking as SAR, where the terms $(Y - \rho W Y)$ and $(X \beta - \rho W X \beta)$ can be considered as spatially filtered variables, regression modeling with spatially auto correlated data can be improved by including spatial information in the model. The ESF approach does so by adding a linear combination of selective eigenvectors of the spatial weights matrix as covariates in the linear regression model, i.e.,
where $E$ is a set of selective eigenvectors of the spatial weights matrix. The model meets all
the requirements of OLS hence methods for estimation and assessment are the same as OLS.
The key operation lies in the selection of the set of eigenvectors. The lab below uses a forward
selection method with AIC as the criteria to select the appropriate eigenvectors. Note the
following basic steps:

Transform the binary connectivity matrix (C matrix)

$$(I – 11T/n)C (I – 11T/n)$$

Calculate the eigen values and eigenvectors of above matrix.

Perform an iterative selection of the eigenvectors, based on some criterion and selection
methods.

Perform OLS with the added eigenvectors.

Evaluate the results.

ESF can be applied to variables that are normal, binomial, and Poisson.

Various different models like The Winsorized auto- Poisson model, Drumins models, Scottish
lip cancer model, Snow Cholera model where explained with relation to spatial auto correlation
spatial statistics and Eigen vectors.

All the above process where tried out in R and GeoDa software as a part of our assignment.
3.2 Mobile Laser Scanning (MLS) and Mapping

(Faculty: - Dr. Harri Kaartinen, Dr. Xinlian Liang and Dr.Antero Kukko)

Introduction
Multi-sensor surveying from a moving ground vehicle that integrates various navigation and data acquisition sensors on a rigid, moving platform for mapping of the surrounding objects remotely:

History
1983 Mobile Highway Inventory System
1996-1998 First laser-based MMSs
2004 Tele Atlas starts to use mobile mapping
2005 Street mapper
2006 FGI ROAMER
2008- Optech, Navteq, Riegl, Mitsubishi, Topcon
2010 Trimble

Principle of MLS
Mobile laser scanning is a technique to measure objects in 3D as point clouds from ground vehicle. In effect: profile measurements are carried out using the laser scanner to measure the required distances and angles simultaneously within a series of successive parallel planes intersecting the road surfaces, pavements, “street furniture”, buildings and vegetation that are located adjacent to the roads or streets along which the mobile mapping vehicles are being driven.

The location of each new range observation is being measured continuously and accurately using an integrated suite of positioning devices – comprising a GPS or GNSS receiver, an IMU; and an odometer or DMI device as the vehicle moves on.

Application of MLS
Purpose is to produce precise and detailed information from objects for detection localization modeling analysis and monitoring.

MLS Workflow

Planning: Scanning parameters according to application. GNSS reference data source used for this application. Real-time positioning data link for correction data (radio, GPRS...) is used. Post-processing is done for data stored or loaded separately. Further reference data for data validation and adjustment is processed. Selection of a good starting and ending location is required. a need for zero velocity updates is seen.

MLS measurement:
GNSS reference data collected during the whole campaign and further setting up and measurement of reference targets is performed. The steps include setting up the system and the initialization is done. Static navigation data collection can be performed using the system but for kinematic INS alignment has to be done in the system hence MLS data collection can be divided in two ways of collection. Data coverage, on-line control, ZUPTs help in finalizing and hence Kinematic INS alignment and Static navigation data collection both work simultaneously the last step is Data log checking.

The descriptive figure of the same is shown in figure.

**MLS System:**
The MLS system can be broadly classified in two categories:
1. Sensors
2. Platforms

**Hardware used for MLS:**
- Laser scanners
- Cameras
- Other electro-optical sensors
- Spectrometer
- Thermal camera
- Range camera/flash LIDAR
- Radar
- Pollution sensors
- Navigation system

**Selection criteria for sensor:**
- Measurement principle
- Measurement frequency
- Profile frequency
- Measurement range
- Field of view
- Range accuracy
- Angular resolution
- Application
MLS processing:-
Inertial navigation: Typically a strap-down realization is used. In a strap down realization, the mechanical gimbals (gimbal can be any support that can pivot around an axis, Most gimbal systems look like a series of concentric rings) of a gyroscope system are eliminated altogether by strapping down the gyros and accelerometers onto the mounting frame. The principle is to use the gyros a means of measuring rotations in space so that the system always knows in which direction the accelerometer axis set is pointing. In a strap down system, the very high drift accuracy is needed, but it is also necessary to measure rotations within the full maneuver envelope of the platform – up to several hundreds of degrees per second. Furthermore, the gyro scale factor has to be extremely accurate and linear. As rotations in three axes are not commutative, tiny errors in scale factor accuracy can lead to large attitude errors. The initial enabler for strap down IMUs was the development of RLG. An RLG has virtually no moving parts, and it had been turned out that the RLG inherently has extremely good scale factor accuracy, typically about 5 ppm, and furthermore it dissipates the same power, regardless the rotation rate.

Georeferencing:
The motion of a vehicle-based terrestrial mapping system is described in a local coordinate frame, the so-called navigation frame. The determination of the position and attitude of the vehicle, or platform, is based on measurements from various sensors attached to the sensor platform on the vehicle, typically a GNSS-IMU system, and possibly aided with an odometer wheel. These sensors deliver physical quantities, i.e., accelerations and position, measured within independent frames, each defined according to the instrument’s characteristics. Mapping sensors operate in the coordinate frames of their own independently. Each of the observations is defined within the sensor frame and is not directly tied to the world coordinates. Platform frame is the co-ordinate frame to which all of the mapping sensor observations are tied with, and which is defined by the IMU attached. Navigation, body and sensor frames are local frames defining the reference frames describing the primary observables measured from the moving vehicle. Coordinate frames and their mutual transformations are needed to deliver all acquired object data, e.g., images and LIDAR points, in a specified map coordinate system (through ECEF) for modeling, measurement and analysis purposes. Coordinate frames for the GNSS-IMU navigation. Left: ECEF (XYZ) and navigation (NWU) frames. Right: IMU body frame.

The rotation and translations between the sensor and GPS-IMU body frames are determined either from the design of the particular system or
from calibration. Typically the translations are determined reliably enough from the design, and are to be considered constant, but rotations are more critical as they possess the range dependent factor for the uncertainty in object location determination.

*Laser scanning*
Position of points on ground based on:
- Vehicle position (lat/lon/el)
- Vehicle orientation (roll/pitch/heading)
- Scan angle
- Round-trip propagation time of laser pulse, or phase-shift range
- Raw (or source) data recorded in rover and on base (DGPS base station, VRS Service)
- Recorded data post-processed for point cloud

Practical session were taken on forestry and building modeling as a part of exercise. Data handling on software was done in lab sessions.
3.3 Open Source Map Making Technologies
(Faculty: Dr. Jorge Gustavo Rocha, University of Minho; Dr. Zhijie Zhang, Fudan University)

**Aim:**
“OPEN SOURCE”- The name itself implies that which is open and free for everyone to use and access.

In the 5th ISPRS-3S- Summer Student Seminar there were four courses namely Spatial Statistics in Practice, Geospatial Service Platform for Education and Research, Mobile Laser Scanning and Mapping and Open Source Map Making Technologies. Our subject was Open Sources Mapmaking Technologies. This course introduced several open sources technologies to handle maps and geographic information in very flexible and powerful way. To unleash the power of maps and geographic data handling we chain several different components to get the better of each one.

**Faculties**
Dr. Jorge Rocha, Professor of Computer Science since 2005, at University of Minho taught us about open source development, crowd sourcing and community engagement. He is the Head of the GIS research Lab at the University of Minho.

Dr. Zhijie Zhang, Associate Professor in Fudan University and is the leader of GIS Training Centre and the Laboratory for Spatial Analysis and Modelling in the School of Public Health.

**Course Content**
Websites: OSGeo, mapmaking.info, Geofabrik.de.

**Daily activities:**
We learnt about:
Desktop GIS with QGIS,
Geographic database,
Publishing maps on the web and
Developing map based web development.

On the very First day we installed OSGeo Live. We understood the difference between Desktop GIS with QGIS. On day following topics were covered:
Learning about QGIS: features of QGIS, Exploring the interface of QGIS. Exploring vector data: map navigation, electing and deselecting features, filtering features, managing the selection, saving the selection, managing layers, creating group layers, styling, managing projects.
Exercise on province in China.

Actions on features: Review available attributes, styling provinces, defining actions, trigger actions.

Exercise on Wuhan in Hubei.

Vector analysis: We had an exercise on the shapefiles of highway, building and Wuhan. We calculated the Buffer around selected features and calculate the affected buildings. And at last we calculate the area and cost of amount for particular buffered area.
Georeferencing maps:

Project setup, layer order and style, activate georeference plugin

Creating vector data: Setup the Project, creating new shapefiles, digitizing features, styling features.

Working with raster data: Downloading the Digital Terrain Model, Reprojecting the DTM, sampling raster data, DEM analysis- Hill shade, Slope and Aspect.
Introducing SQL with geometry types: Starting PGAdmin-III, creating new database, Importing data, Introducing SQL, SQL queries, Introducing PostGIS Spatial support.

Exploring PostGresSQL data with QGIS: DB manager plugin, showing queries.

Database triggers: Creating new tables to define triggers, testing the triggers.

Routing with OSM data:
Routing on OpenstreetMap, Downloading Routino, compiling Routino, calculating a route in terminal emulator, Routino web configuration, Update Openstreet Map automatically.
Preparing maps with Tilemill: Styling maps with Tilemill, Creating new project, exploring the layer panel, improving the default style, Conditional style, Exporting Maps, Serving tiles.

Publishing online with CartoDB.
CartoDB is the name of an incredible stack of open source tools to make dynamic maps on the web. CartoDB was developed by Vizzuality and they provide a CartoDB up and running that we can use for free (small maps). To do these exercises, we will create a free account on CartoDB and use it to publish some maps on the web. We can use the SQL panel to create a map from a query.
R-Info:
Introduction to the software, getting start with R, Spatial data analysis, Basic functions.

Project Preparation and presentation.

Conclusion:
The course was based on learning multiple software’s because open source is based on multiple applications. So, to produce an outcome which can be shared globally, it is necessary to get the best out of multiple software’s. This course is actually helpful in the present world as we need to handle large database and it is impossible to handle such database without a common interface.
3.4 Geospatial Services Platform for Education and Research
(Faculty: - Dr. Huayi Wu, Dr. Peng Yue, Dr. Wanshou Jiang, Dr. Wei Guo, Wuhan University)

Aim:

The course of Geospatial Services Platform for education and research has a motive of share cutting-edge achievements of a geospatial service platform with Students and researcher. The content of the course includes the basic knowledge introduction and exercises. In this course Students can learn how to use online service platforms for geospatial resource sharing and problem-solving.

Geospatial Services platform for education and research contain the three topics
1. Web Services
2. Microsoft Azure Platform
3. Geo Square and Geo C

Web services is a method of communication between two electronic devices over a network. It is a software function provided at a network address over the web with the service always on as in the concept of utility computing.

Different books and different organizations give different definitions to Web Services. Few definitions are given here and all the definitions are correct.

A web service is any piece of software that makes it available over the internet and uses a standardized XML messaging system. XML is used to encode all communications to a web service. For example, a client invokes a web service by sending an XML message, and then waits for a corresponding XML response. Because all communication is in XML, web services are not tied to any one operating system or programming language--Java can talk with Perl; Windows applications can talk with UNIX applications.

Web Services are self-contained, modular, distributed, dynamic applications that can be described, published, located, or invoked over the network to create products, processes, and supply chains. These applications can be local, distributed, or Web-based. Web services are built on top of open standards such as TCP/IP, HTTP, Java, HTML, and XML. Web services are XML-based information exchange systems that use the Internet for direct application-to-application interaction. These systems can include programs, objects, messages, or documents.

A web service is a collection of open protocols and standards used for exchanging data between applications or systems. Software applications written in various programming languages and running on various platforms can use web services to exchange data over computer networks like the Internet in a manner similar to inter-process communication on a single computer. This interoperability (e.g., between Java and Python, or Windows and Linux applications) is due to the use of open standards.

The basic Web services platform is XML + HTTP. All the standard Web Services works using following components
1. SOAP (Simple Object Access Protocol)
2. UDDI (Universal Description, Discovery and Integration)
3. WSDL (Web Services Description Language)

How the Web Services Work

Java-based Web Service on Solaris that is accessible from your Visual Basic program that runs on Windows. You can also use C# to build new Web Services on Windows that can be invoked from your Web application that is based on Java Server Pages (JSP) and runs on Linux and windows. Two example of web services were performed:
1. To calculate the different formulas using Web Services (Calculator)
2. To print a text on the web page (Hello World with person name)

The project which were given as an exercise to the students are
1. Average Filtering
2. Buffer Analysis
3. Publish both of above in the webpage using web services. For that we are using Eclipse for writing code and Internet Browser. With the Web Services we had also learn a software

**GEOJModelBuilder.**

GEOJModelBuilder is developed by Dr. Peng and his Team at State Key Laboratory of Information Engineering in Surveying, Mapping and Remote Sensing (LIESMARS), Wuhan University. GEOJModelBuilder is an open-source (released under the GNU General Public License version 2) model builder tool that couples geospatial Web services, NASA World Wind and Sensor Web to support geoprocessing modeling and environmental monitoring. The tool can allow users to drag and drop various geospatial services to visually generate workflows and interact with the workflows in a virtual globe environment. It also allows users to audit trails of workflow executions, check the provenance of data products, and support scientific reproducibility.

GEOJModelBuilder contains four modules:

1. **Geoprocessing Workflow Designer:** A scientific workflow can be visually generated by dragging and dropping various geospatial services. The implementation follows the Model-View-Control pattern. Graphics are stored separately with models. This tool separates geoprocessing workflow from the Web service and data which is flexible in that we can choose alternative services or data when the workflow is executed.

2. **Model Executor:** A workflow execution engine is implemented to transform a geoprocessing workflow into an executable workflow, monitor the status of execution and record the provenance.

3. **Service and data management:** This module’s functionality is to manage services and data. OGC-Standard services, such as Web Processing Service (WPS), Web Feature Service (WFS), and Sensor Observation Service (SOS) can be managed as fundamental tools to construct workflows. NASA World Wind is available for the visualization of sensors, input data and results.

4. **Environmental Monitor:** Sensor Web services such as SOS, SES and WNS are used in environmental monitoring. A middleware named SES Middleware is proposed to integrate SOS, SES, WNS and WPS. They are responsible for observations, user subscription, user notification and data processing.
The example has carried out in the class and the project has allocated to develop a flood modelling:

*Microsoft Azure* is Microsoft's operating system for cloud computing. Technologies for cloud computing, Windows Azure is intended to simplify IT management and minimize up-front and ongoing expenses. To this end, Azure was designed to facilitate the management of scalable Web applications over the Internet. The hosting and management environment is maintained at Microsoft data centers.

*Windows Azure* can be used to create, distribute and upgrade Web applications without the need to maintain expensive, often underutilized resources onsite. New Web services and applications can be written and debugged with a minimum of overhead and personnel expense. New capabilities can be added "on the fly" to existing packaged applications.

The Azure operating system is the central component of the company's Azure Services Platform, which also includes separate application, security, storage and virtualization service layers and a desktop development environment.

A feature called Automated Service Management facilitates application upgrading without compromising performance. Functions such as load balancing, caching, fault tolerance and redundancy are included to ensure high availability.

Windows Azure supports a wide variety of Microsoft and third-party standards, protocols, programming languages and platforms. Examples include XML (Extensible Markup Language), REST (representational state transfer), SOAP (Simple Object Access Protocol), Eclipse, Ruby, PHP and Python.

In Microsoft Azure we learn the following Topics:

1. An understanding of cloud computing
   Why and when you would use it in scientific or other research
2. Virtual machines Windows Server & Linux
   - Wide variety of pre-configured virtual machines available from the gallery
   - How to make your own virtual machine from an existing installation
   - An example using Windows and Visual Studio
   - An example using Linux and IPython notebook
3. Cloud Services and Service Bus Queue
   - Windows Azure Compute Options
   - What is a Cloud Service
   - Traditional Architecture Challenge
   - What is a SB Queue
   - Scalable Architecture with SB Queues
4. Running HPC Server in Windows Azure
   - Microsoft's High Performance Computing (HPC) distributed computing Server
   - A design pattern for scaling parameter sweep/map reduce for scientific analysis using standard tools with Windows HPC
Examples of when this is useful for research scientists

5. Introduction to HDInsight and Big Data
   - Big data analytics using HD Insight and Horton works HDP
   - Azure SQL and no-SQL concepts.
   - Examples of when this is useful for research scientists

6. Installing a Linux on Azure System and run the Commands on the Command Line

**GeoSquare** is a web platform for Geographic information resource discovery, sharing and the user could access GeoSquare through its website [www.geosquare.org](http://www.geosquare.org), registered users have permission to query resources and invoke the service.

Geospatial Service Web (GSW) is a virtual network of intelligent geographical information analysis and decision support tools that incorporate latest progress in Geoscience research.

GSW provides intelligent web-based services including the semantic integration of geospatial information, automated geographic ontology mapping, geospatial semantic reasoning and knowledge discovery, and integration and sharing of geospatial semantics in heterogeneous environments.

In December 2011, the first version of integrated GSW prototype, GeoSquare was released. The GeoSquare project was initiated by International Collaborative Center for Geocomputation Studies (ICCGS) and sponsored by State Key Laboratory for Information Engineering in Surveying, Mapping and Remote Sensing (LIESMARS) at Wuhan University. It provides a web-based platform to encourage geospatial data, information, and knowledge sharing through highly interactive and expressive graphic interfaces. GeoSquare integrates heterogeneous and distributed geospatial data, service, and infrastructure.

The GeoSquare project was implemented based on common Web technologies such as the enterprise Web portal, Rich Internet Applications, Java User Interface toolkits, and workflow engines. Most of these technologies are built upon open source standards and easy to develop. These technologies ensure the delivery of content-rich and cross-platform applications. In addition, the compliance of Web Services and OGC standards significantly promotes GeoSquare interoperability.

GeoSquare integrates complex service chaining tools (GeoChaining), open high-performance geoprocessing platform (OpenRS), and three-dimensional visualization clients (GeoGlobe) into an integrated environment. GeoSquare is capable of manipulating Internet-based GIServices and other geospatial resources with easy-to-use user interfaces.

GeoSquare consists of three tiers: application tier, server tier, and resource tier.

1. **Application tier**
   The web portal is the entrance of the GeoSquare. The data and service registry center are physical computer servers where geographic data, information, and knowledge are stored. In registry center, users can register (or upload) the geospatial data, giservice, and geoprocessing model for sharing in public or local group. GeoChaining plays a central role in GeoSquare because it seamlessly connects to a data and service registration center and incorporates GeoGlobe as built-in visualization environments. All registered geospatial resources can be readily accessed in GeoChaining, in which quality information of resources is also available. With GeoGlobe visualization capabilities, users can directly observe remote geospatial resources (e.g. data, geoprocessing, and WMS service) as well as final execution results of GIService chains.
(2) **Server tier**

All the server components supporting the registry center and GeoChaining are in server tier, including the workflow engine, WMS crawler, WMS monitor, status monitor, and so on. This tier is responsible for all the geoprocessing logic. When a user registers a geodata, the data parsing module would extract the metadata and store the information into the resource tier. The FTP server is used to upload the large volume of geodata. Different geoprocessing service can be orchestrated into a geoprocessing service composition model which executes in the workflow engine.

The WMS crawler and WMS monitor focus on searching for WMS resource and QoS supervising. The status monitor was designed to be in charge of collecting the running status of component geospatial web services in a geoprocessing service chain.

(3) **Resource tier**

Microsoft Azure platform provides a Cloud environment to help developers build, host, and scale applications through Microsoft data centers. It provides a platform for running Windows applications and storing their data in the Cloud. Geoprocessing functions can be deployed in Microsoft Azure to provide more scalable and reliable services. Currently, the GeoSquare platform is built on Windows Azure Cloud for better performance and user experience. GeoChaining is work same as the GeoSquare but GeoSquare is based on web Platform but GeoChaining is the Desktop Based but it connect with the GeoSquare through username and password and work it.

At the end of the summer school the learning was how the web services are used to develop own website and how professional cloud Microsoft Azure is used to develop a webpage also install a Virtual machine and how to install a software in the virtual machine and used it for development instead of installing all the software to the computers some time some software are not supported some operating system than it needs to install virtual machine for temporary and get the result for the research purpose. It can upload the work on the cloud and get some comments on it. We can enhance and use the ready available tool on the cloud for the research. With the GeoSquare and GeoChaining have a capacity to develop algorithms and upload on its own page. GeoJmodeler have a capability to develop algorithm model and run it for the result.
4. Some memorable events in China

4.1 Educational Tours in Wuhan

Tours in Wuhan were combined with the technical tour, historical tour along with entertainment. A visit to any place provides a person with a lot of experience. In China, apart from experience the visits left for us some sweet memories to come back with. The visit in Wuhan was mainly for educational purpose. The organizers of Wuhan University included some surprises for all of us. We all, the students and the teachers did not go back empty handed but took away lots of love and wishes from the University and the stay in Wuhan. The first tour was a technical tour i.e. the visit to the GeoStar Company which was one of the sponsors of ISPRS Mid-term Symposium.

Visit to Geo Star Company

Wuda geo informatics co. ltd with its innovative technology and intellectual property rights is the only high tech company in China which can provide services covering the entire life cycle of geo spatial information, from fast spatial data acquisition through production, to integration and management, sharing and publishing. Among Geo spatial companies in china, Geo star has the most inclusive and prestigious photogrammetry qualifications. Geo star soft wares, one of the company’s leading products is the exclusive GIS development platform used for China state grid and is the most popular softwares for public in china. Since 1993 the product has won many National awards for technological innovations and achievements. GeoStar performs spatial data services for clients worldwide. Located in Wuhan, Central China, the company has been providing high quality services to European and American partners for almost a decade. The goal of the company is innovation, developing new GIS products and solutions, extending Geospatial technology into new industries and new fields, to empower users to achieve their goal through geospatial intelligence.

A visit to Geo star company as a part of ISPRS Conference on 21st of May, 2014 was organized for all the students, delegates and members of the committee. The main purpose behind the visit was to give a brief about the company and it’s working, also to help aspiring Geo informatics students to understand the work at professional level.

Company tour started with a brief introduction about the working staff. Two of the staff members accompanied the group for the tour. As per the tour, the company is subdivided in working which includes development of software and its application.

The working of the company is divided floor-wise. The base level works in the direction of software development. A team of thirty people were working as a part of the same. The other floor works in the direction of using the application and improvement of the same. The company also works in the field of photogrammetry, UAV and IT related software’s.

A presentation about the company profile, policy and progress in the past years was given. The vice president of the company gave a speech about the company’s upcoming projects and vote of thanks for Wuhan University.

The tour was followed by Dinner hosted by Geo star company. The meeting with delegates and known personalities proved to be helpful for students, trainees, new comers in this field.

Visit to Three Gorges Dam

The next visit was the Three Gorges Dam, one of the main infrastructure projects in China. The Three Gorges Dam is a hydroelectric dam that spans the Yangtze River by the town of Sandouping, located in Yiling District, Yichang, Hubei province, China. The Three
Gorges Dam is the world's largest power station in terms of installed capacity (22,500 MW).

A visit to Three Gorges Dam was organized by Wuhan University on cost basis for the participants, committee members and students who came for the ISPRS meet. The journey was made by train, followed by bus to the place of visit. The group was directly taken to the place where the model of the dam was placed. It was demonstrated that the dam is a hydroelectric project that spans Yangtze River by the Yelling district, Hubei province, China. It is the world’s largest power station in terms of installed capacity (22,500 MW). In 2012, the amount of electricity generated was the highest. The dam was completed and fully functional by July 4, 2012, when the last of the main turbines in the underground plant began production. Each main turbine has a capacity of 700 MW. The dam body was completed in 2006. Coupling the dam’s 32 main turbines with 2 smaller generators (50 MW) each to power the plant itself, the total electric generating capacity of the dam is 22500 MW.

As well as producing electricity, the dam is intended to increase the Yangtze River’s shipping capacity and reduce the potential for floods downstream by providing flood storage space. The Chinese government regards the project as a historic engineering, social and economic success, the design of the state of the art large turbines, and a move towards limiting greenhouse gas emission. However, the dam flooded archeological and cultural sites and displaced some 1.3 million people and is causing significant ecological changes, including an increased risk of landslides. The dam has been a controversial topic both domestically and abroad.

Made of concrete and steel, the dam is 2,335 m (7,661 ft.) long and the top of the dam is 185 meters (607 ft.) above sea level. The project used 27.2 million cubic meters (35.6×106 cu yd.) of concrete (mainly for the dam wall), 463,000 tons of steel (enough to build 63 Eiffel Towers) and moved about 102.6 million cubic meters (134.2×106 cu yd.) of earth. The concrete dam wall is 181 meters (594 ft.) high above the rock basis.

When the water level is at its maximum of 175 meters (574 ft.) above sea level, which is 110 meters (361 ft.) higher than the river level downstream, the dam reservoir is on average about 660 km (410 mi) in length and 1.12 km (3,700 ft.) in width. It contains 39.3 km3 (31,900,000 acre·ft) of water and has a total surface area of 1,045 square km (403 sq. mi). On completion, the reservoir flooded a total area of 632 square km (244 sq. mi) of land, compared to the 1,350 square km (520 sq. mi) of reservoir created by the Itaipu Dam. A large dam across the Yangtze River was originally envisioned by Sun Yat-sen in The International Development of China, in 1919. He stated that a dam capable of generating 30 million horsepower (22 GW) was possible downstream of the Three Gorges. In 1932, the Nationalist government, led by Chiang Kai-shek, began preliminary work on plans in the Three Gorges.
In 1939, Japanese military forces occupied Yichang and surveyed the area. A design, the Otani plan, was completed for the dam in anticipation of a Japanese victory over China.

In 1944, the United States Bureau of Reclamation chief design engineer, John L. Savage, surveyed the area and drew up a dam proposal for the 'Yangtze River Project'. Some 54 Chinese engineers went to the U.S. for training. The original plans called for the dam to employ a unique method for moving ships; the ships would move into locks located at the lower and upper ends of the dam and then cranes with cables would move the ships from one lock to the next. In the case of smaller water craft, groups of craft would be lifted together for efficiency. It is not known whether this solution was considered for its water-saving performance or because the engineers thought the difference in height between the river above and below the dam too great for alternative methods.

After the 1949 Communist takeover, Mao Zedong supported the project, but began the Gezhouba Dam project nearby first, and economic problems including the Great Leap Forward and the Cultural Revolution slowed progress. After the 1954 Yangtze River Floods, in 1956, Mao Zedong authored "Swimming", a poem about his fascination with a dam on the Yangtze River. In 1958, after the Hundred Flowers Campaign, some engineers who spoke out against the project were imprisoned.

During the 1980s, the idea of a dam reemerged. The National People's Congress approved the dam in 1992: out of 2,633 delegates, 1,767 voted in favour, 177 voted against, 664 forfeited, and 25 members did not vote. Construction started on December 14, 1994. The dam was expected to be fully operational in 2009, but additional projects, such as the underground power plant with six additional generators, delayed full operation until May 2012. The ship lift is expected to be completed in 2014. The dam had raised the water level in the reservoir to 172.5 m (566 ft.) above sea level by the end of 2008 and the designed maximum level of 175 m (574 ft.) by October 2010.

The area of interest was the scenic beauty and also the architectural pillars and statues. The capacity of the tourists that can be handled by the place is 60,000 per day. One of the interesting points to note was the escalator at each level on the hilly terrain which made it more comfortable and accessible for the people. It turned out to be more interesting because the view of the project was demonstrated at three different platforms, which were at three different levels. The trip turned out to be very interesting as the students were amazed by the grandeur and functionality of the project.

Visit to history Museum of Wuhan University

A visit to the Museum of Wuhan University was organized as a part of summer school held by Wuhan University on 25th May, 2014. This museum was initially used as a library. It was the oldest library in Wuhan and now used as an auditorium. Lectures by noble delegates are organized in this historical place. An interesting thing to note is that the logo of Wuhan University was inspired by the same.
This library was built by a German Architect. It has a collection of over 200,000 objects, including the sword of Goujian, an ancient set of bronze bells and extensive artifacts from the tomb of Marquis Yi of Zeng and tombs Baoshan. The particular importance of several of the archeological elements is recognized by the national government by including them in the short list of Chinese cultural relics forbidden to be exhibited abroad.

As a part of the tour, the group was taken around the building and a presentation about the history of the museum was given. Pictures of the history of this building and documents of historical importance were displayed on the different floors of the building.

As a part of student activity session, badminton tournament was organized to encourage the activity. All the group members participated enthusiastically and showed great zeal in the sport. Even the faculty members very sportingly participated and even played very well.

This was followed by a dinner organized in a restaurant within the campus of the Wuhan University. It is important to mention that there were special arrangements for vegetarian food. The university still kept some surprises. The evening ended with a movie show in the auditorium of LIESMARS.
4.2 Education Tours in Beijing

During our short stay in Beijing, we visited some very important places:-

*Summer Palace*

The Summer Palace is located northwest of Beijing's center in Haidian District, between the Fourth and Fifth Ring Roads. Head north at Suzhou Bridge on the north-western 3rd Ring Road, north at Sihai Bridge on the north-western 4th Ring Road, or south at the northern 5th Ring Road at the Zhongguancun/Beiqing Road exit. Public transportation also serves the Summer Palace.

The Summer Palace started out life as the 'Garden of Clear Ripples' in 1750 (Reign Year 15 of Qianlong Emperor). Artisans reproduced the garden architecture styles of various palaces in China. Kunming Lake was created by extending an existing body of water to imitate the West Lake in Hangzhou. The palace complex suffered two major attacks—during the Anglo-French allied invasion of 1860 (with the Old Summer Palace also ransacked at the same time), and during the Boxer Rebellion, in an attack by the eight allied powers in 1900. The garden survived and was rebuilt in 1886 and 1902. In 1888, it was given the current name, Yihe Yuan. It served as a summer resort for Empress Dowager Cixi, who diverted 3 million taels of silver, said to be originally designated for the Chinese navy (Beiyang Fleet), into the reconstruction and enlargement of the Summer Palace.

The Summer Palace is a vast ensemble of lakes, gardens and palaces in Beijing, China. The Summer Palace is mainly dominated by Longevity Hill and the Kunming Lake. It covers an expanse of 2.9 square km (720 acres), three-quarters of which is water. Longevity Hill is about 60 metres (200 feet) high and has many buildings positioned in sequence. The front hill is rich with splendid halls and pavilions, while the back hill, in sharp contrast, is quiet with natural beauty.

The central Kunming Lake covering 2.2 square km (540 acres) was entirely man-made and the excavated soil was used to build Longevity Hill. In the Summer Palace, one finds a variety of palaces, gardens, and other classical-style architectural structures.

In December 1998, UNESCO included the Summer Palace on its World Heritage List. It declared the Summer Palace "a masterpiece of Chinese landscape garden design. The natural landscape of hills and open water is combined with artificial features such as pavilions, halls, palaces, temples and bridges to form a harmonious ensemble of outstanding aesthetic value." It is a popular tourist destination but also serves as a recreational park.
On its southern slope, Longevity Hill is adorned with an ensemble of grand buildings: The Cloud-Dispelling Hall, the Temple of Buddhist Virtue, and the Sea of Wisdom Temple form a south-north (lakeside - peak) oriented axis which is flanked by various other buildings. In the center of the Temple of Buddhist Virtue stands the Tower of Buddhist Incense (Fo Xiang Ge), this forms the focal point for the buildings on the southern slope of Longevity Hill. The tower is built on a 20-meter-tall stone base, is 41 meters high with three stories and supported by eight ironwood (lignumvitae) pillars.

*The Great Wall of China*

The Great Wall of China is a series of fortifications made of stone, brick, tamped earth, wood, and other materials, generally built along an east-to-west line across the historical northern borders of China in part to protect the Chinese Empire or its prototypical states against intrusions by various nomadic groups or military incursions by various warlike peoples or forces. Several walls were being built as early as the 7th century BC; these, later joined together and made bigger and stronger, are now collectively referred to as the Great Wall. Especially famous is the wall built between 220–206 BC by the first Emperor of China, Qin Shi Huang. Little of that wall remains. Since then, the Great Wall has on and off been rebuilt, maintained, and enhanced; the majority of the existing wall is from the Ming Dynasty. Other purposes of the Great Wall have included border controls, allowing the imposition of duties on goods transported along the Silk Road, regulation or encouragement of trade and the control of immigration and emigration. Furthermore, the defensive characteristics of the Great Wall were enhanced by the construction of watch towers, troop barracks, garrison stations, signaling capabilities through the means of smoke or fire, and the fact that the path of the Great Wall also served as a transportation corridor.

The main Great Wall line stretches from Shanhaiguan in the east, to Lop Lake in the west, along an arc that roughly delineates the southern edge of Inner Mongolia. A comprehensive archaeological survey, using advanced technologies, has concluded that the Ming walls measure 8,850 km. This is made up of 6,259 km sections of actual wall, 359 km (223 mi) of trenches and 2,232 km of natural defensive barriers such as hills and rivers. Another archaeological survey found that the entire wall with all of its branches measure out to be 21,196 km.
Juyongguan Pass of Great Wall of China

Juyongguan Pass is located 20 kilometers (12 miles) north of Changping County, about 60 kilometers (37 miles) from Beijing. It is a renowned pass of the Great Wall of China. Enlisted in the World Heritage Directory in 1987, it is a national cultural protection unit.

Situated in a valley surrounded by mountains, Juyongguan Pass has long been a military stronghold. As early as the spring and Autumn Period (770BC-476BC) and Warring States Period (476BC-221BC), the Yan State built fortifications here. In the Northern and Southern Dynasties (386-589), this section was linked to the Great Wall of China. This pass served as a natural barrier to the capital of Yuan (1271-1368) and Ming (1368-1644) Dynasties. Therefore, immediately after the founding of his reign, Zhu Yuanzhang, the first emperor of the Ming Dynasty, ordered the pass to be rebuilt to protect the borders from intrusions of the Mongolian tribe. Many fierce battles were fought here.

The pass is roughly circular with a perimeter of about 4,142 meters (about 4,530 yards). It consists of two passes, one in the south, one in the north, respectively called 'Nan Kou' and 'Badaling'. In the middle of the pass lies a high platform called 'Cloud Platform', which is made of white marble. In the Yuan Dynasty, three stone towers were built on the platform. At the end of Yuan Dynasty, they were burnt down. Later, a temple called 'Tai'an' was built on the site, but it was burnt down during the reign of Emperor Kang Xi of Qing Dynasty (1644-1911), after which only the platform remained. Inside the platform is an arched doorway. On the walls of the doorway, the statues of four heavenly gods and sutra scriptures are carved.

Juyongguan Great Wall Juyongguan Pass is not just a military stronghold, but also a beautiful scenic spot. Around the pass, beautiful flowers and lush trees dot the mountains. A splendid picture! As early as the Jin Dynasty (1115-1234), it was named as one of the eight best scenery of Beijing. The extant pass was built in the Ming Dynasty. In the Qing Dynasty, reconstruction work was neglected. In 1992 and 2000, the pass was renovated.

Tombs of Ming Dynasty

50 kilometers northwest from Beijing City, at the foot of Tianshou Mountain, is the Ming Tombs Scenic Area, where lie the mausoleums of thirteen emperors of the Ming Dynasty (1368 - 1644). Since 1409 when Zhu Di, the first emperor of the Ming Dynasty, built his Changling Tomb here, the succeeding twelve emperors had their tombs built around Changling during the next 230 years, covering a total area of over 120 square kilometers. This is the best preserved tomb area with the most emperors buried. Every year millions of tourists come to the site to appreciate its long history and palatial architecture.
In the scenic area, each mausoleum has its own independent unit. The layout and arrangement of all the thirteen mausoleums are very similar, but they vary in size as well as in the complexity of their structures. Each of the tombs was built in an area at the foot of the mountain, with distances ranging from half a kilometer to eight kilometers between them. The other tombs stretch out on the two sides of Changling Tomb in a fan shape, except for the Siling Tomb, which sits separately in the southwest corner. From site selection to design, great attention was paid to the harmony and unity with nature, pursuing a perfect situation of ‘made by God’ and reflecting the philosophy ‘the unity of heaven and humanity’. As outstanding representatives of the ancient Chinese mausoleum, the Ming Tombs demonstrate the richness of traditional Chinese culture.

**Changling Sacred Way**

The Sacred Way, also known as Changling Sacred Way, is the approach to the Changling Tomb. Along the Way from south to north, you will see a number of sites (or sights) of interest and beauty, including the Stone Tablet Archway, Great Red Gate, Tablet Pavilion, Ornamental Columns, Stone Figures, Lingxin Gate.

In the front part of the imperial necropolises, there usually is a Sacred Way (or Divine Road) which means the road leading to heaven. The Emperor, known as the Son of the Heaven, who came from Heaven to his country through the Sacred Way, also deservedly would return to Heaven through this road.

The road is often lined with stone statues which are important decorations of the mausoleum. These statues are usually 12 human figures (including the general, civil officials and meritorious officials) and 24 animals which are lion, camel, elephant, Xiezhi (a mythological unicorn), Qilin (one of the four "divine animals, the other three are dragon, phoenix and tortoise), and horse. There are 4 of each of these animals: two standing and two squatting with different meanings. Lion symbolizes awesome solemnity because of their ferocity. Camel and elephant are meant to suggest the vastness of the territory controlled by the court, because they are dependable transport in desert and tropics. Xiezhi was put there to keep evil spirits away, because it was believed to possess the sixth sense to tell right and wrong. If two men fight, a Xiezhi would gore the wicked one. Qilin, an auspicious symbol, was placed on two sides. Horse, as the emperor's mount, is absolutely indispensable. It is said that these animals is supposed to change guard at midnight.
Established in 1911, Tsinghua University is one of the most famous universities of China, as well as a well-known institute of high education and advanced research of China. By the end of 2009, Tsinghua had 15 schools, 55 departments and a faculty of 7,062, including 1,232 professors, 1,727 associate professors and 2,829 lecturers; among them, 37 were member of China Academy of Science and 34 were member of China Academy of Engineering. Meanwhile, it had 35,369 students, including 1,765 international students; among them, 14,285 were undergraduate (including 886 international ones), 14,090 were graduate (including 886 international ones), and 6,994 were doctorate (including 125 international ones).

As one of Tsinghua University’s 15 schools, Tsinghua University’s School of Architecture (referred to as Tsinghua SA or the School hereafter) was transformed in 1988 from the former Department of Architecture which was established by Prof. Liang Sicheng in October 1946. Currently, it is composed of four departments, nine research institutes, three professional practical sites, and three ministerial laboratories. In addition, the Institute of Architectural & Urban Studies, the Center for Human Settlements, and the Research Center of Building Energy-Saving affiliated to Tsinghua University are also located at School of Architecture.

Since the institutions of accreditation on undergraduate and graduate programs of architectural design and graduate programs of urban planning were implemented in China respectively in 1992, 1995 and 1998, Tsinghua SA has passed all the accreditations with the remark of excellent. And in the National Assessment on Architecture carried out by China Degree & Graduate Development Center in 2003, Tsinghua SA ranked No. 1 among China’s schools of architecture and took the leading position again in 2008 in the second national assessment. Currently, Tsinghua SA has a faculty of 107, including 36 professors, 50 associate professors and 21 lecturers. Among them, four are member of China Academy of Science or/and China Academy of Technology, and four are from overseas. 85, or 80%, of the faculty have a doctoral degree and 67, or 63%, have an either academic or professional experience of at least 6 months abroad. The faculty team of high quality in terms of knowledge, passion, competence, and innovation becomes a fundamental guarantee to the high quality of education.
Since its establishment in 1946, Tsinghua SA has insisted on the goal of cultivating professional leaders of architecture and gradually confirmed its development strategy of being based on the Sciences of Human Settlements, paying due attention to the requirements of China’s construction and development and the challenges of academic frontiers, and combining education with research and practice. In the past decades, the School has finished over a hundred research projects commissioned by the government of various levels, as well as international collaborative research projects, which cover the fields of regional study, urban and rural study, urban planning and design, housing, architectural design and theory, architectural history and historic preservation, landscape planning & design, tourism planning and natural preservation, ecological planning and green architecture, built environment simulation and building energy-saving, computer aided design GIS and remote sensing, and so on.

Tsinghua SA has a high reputation both at home and abroad with thanks to its high quality of education and research. Every year, it can attract the best graduates of high school all over China through the National College Entry Examination. At the end of 2009, there were 977 registered students of architecture at Tsinghua SA, including 47 international students. Among them, 432 were undergraduate student (including 18 international one), 382 were graduate student (including 22 international one), and 158 were doctorate student (including 7 international ones).

Tiananmen Square

Tiananmen Square is a large city square in the center of Beijing, China, named after the Tiananmen gate (Gate of Heavenly Peace) located to its North, separating it from the Forbidden City. Tiananmen Square is the fourth largest city square in the world (440,000 m² – 880×500 m or 109 acres – 960×550 yd). It has great cultural significance as it was the site of several important events in Chinese history.

Outside China, the square is best known in recent memory as the focal point of the Tiananmen Square protests of 1989, a pro-democracy movement which ended on 4 June 1989 with the declaration of martial law in Beijing by the government and the shooting of several hundred or possibly thousands of civilians by soldiers.

The Tiananmen Gate to the Forbidden City was built in 1415 during the Ming Dynasty. Heavy fighting between Li Zicheng and the early Qing emperors damaged (or perhaps destroyed) the gate towards the demise of the Ming Dynasty. The Tiananmen Square was designed and built in 1651, and has since enlarged four times its original size in the 1950s.

Near the center of today's square, stood the "Great Ming Gate", the southern gate to the Imperial City, renamed "Great Qing Gate" during the Qing Dynasty, and "Gate of China" during the Republic of China era. Unlike the other gates in Beijing, such as the Tiananmen and the Qianmen, this was a purely ceremonial gateway, with three arches but no ramparts, similar in style to the ceremonial gateways found in the Ming Dynasty Tombs. This gate had a special status as the "Gate of the Nation", as can be seen from its successive names. It normally
remained closed, except when the Emperor passed through. Commoner traffic was diverted to side gates at the western and eastern ends of today's square, respectively. Because of this diversion in traffic, a busy marketplace, called Chessgrid Streets developed in the big, fenced square to the south of this gate.

British and French troops who invaded Beijing in 1860 pitched camp near the gate and briefly considered burning down the gate and the entire Forbidden City. They decided ultimately to spare the palace and to burn instead the emperor's Old Summer Palace. The Qing emperor eventually agreed to let the foreign powers barrack troops – and later establish diplomatic missions – in the area, resulting in the Legation Quarter immediately to the east of the modern square. During the Boxer Rebellion of 1900 the siege badly damaged the office complexes and several ministries were burnt down. In the conflict's denouement, the area became a space for foreign troops to assemble their armies and horses.

In 1954, the Gate of China was demolished, allowing for the enlargement of the square. In November 1958 a major expansion of Tiananmen Square started, which was completed after only 11 months, in August 1959. This followed the vision of Mao Zedong to make the square the largest and most spectacular in the world, and intended to hold over 500,000 people. In that process, a large number of residential buildings and other structures have been demolished. On its southern edge, the Monument to the People's Heroes has been erected. Concomitantly, as part of the Ten Great Buildings constructed between 1958–59 to commemorate the ten-year anniversary of the People's Republic of China, the Great Hall of the People and the Revolutionary History Museum (now National Museum of China) were erected on the western and eastern sides of the square.

The year after Mao's death in 1976, a Mausoleum was built near the site of the former Gate of China, on the main north-south axis of the square. In connection with this project, the square was further increased in size to become fully rectangular and being able to accommodate 600,000 persons.

The urban context of the square was altered in the 1990s with the construction of National Grand Theatre in its vicinity and the expansion of the National Museum. Tiananmen Square has been the site of a number of political events and student protests. Perhaps the most notable events are protests during the May Fourth Movement in 1919, the proclamation of the People's Republic of China by Mao Zedong on October 1, 1949, the Tiananmen Square protests in 1976 after the death of Premier Zhou Enlai, and the Tiananmen Square protests of 1989, which resulted in military suppression and the deaths of hundreds, if not thousands, of civilian protestors. One of the most famous images that appeared during these protests was when a man stands in front of a moving tank and refuses to move. This became a revolutionary icon in fighting against the government at the time.

Other notable events include annual mass military displays on each anniversary of the 1949 proclamation until 1 October 1959; the 1984 military parade for the 35th anniversary of the People's Republic of China which coincided with the ascendancy of Deng Xiaoping; the 1989 Tiananmen Square massacre; military displays and parades on the 50th anniversary of the People's Republic in 1999; the Tiananmen Square self-immolation incident in 2001; military
displays and parades on the 60th anniversary of the People's Republic in 2009, and an incident in 2013.

Forbidden City

The Forbidden City was the Chinese imperial palace from the Ming dynasty to the end of the Qing dynasty. It is located in the center of Beijing, China, and now houses the Palace Museum. For almost 500 years, it served as the home of emperors and their households, as well as the ceremonial and political center of Chinese government. Built in 1406 to 1420, the complex consists of 980 buildings and covers 72 ha (180 acres). The palace complex exemplifies traditional Chinese palatial architecture, and has influenced cultural and architectural developments in East Asia and elsewhere. The Forbidden City was declared a World Heritage Site in 1987, and is listed by UNESCO as the largest collection of preserved ancient wooden structures in the world. Since 1925, the Forbidden City has been under the charge of the Palace Museum, whose extensive collection of artwork and artifacts were built upon the imperial collections of the Ming and Qing dynasties. Part of the museum's former collection is now located in the National Palace Museum in Taipei. Both museums descend from the same institution, but were split after the Chinese Civil War. The Forbidden City is a rectangle, measuring 961 meters (3,153 ft.) from north to south and 753 meters (2,470 ft.) from east to west. It consists of 980 surviving buildings with 8,886 bays of rooms; however this figure may not include various antechambers. Another common figure points to 9,999 rooms including antechambers; although this number is frequently cited, it is likely an oral tradition, and it is not supported by survey evidence. The Forbidden City was designed to be the center of the ancient, walled city of Beijing. It is enclosed in a larger, walled area called the Imperial City. The Imperial City is, in turn, enclosed by the Inner City; to its south lies the Outer City.
The Forbidden City remains important in the civic scheme of Beijing. The central north–south axis remains the central axis of Beijing. This axis extends to the south through Tiananmen gate to Tiananmen Square, the ceremonial center of the People's Republic of China, and on to Yongdingmen. To the north, it extends through Jingshan Hill to the Bell and Drum Towers. This axis is not exactly aligned north–south, but is tilted by slightly more than two degrees. Researchers now believe that the axis was designed in the Yuan dynasty to be aligned with Xanadu, the other capital of their empire.

The Forbidden City is surrounded on three sides by imperial gardens. To the north is Jingshan Park, also known as Prospect Hill.

To the west lies Zhongnanhai, a former garden centered on two connected lakes, which now serves as the central headquarters for the Communist Party of China and the State Council of the People's Republic of China. To the north-west lies Beihai Park, also centered on a lake connected to the southern two, and a popular park. To the south of the Forbidden City were two important shrines – the Imperial Shrine of Family and the Imperial Shrine of State, where the Emperor would venerate the spirits of his ancestors and the spirit of the nation, respectively. Today, these are the Beijing Labouring People's Cultural hall.

While development is now tightly controlled in the vicinity of the Forbidden City, throughout the past century uncontrolled and sometimes politically motivated demolition and reconstruction has changed the character of the areas surrounding the Forbidden City. Since 2000, the Beijing municipal government has worked to evict governmental and military institutions occupying some historical buildings, and has established a park around the remaining parts of the Imperial City wall. In 2004, an ordinance relating to building height and planning restriction was renewed to establish the Imperial City area and the northern city area as a buffer zone for the Forbidden City. In 2005, the Imperial City and Beihai (as an extension item to the Summer Palace) were included in the shortlist for the next World Heritage Site in Beijing.
Temple of Heaven

The Temple of Heaven, literally the Altar of Heaven is a complex of religious buildings situated in the southeastern part of central Beijing. The complex was visited by the Emperors of the Ming and Qing dynasties for annual ceremonies of prayer to Heaven for good harvest. It has been regarded as a Taoist temple, although Chinese heaven worship, especially by the reigning monarch of the day, pre-dates Taoism. The Temple grounds cover 2.73 km² of parkland and comprises three main groups of constructions, all built according to strict philosophical requirements:

- The Hall of Prayer for Good Harvests is a magnificent triple-gabled circular building, 36 meters in diameter and 38 meters tall, built on three levels of marble stone base, where the Emperor prayed for good harvests. The building is completely wooden, with no nails. The original building was burned down by a fire caused by lightning in 1889. The current building was re-built several years after the incident.
- The Imperial Vault of Heaven is a single-gabled circular building, built on a single level of marble stone base. It is located south of the Hall of Prayer for Good Harvests and resembles it, but is smaller. It is surrounded by a smooth circular wall, the Echo Wall that can transmit sounds over large distances. The Imperial Vault is connected to the Hall of Prayer by the Vermilion Steps Bridge, a 360 meter long raised walkway that slowly ascends from the Vault to the Hall of Prayer.
- The Circular Mound Altar is the altar proper, located south of the Imperial Vault of Heaven. It is an empty circular platform on three levels of marble stones, each decorated by lavishly carved dragons. The numbers of various elements of the Altar, including its balusters and steps, are either the sacred number nine or its nonplus. The center of the altar is a round slate called the Heart of Heaven or the Supreme Yang, where the Emperor prayed for favorable weather. Thanks to the design of the altar, the sound of the prayer will be reflected by the guardrail, creating significant resonance, which was supposed to help the prayer communicate with the Heaven. The Altar was built in 1530 by the Jialing Emperor and rebuilt in 1740.
5. Achievements of the students

Rushikesh Padsala, 2nd Semester, M.Tech in Geomatics, CEPT University presented a poster paper during International Symposium at Wuhan University, China on 21st May 2014. His paper was on "Web Based GIS Application for Forest Right Act Implementation". This is a work of one of the senior students of Geomatics. He explained that in Madhya Pradesh, the forest dwellers have taken the Forest Rights Act upon themselves to actively engage in the effective operationalization of this Act. The Act aims to ensure that tribes and traditional forest dwellers obtain legal access to forest resources and protection from exploitation. In order to supplement government agencies, civil engineers, planners and forest dwellers with an approachable solution, a GIS based application was created to centralize geodatabase for Sheopur (Madhya Pradesh, Study Area) to provide secure data visualization based upon data collected from various ground truth sources.

Ms. Harshita Shahdadpuri, 2nd Semester, M. Tech in Geomatics, CEPT University presented on “CEPT University” in the Student Activity Session on 21st May 2014. She has presented a history of the University, its pedagogy, on the specializations offered, on the students’ activities, facilities, environment and achievements. This session included the presentations of six other international universities from where the students have come to participate.

Ms. Jayita Chakraborty, 2nd Semester, M. Plan, CEPT University and Prashanti Borthakur, Symbiosis University, Pune, currently a trainee at CEPT University presented their group work on “Swine Flu Vaccination” and “Traffic Accidents in Beijing” on 27th May 2014. There were total five presentations. Each presentation was the best presentation in their respective Theme Schools. Ms. Chakraborty has presented the origination and how swine flu got spread across china and various drivers which triggered the spread of the disease and showed how the common people be made aware of the disease with the help of social network. Ms. Prashanti in her presentation on “Traffic Accidents in Beijing” presented all the predicted traffic congested roads and accident points with hospitals in
its approachable distance in order to find shortest and quickest way to reach hospital in case of emergencies or accidents.

6. Conclusion

The course did not limit itself to the field of photogrammetry and remote-sensing, but it unfolded the multidisciplinary benefits of geoinformatics, including urban planning and land use management, in-car navigation systems, virtual globes, public health, local and national gazetteer management, environmental modeling and analysis, military, transport network planning and management, agriculture, meteorology and climate change, oceanography and coupled ocean and atmosphere modelling, business location planning, architecture and archeological reconstruction, telecommunications, criminology and crime simulation, aviation and maritime transport. The importance of the spatial dimension in assessing, monitoring and modelling various issues and problems related to sustainable management of natural resources is recognized all over the world. The course not only made the students aware of the research and development in the field of Geoinformatics, but also stretched out how cartography can become an important technology to decision-makers across a wide range of disciplines, industries, commercial sector, environmental agencies, local and national government, research, and academia, national survey and mapping organisations, International organisations, United Nations, emergency services, public health and epidemiology, crime mapping, transportation and infrastructure, information technology industries, GIS consulting firms, environmental management agencies), tourist industry, utility companies, market analysis and e-commerce, mineral exploration, etc. Many government and non-government agencies have already started to use spatial data for managing their day-to-day activities but data handling still pose a major problem to them. The course threw some light upon the future possibilities that could be offered to the government to overcome such problem. “I strongly recommend that such summer schools or Study tours especially out of India should be encouraged more so that students can get a wider scope of the field in which they are studying as well as can get a broader aspect of what is happening outside the country. This can not only help in developing subject knowledge but also help us to get a global experience and ultimately lead to good personal/professional development. It was a great experience 5/5 star to our summer school. I wish our department as well as our University organize many more knowledge gaining and interesting tours, summer/winter schools.”

Rushikesh Padsala (PT 20613)

“Working in team of seven with people from China, Russia and others proved to be interesting learning experience. Learning software designed by the students of the university encouraged and motivated me to pull my socks up. I knew that China will always have this language problem and food issue but we did manage well and sort things by either finding helpful Chinese people around with Basic English knowledge or using Google translator. The infrastructure kept my eyes wide open always. The East Lake on one side of the University, the yellow crane tower, dinner at five star hotels with Chinese cuisine (though there was nothing we could eat) all such attractions in Wuhan made this trip worth. As for suggestions I feel a team head for the whole trip if selected would have sort minor mishap at the sessions. I have a confirmed participation in all the other summer/winter schools Geomatics department is organizing.”

-Harshita Shahdadpuri (PT201213)

“The most interesting presentation I enjoyed was the one given by Ms. M Madden on the NASA DEVELOP Program at the University of Georgia. She gave description on the programme, procedure and eligibility criteria. It was highly informative. The experience we got was extremely beneficial and will definitely be a great tool for future research work. We got to make many new friends and also learnt adjusting in different places with new culture
and environment. On the whole we enjoyed enormously and at the same time got to know many new techniques and practices learnt in the field of GIS. The exposure we got would not have been fruitful without the constant present, support and motivation of our guide and instructor dearest Anjana Mam.”

- Aishwarya Sasikumar (UP0712)

“We were feeling proud to be Indian and always possess the feeling of representing our nation and the CEPT University. Whenever we get admired, we were feeling thankful to Anjana Mam, our faculty members and our university which gave us such a great opportunity and open our minds towards building our future career. We have presented about the CEPT University, we have presented a research paper through poster presentation, two of our group mates received Best Group Project award. We all were very happy to receive certificates of participation. The final part of the summer school was in Beijing. We had a tour to see the city planning, the architect of the city and the defence mechanism of the country during early era. Our Summer School ended with knowledge, fun and adding lot many new international friends.”

- Yashi Sharma (UP5512)