
ALUMNI MAGAZINE
FACULTY OF GEO-INFORMATION SCIENCE
AND EARTH OBSERVATION
UNIVERSITY OF TWENTE

ITC NEWS

OPENING ACADEMIC PROGRAMME



DIES NATALIS UT



MESA



3D BUILDING MODELS



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This year's picture is special by the appearance of Dutch Minister Lillianne Ploumen (Foreign Trade and Development Cooperation) who said to the new students of ITC: "You've come to the right place" and the appearance of Mr Victor van der Chijs (President of the Executive Board of the University of Twente) who said "The way Faculty ITC operates internationally is an example for the whole university."



INTRODUCTION

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"If I have seen a little further, it is by standing on the shoulders of giants." This graphic quotation is most famously attributed to Sir Isaac Newton, the remarkable physicist, mathematician and astronomer. And even though the concept actually dates back quite a bit earlier, surely it still strikes a chord in today's modern world of rapidly advancing technology. Somehow it seems particularly appropriate at this juncture; after all, looking through the current issue of *ITC News*, which brings 2014 to a close, you may be surprised to come across projects or research that you are already in the process of extending or developing now in 2015.

Perhaps nowadays we refer rather less to giants and rather more to cooperation and collaboration, but the stimulus remains the same: pushing back the boundaries of science and technology to ensure benefits for both people and planet. The long history of the University of Twente, and indeed the changing role of ITC itself since its inception, is an object lesson in this building process (pages 3 and 7). What's more, it is not the only example of this kind that can be found in the following pages.

Faithful readers may remember the introduction of the ITC Group Decision Room some four years ago. If you turn to page 16, you will find an article that highlights how its facilities have recently enabled local stakeholders to analyse the environmental and socio-demographic factors leading to spatial inequalities in health outcomes in Dordmund. Furthermore on the research front, software has been developed that facilitates the swift and cost-effective production of 3D building models (page 13). A great stride forward! Of course, research and revolutionary technology by their very nature may not always deliver the anticipated results (page 12). Fortunately, however, such setbacks can frequently serve as a springboard to renewed initiatives and enterprise.

So what of the future? To some extent this will lie in hands of the ITC freshmen welcomed last October by Minister Lilianne Plouman with the words: "You've come to the right place!" (page 3). Their studies may well entail many challenges – possibly in terms of research, possibly of a more personal nature (page 27) – and, although giants are unlikely to cross their curriculum path, a small piece of advice may not come amiss (page 18): "Keep a sharp lookout for wolves and bears!"

Virtually yours,
Jorien Terlouw
Editor



MAIN FEATURES

Minister Ploumen: “You’ve come to the right place”

“You’ve come to the right place” was the message of Minister Lilianne Ploumen (Foreign Trade and Development Cooperation) to the new students of ITC. Opening the Academic Programme on 1 October 2014, the Minister praised the role played by ITC worldwide.

Minister Ploumen illustrated the impact of ITC’s work using two examples: a recent UN meeting she had attended that concerned responsible land use planning, and her contacts in Indonesia regarding new opportunities for geothermal energy. In both cases, the ITC Faculty of Geo-Information Science and Earth Observation plays an important role in research, education and public-private partnerships. For Minister Ploumen, this was reason enough to address the ITC “freshmen”, who hail from all over the world, with the words: “You’ve made the right choice, because it happens here, in Twente!”

ITC dean, Professor Tom Veldkamp, outlined the history and context of ITC. Initiated as the International Training Centre for Aerial Survey in the 1950s, ITC became a UT faculty in 2010.

According to Veldkamp, the entrepreneurial and international objectives described by the UT in its Vision2020 strategy fit the profile of ITC as well. In many of the developing countries with which ITC closely cooperates, there are opportunities for entrepreneurial ITC alumni.



Minister Ploumen: “You’ve come to the right place.”



This year's picture is special by the appearance of Dutch Minister Lilianne Ploumen (Foreign Trade and Development Cooperation) who said to the new students of ITC: "You've come to the right place" and the appearance of Mr Victor van der Chijs (President of the Executive Board of the University of Twente) who said "The way Faculty ITC operates internationally is an example for the whole university."

As a living example of this, Dr Jane Bemigisha from Uganda delivered this year's Schermerhorn Lecture. An MSc and PhD alumna of ITC, she is now CEO of a company in her home country. In her lecture, she illustrated the boundary conditions for establishing a company in Uganda. Although Ugandese are known for their entrepreneurial attitude, nevertheless the failure

rate of companies is high. Dr Bemigisha's company, ESIPPS International, has almost the same bandwidth and perspective as ITC, for example using satellite data to protect the vulnerable environment. At the same time, the questionable presence of electric power supply can still be a limiting factor for starting a company.



ITC dean, Professor Tom Veldkamp, outlined the history and context of ITC.



Words of Welcome of Ms Jelena Marjanovic, on behalf of the Student Association Board.



Mr. Victor van der Chijs, Minister Ploumen and Ms Erna Leurink (Managing Director Faculty ITC).

The annual Best Paper Award went to Vincent Omondi Odongo for a paper published in the *Journal of Hydrology* and was presented to him by Dean Tom Veldkamp.

ITC students are invited to attend the Opening of the Academic Programme in the traditional dress of their home country. ■



Dr Jane Bemigisha from Uganda delivered this year's Schermerhorn Lecture.



The annual Best Paper Award went to Vincent Omondi Odongo.

THE ITC RESEARCH AWARD is presented annually to the best ISI publication by a PhD candidate (first or sole author) at ITC. This year we received nominations for 13 papers. Based on the abstracts, a shortlist of four papers was drawn up by a panel of six (one tenure track scientist from each department).

The winner of this year's ITC Research Award is Mr Vincent Odongo for his paper entitled: "Coupling socio-economic factors and eco-hydrological processes using a cascade-modelling approach", which was published in the *Journal of Hydrology*.

The paper has 10 co-authors, namely Mulatu, Muthoni, Van Oel, Meins, Van der Tol, Skidmore, Groen, Becht, Onyando and Van der Veen.

This paper was published in the prestigious *Journal of Hydrology*, in a special issue entitled "Creating Partnerships between Hydrology and Social Science: A Priority for Progress". The winning publication shows how socio-economic factors cause land cover changes, which in turn affect hydrology and ecology in a unique basin in Africa's Rift Valley. The paper stands out as a truly interdisciplinary publication, illustrating cross-disciplinary cooperation. This is evidenced by the range of co-authors from the PGM and NRS departments, including professors Van der Veen and Skidmore, as well as the WRS home department of Vincent. Furthermore, not just one but three PhD candidates contributed to this paper (in addition to Vincent himself, David Mulatu and Francis Muthoni). So in fact many people can share in the acclaim for this achievement.



Old meets new: Emeritus Prof Klaas Jan Beek welcomes a new student to ITC.

Three Million Euros for Earth Observation Training in Africa

Kim Bekmann

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The University of Twente (UT) will provide training on earth observation in Africa. To this end, the UT, together with VITO and Particip, will receive an amount of €3,000,000. The recently established MESA (Monitoring for Environment and Security in Africa) Training Service is aimed at 48 countries south of the Sahara Desert. The ultimate goal is to provide African policy makers and planners with relevant satellite-based information. This information should help them to solve social problems and make choices for the benefit of their people on the basis of the right data.

Training

The training courses will be provided by the ITC Faculty of the UT. Ben Maathuis, assistant professor at the faculty, says: "We will instruct African authorities, meteorological services, universities and companies on how to use geographical information systems, earth observation data, as well as spatial information. We will provide training for public officers and lecturers at local universities. They will learn how to install and manage satellite receiving

stations. In addition, they will learn how to use the accompanying software in order to retrieve data such as maps and diagrams. Everywhere in Africa, we will establish small cheap receiving stations in order to enable local institutions to collect the right data without the internet." The training courses will be provided not only at four special training centres of meteorological services across Africa, but also on the basis of distance learning in a special digital learning environment.

Ben Maathuis, assistant professor at the faculty, says: "They will learn how to install and manage satellite receiving stations."



MESA

Despite the economic growth of recent years, Africa still has the poorest population in the world. In addition, the continent struggles with problems such as droughts, floods, forest fires and erosion. The objective of MESA is to make satellite data about land, sea and climate available to policy makers and planners. These data can play a key role in solving the continent's problems. On the basis of this information, policy makers and planners can make sustainable choices in order to promote the progress and well-being of the African population. Furthermore, MESA intends to transform this satellite information into services for governments and businesses, thus providing them with up-to-date information on such topics as forest fires, floods, deforestation, agriculture and food security – for example by means of SMS messages. Fishermen may for instance receive an SMS message with information on those spots where the most fish can be found. Foresters may receive an SMS message whenever there is a case of forest fire in their vicinity.

MESA will focus on poverty reduction and sustainable development in 48 countries south of the Sahara Desert in Africa. The project will run until 2018, and will be financed by the European Development Fund (EDF) and coordinated by the Commission of the African Union. ■



The objective of MESA is to make satellite data about land, sea and climate available to policy makers and planners. These data can play a key role in solving the continent's problems.

Dies Natalis 2014: We are the World!

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We are the world! United by this less-than-modest motto, the UT community celebrated the 53rd birthday of the University of Twente on Friday, 28 November 2014. The key theme of the Dies Natalis was internationalization. In his role as dean of the ITC Faculty, Tom Veldkamp shed some light on this theme.

Internationalization is more important than ever. As globalization increases in intensity, so the mobility of scientists and students is on the rise as well. "Worldwide problems know no bounds, which means that we should not let ourselves be limited by boundaries either," said UT rector Ed Brinksma in the invitation to the Dies Natalis.

Greater Amsterdam Requires Faster Train Connection

During the opening of the Dies, Ed Brinksma described the international traditions of universities in general and of the UT in particular. In the presence of the ambassadors of Ghana, Sudan and Rwanda, among



Worldwide problems know no bounds, which means that we should not let ourselves be limited by boundaries either," said UT rector Ed Brinksma.

others, Brinksma showed that nowadays these traditions are still upheld at our universities, although everything is placed within the context of modern internationalization. "Internet, communication, media and transport create world cities. It is our task to educate people to be world citizens who can find their way in this environment."

During the Dies celebration, Brinksma argued for a fast train connection between Twente and the Randstad. "Internationalization and urbanization are not a threat to Twente; quite the contrary. We cannot be the heart of a metropolis, but we do have high tech and innovation to offer. As an innovative suburb of "Greater Amsterdam" we can play a serious part. A travel limit of 90 minutes is part of this, just as in cities such as Shanghai, Tokyo and New York. We cannot do other than invest in better connections."

The rector also made this recommendation in light of the increasingly international character that the UT has achieved in the 53 years of its existence. Scientists frequently collaborate with colleagues from all over the world in their research; the student intake is becoming ever more international; and alumni too can be found in all parts of the world. At the same time, demographers particularly foresee growth in the Randstad. According to Brinksma, the knowledge infrastructure that the UT has built, together with Kennispark Twente, can dovetail with this. Furthermore, the Netherlands can function as a city state provided that the preconditions are met.

Crossing National Borders

If there is anyone who understands the importance of internationalization, it's Tom Veldkamp. His faculty Geo-Information Science and Earth Observation (ITC) operates solely outside Dutch borders and has to date produced more than 20,000 alumni, spread out across the entire world and often ending up in influential positions. Veldkamp refuses to call himself an internationalization expert, but over time his research area (geo-information) has gained him a wealth of international experience.

"Internationalization means that you enlarge the worldwide impact of your research and education," explained Veldkamp at the start of his speech. "To me, it signifies that you work together on a great challenge through which you cross national borders, earning you – as the UT – worldwide recognition in doing so."

Focused on Local Context

Veldkamp shared his international experiences with his audience. "This will hopefully help in better preparing the UT community for the challenge that internationalization offers in this fast-globalizing world."

The dean called attention to the importance of continuing to strengthen the relationships with alumni. He described the ties with old UT students abroad – from Germany to Africa, from Indonesia to the United States. According to Veldkamp, it is likewise of vital importance to enter into intensive collaboration with local stakeholders within their local context. "We have to

**"Do not be afraid to experiment or take risks.
We have to learn how to dance to both the
rhythm of the world and the local music.
And you do not learn to dance just by looking
at it; you have to practice as well!"**

"Internationalization means that you enlarge the worldwide impact of your research and education" explained Veldkamp at the start of his speech.





The Dies Natalis was honoured by the visit of H.E.Mohamed Elhassan Ibrahim Hassan, Ambassador of Sudan and other Embassy representatives from Ghana, Poland, Rwanda and Saudi Arabia.

go there,” he said. “This takes time; building a long-term relationship is not an easy task. In addition it is important in the case of internationalization to focus on spearheads and to maintain a distinguishing profile. Our reputation in the region and in Europe does not necessarily have to be the same as our international reputation. Twente is not a one-size-fits-all formula. We have to do what we promise and work on our reputation – not just in the field of research and education, but also with an eye to (technological) projects with social relevance.”

Technology Restricted to Area and Context

In his speech Veldkamp outlined the example of Ethiopian farmers and the revolutionary technology package. The project had been set up so that the farmers could increase the yield of their crops.

However, the artificial fertilizer that was used turned out to be an overly expensive investment, the costs of which could not always be recovered because of low food prices. “Technology is tied to an area and a context, just like language and cultural identity.”

Veldkamp concluded with heartfelt advice on the basis of a swinging metaphor: “Do not be afraid to experiment or take risks. We have to learn how to dance to both the rhythm of the world and the local music. And you do not learn to dance just by looking at it; you have to practice as well!” ■



Academic Cortège of the University of Twente.

EDUCATION NEWS

Tailor-made Course: New Approaches to Land Administration

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From 15 to 26 September 2014, a tailor-made training course entitled “New Approaches to Land Administration” took place at the premises of ITC. This course was organized within the framework of the project Strengthening of Human Resources in Land Administration in Guatemala, a four-year project funded under the Nuffic NICHE programme. This NICHE project targets three regional centres (CUNOC, CUNORI and CUDEP) of the University of San Carlos in Guatemala. The University of Twente, through the Faculty ITC, is coordinating the project. Kadaster International is consortium partner and the Centro Universitario de Occidente (CUNOC) is the counterpart organization in Guatemala.

After an analysis of the (future) challenges in land administration education in Guatemala, Nuffic approved the implementation of a tailor-made course for seven staff members of the university centres on the decision-making process and on tools and methods for developing new educational components for the Land Administration curriculum. The course was primarily directed at female staff of the centres.

The twofold objective of the dedicated training course was: first, to train a group of Land Administration teachers in novel approaches to understanding, creating, and managing modern land administration systems to achieve a timely and effective response to stakeholders’ requirements; second, to expose the staff members of the university centres to the techniques for developing educational components that incorporate the above-mentioned knowl-

edge and at the same time satisfy the educational needs of the students in Guatemala. In addition to following lectures and discussing the educational material,

the course participants visited Kadaster International in Apeldoorn and the Municipality of Enschede. ■



Participants and staff of the tailor-made training course entitled “New Approaches to Land Administration.”

MY TOUCH CONTRIBUTING TO URBAN PLANNING DECISION PROCESSES



JOSE ANDRES MORALES,
MASTER'S STUDENT GEO-INFORMATION SCIENCE AND EARTH OBSERVATION AT ITC

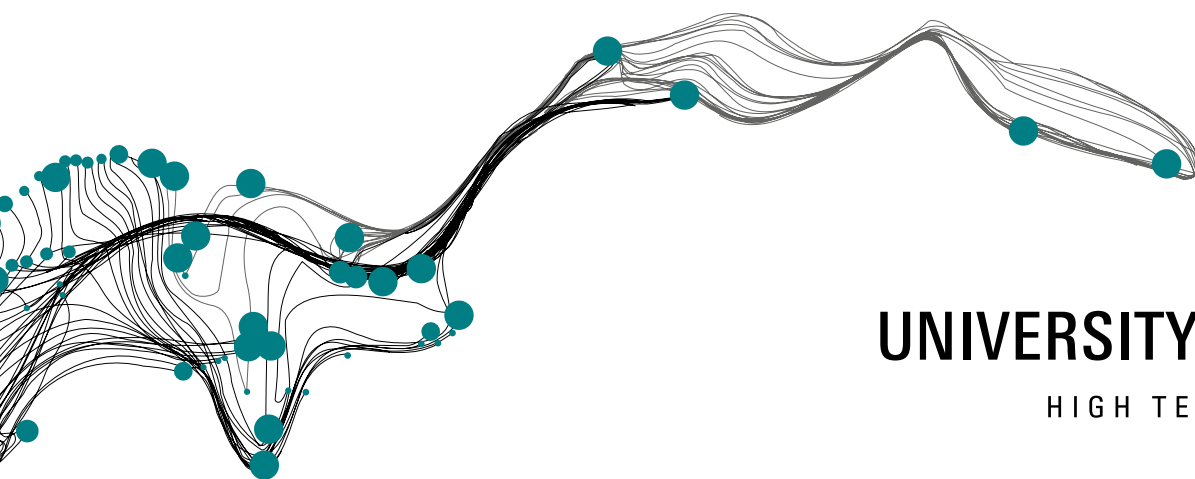
"I chose ITC because of the education's focus on geo-information systems and because it is one of the most renowned institutes in this field. I am especially interested in two broad subjects: design and urban planning. To design in such a way that architecture really starts to interact with its urban context is my passion"

As Jose Andres Morales has discovered, the faculty of Geo-Information Science and Earth Observation (ITC) of the University of Twente in Enschede, the Netherlands, is one of the world's foremost education and research establishments in the field of geo-information science and earth observation. We offer a wide range of the world's best degree courses in the following fields:

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RESEARCH NEWS



European Production of Rapeseed for Biodiesel Inadvisable

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Researchers at the University of Twente have demonstrated that the production of biodiesel from rapeseed in Europe does not currently offer a sustainable solution to the energy problem. In large areas of Europe, production actually consumes more energy than it yields, the researchers concluded. Farmers use so many fossil fuels and artificial fertilizers for the cultivation of rapeseed that the process is not energy efficient. If they refrain from using them, then the rapeseed yield is low and results in too little energy. Moreover, the researchers found that the most favourable areas for cultivating rapeseed as an energy crop are precisely those areas that are important for food production.

Rapeseed is used for the production of biodiesel on a wide scale, particularly in Europe. The researchers at the UT looked into where the most favourable conditions

for the cultivation of rapeseed in terms of energy efficiency are to be found. Energy returns compared with energy investment were low across the whole of Europe.

Energy efficiency can be expressed in terms of Energy Return on Energy Invested (EROEI). Researchers at the UT gathered data on the EROEI values for every EU

Farmers use so many fossil fuels and artificial fertilizers for the cultivation of rapeseed that the process is not energy efficient.



Where to produce rapeseed biodiesel in Europe?

Energy efficiency of biodiesel production low and spatially heterogeneous

country and also for Switzerland. They did this using expected yields extrapolated from maps showing the suitability of areas for rapeseed cultivation. In Europe, rapeseed biodiesel is produced with EROEI values of 2.2 or lower, while a value of 3 or more is viewed as being the only practicable option.

Competition with Food Producers

The areas in which rapeseed can be cultivated with the highest levels of efficiency are important areas for food production. For example, a large part of the area suitable for rapeseed cultivation in Italy is used for the production of risotto rice, and in Germany farmers use the areas with relatively high energy efficiency values for rapeseed production for the cultivation of wheat and sugar beet. UT researcher Iris

van Duren suggests that the plans for the cultivation of rapeseed need to be supplemented with EROEI maps. "Where rapeseed will be able to grow is not the only relevant factor," explains Van Duren. "We should also be looking at where the cultivation of rapeseed for bio-energy can be efficient. In areas that in theory are suitable for rapeseed cultivation, 37.6% of the area will only be able to produce rapeseed for biofuels with a loss of energy. So in the end, you are actually wasting more energy than you are producing." According to Arjen Hoekstra, another big disadvantage of using rapeseed for energy production is the fact that the water footprint for rapeseed is extremely high." ■

Software Capable of Quickly Producing 3D Building Models

Kim Bekmann

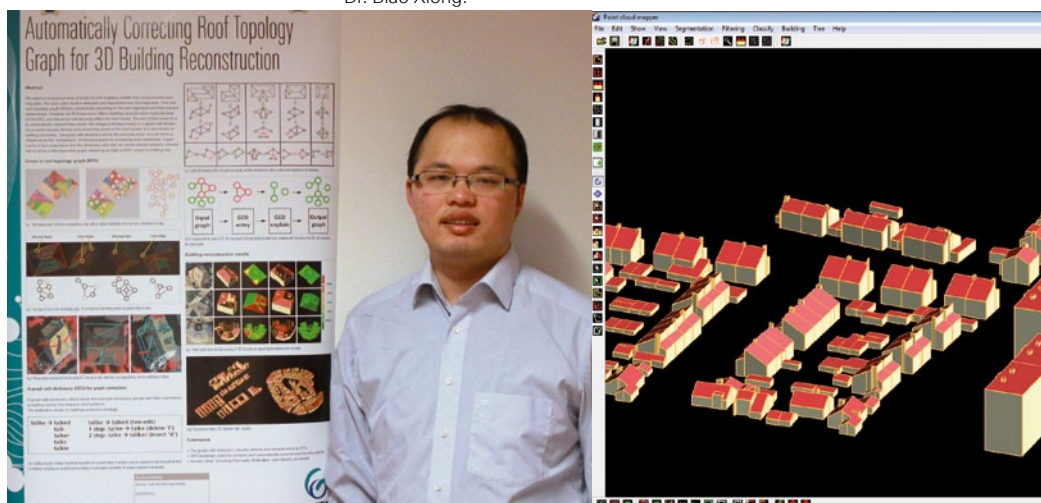
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ITC researchers have developed software that enables users to quickly produce 3D models of buildings for relatively little money. 3D models are used for navigation purposes, training purposes, urban planning and safety, building maintenance and the fitting of solar panels, to mention just a few examples. The software can automatically generate 95% of the detailed 3D building models, thus reducing production costs and lead time. The software is based on research conducted by Biao Xiong, who obtained his doctorate at ITC on 5 December. The software is already being used for the provision of 3D maps.

Current methods of producing 3D models are not automatic processes, and often the software uses aerial photographs or laser measurements to generate the models. These methods are expensive and time-consuming. Xiong has developed software that enables its users to automatically generate 95% of 3D building models using laser data. The remaining 5% of modelling is manual work made efficient. The models of the buildings are very detailed and even depict dormers.

Xiong: "The software can be used by a wide audience. Municipalities and land registries can use the method, but compa-

Dr. Biao Xiong.



nies may also find it interesting. A roofer may base his quotation on the 3D model of a roof, for example. This software is also very interesting for companies such as Google. Google already has 3D maps at its disposal, but it is very expensive and time-consuming to generate these maps. They are not up to date, and constantly updating the entire collection would be too time-consuming. However, with our method, you can automatically update the maps by 95%. It only takes me a week to produce a 3D model of the entire city of Enschede with my laptop. We would, of course, need more people and computers to make a 3D model of the whole of the Netherlands, but that should be feasible within a month. Production costs are much lower compared with current methods, as most of the work is done automatically.” Together with four colleagues, Xiong has launched a start-up called Dipper: “Our aim is to develop easy-to-use applications.” Xiong obtained his doctorate on 5 December: “Who knows, Sinterklaas may also be thrilled. He can use this model to identify the best route to reach the chimney,” he jokes.

To generate the 3D models, the software makes use of laser data (LiDAR), which are measures taken from a helicopter or an aeroplane (such as those to be found in the Actueel Hoogtebestand Nederland, AHN2, the up-to-date collection of height data in the Netherlands). These data are freely available. The buildings are reconstructed from the point clouds in LiDAR data. Roof constructions are also detected using this technique. Next, elements of buildings are recognized by analysing roof constructions. The elements are then modelled into an entire building. If a mistake is discovered in the roof construction, it is automatically corrected thanks to the software’s ability to recognize and memorize error patterns. This assures the quality of the 3D

model. Assistant professor Sander Oude Elberink: “At Level of Detail 2 (LoD2), the 3D models are very detailed. This is a level of detail at which roof constructions, including dormers, can be modelled. This is an enormous improvement compared with the existing software generating models at Level of Detail 1. In comparison, LoD1 is a level of detail at which each building is reconstructed at just one height, which leads to these building models having only flat roofs.” ■



The software can automatically generate 95% of the detailed 3D building models, thus reducing production costs and lead time.



BIAO XIONG obtained his doctorate at the ITC Faculty of the University of Twente on 5 December 2014. His doctoral thesis is entitled *Reconstructing and Correcting 3D Building Models Using Roof Topology Graphs*. His thesis supervisor was Professor George Vosselman and his assistant thesis supervisor Dr Sander Oude Elberink. You can find the full version of his thesis at: www.itc.nl/library/papers_2014/phd/xiong.pdf.



THE ITC RESEARCH PROGRAMME

defines the scientific scope of knowledge development, which is underpinned by the scientific expertise of ITC and tailored to the international research agenda. The research of Dr. Biao Xiong is conducted within the research theme Acquisition and quality of geo-spatial information.

Acquisition and quality of geo-spatial information (ACQUAL)

Developments in sensor and web technology have led to an increase in earth observation data from many sensors. Advanced methodology is needed to make the most out of the data and to integrate the large amounts of data

such that they are easily and rapidly available for decision making. The users require high speed image analysis to almost continuously monitor global and local geo-spatial processes. We distinguish handling uncertainty in earth observation data and acquisition of topographic information from imagery and point clouds. Emphasis is on the development and applicability of methodology. The research is conducted in three overlapping fields focusing on geometric modelling, process modelling and semantics.

For more information on the projects within this theme: www.itc.nl/ACQUAL

PARTNERSHIP NEWS

Local Stakeholders Collaborating in Dortmund Using the ITC Group Decision Room

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Using facilities of the ITC Group Decision Room, local stakeholders have analysed environmental and socio-demographic factors resulting in spatial inequalities with respect to health outcomes in the city of Dortmund in Germany.

This workshop really had some innovative approaches ready for its participants. The overall aim of the workshop was to attain a shared understanding of a wicked problem setting among different stakeholders. In the first step, the stakeholders had to study environmental and socio-demographic factors affecting health outcomes on a large-scale interactive touchscreen. In the second step, they had to input their own local knowledge about the area into the system. The participants were quite enthusiastic about the use of such a new technology.

The workshop took place within the scope of the Jufo-Salus Junior Research Group, in which the Urban and Regional Planning Department (PGM) of ITC collaborates with the Faculty of Spatial Planning of the Technical University of Dortmund, the Institute of Public Health of the University of Bremen, and the Faculty of Caring and Health of Fulda University of Applied Science. Within this network, five PhD students are conducting research into how cities can be shaped into a healthy living environment for all (i.e. independent of spatial inequalities). The project includes a strong transdisciplinary component. In dialogue with local stakeholders in the case-study cities of Dortmund and Munich, Germany, the PhD students are analysing spatial phenomena of social inequalities in the distribution of environmental goods and burdens, and are developing strategies for healthy urban development.

The workshop itself was part of the PhD thesis of Rehana Shrestha of the Urban and Regional Planning Department (PGM) of ITC. In her PhD she develops an interactive spatial decision

support system (ISDSS) that supports spatial planning and public health professionals in addressing persisting spatial inequalities with respect to urban health in collaborative spatial planning and decision-making processes. A core element of her PhD is to explore the usability and utility of large-scale tangible user interfaces (so-called MapTables). The first building block of her PhD, for which the workshop was conducted, is the development and testing of an interactive spatial understanding support system (ISUSS). ISUSS is an approach using a MapTable to support a heterogeneous group of stakeholders in identifying and defining various perspectives regarding the problem to be addressed



The MapTable displaying various layers of information.

during an early phase of a planning process. The research interest in this workshop was to test how far such a socio-technical workshop approach including a MapTable could help stakeholders to collaborate; to communicate their knowledge, concerns and issues regarding the problem; and to develop a shared understanding of a complex problematic situation.

The ITC Group Decision Room used for the workshop is a fairly new ITC facility: it was developed and installed four years ago (see *ITC News*, issues 2010-3 and 4). The room is equipped with cutting-edge technology in terms of interactive surfaces and tangible user interfaces to facilitate hands-on education and research in the field of collaborative spatial planning and decision making. Since 2010 various groups, short courses and also the normal ITC MSc courses have made use of the room to explore means of interactive support in planning processes.

In the workshop five local stakeholders from Dortmund, representing the health department, the spatial planning department, the local neighbourhood NGO, the local Agenda 21 group, and the Kinderschutzbund (NGO on child protection), had to jointly analyse the health-related environmental problems in the Nordstadt district of Dortmund. This district functions as a case-study area within the whole JuFo-Salus as it is a deprived neighbourhood with several health-related environmental burdens. In the first step, the stakeholders had to explore the existing situation in Dortmund Nordstadt on the MapTable by analysing various layers of spatial information for relevant environmental and socio-demographic indicators. In the second step, they were asked to enrich this problem analysis by adding their own local knowledge and to explain their respective perspectives on envi-

ronmental burdens and benefits affecting the local population unequally. Finally, the participants had to assemble the knowledge gathered in the previous two steps by jointly drawing a so-called rich picture, which is a iconographic representation of a wicked problem. The rich picture was developed jointly on a large piece of paper.

The participants appreciated the workshop very much, and were particularly enthusiastic about the new possibilities of joint data analysis and collaboration that the MapTable offers. They concluded that the system had initiated discussions that would not otherwise have taken place. Furthermore, they recommended other contexts and topics for which the MapTable could be useful, especially decision-making sessions with local residents.

Rehana Shrestha is planning to develop and test two more applications of the MapTable in her PhD within the context of health-related spatial inequalities. One application is the development of a tool for the collaborative assessment of cumulative health-related impacts due to exposure to multi-level environmental burdens. In her third building block, she looks into the use of the MapTable to support role-playing games for public health and urban planning experts together with residents and stakeholders, in which, for example, new instruments for a healthy and inclusive urban development for all are tested. ■

If you would like more information about the JuFo-Salus Junior Research Group, visit the project website www.jufo-salus.de.

An English version is available.

For more information about the ITC Group Decision Room, please contact Johannes Flacke (j.flacke@utwente.nl)



Stakeholders adding their local knowledge by drawing on the MapTable.

NRS Cooperates with the Bulgarian Forest Research Institute

Thomas Groen

t.a.groen@utwente.nl

Three students from ITC's Department of Natural Resources have recently finished a period of fieldwork in the Rhodopi mountains of Bulgaria. Various topics related to biodiversity mapping and the inventorization of forest structure will be tackled by these students based on the data collected in the field, together with satellite imagery. During the fieldwork, the students experienced first-hand that Europe too features some untamed nature, where access is difficult and where wolves and bears still roam. No real bears were spotted (luckily!) but stories of human encounters with bears were numerous and recent in the region. So the students closely followed the advice of the local forestry experts while in the field.

The cooperation between ITC and the Forest Research Institute concerns a mutually beneficial operation. The institute is involved in many conservation and forestry-related projects that are relevant for students following the Natural Resources Management curriculum. At the same time, the remote sensing and GIS skills of the students open up opportunities for the Forestry Research Institute to extract information about their rough and untamed natural areas. Furthermore, the exchange of Bulgarian

hospitality and multi-cultural ITC student openness resulted in a lively and enjoyable atmosphere that generated many memorable moments – for example, when a typical Bulgarian bagpiper appeared on the scene in the hostel!

The students are currently processing all the data collected and working on their theses, which they will defend in the next round of MSc defences. ■





During the fieldwork, the students experienced first-hand that Europe too features some untamed nature, where access is difficult and where wolves and bears still roam.

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ANNOUNCEMENTS

Professor Veldkamp Reappointed Dean of ITC

Communication department

newsmagazine-itc@utwente.nl

The Executive Board of the University of Twente has reappointed Professor Veldkamp as dean of the Faculty of Geo-Information Science and Earth Observation (ITC). His appointment is for a period of five years and will take effect from 1 January 2015. Not only is he dean but also the scientific director of ITC.

Tom Veldkamp is professor of Spatial Environment Quality. His research focuses on the spatial analysis and modelling of soil-landscape systems, particularly those applied in developing countries. Since September 2014 he has been a member of the Technical Committee on Soil Protection (TCB).

The Executive Board appreciates the efforts of Veldkamp, both as dean and as scientist, in the internationalization activities of the university. The Faculty Council was also unanimously positive about the reappointment of Veldkamp as dean. Van der Chijs comments as follows: "If anyone fully understands the importance of internationalization, it is Tom Veldkamp. His faculty ITC operates exclusively abroad and has delivered over 20,000 alumni from all over the world. The alumni of ITC often end up in significant positions. The way ITC operates is an example for the whole university."

In his lecture during the 53rd Dies Natalis of the UT, Tom Veldkamp explained that internationalization meant expanding the global impact of your research and teaching. "To me internationalization is cooperating on big challenges, crossing borders and securing the relevant international acknowledgement as the University of Twente. As dean of ITC, I'm honoured to be able to contribute to these international ambitions." ■



Tom Veldkamp explained during the Dies Natalis of the UT that internationalization meant expanding the global impact of your research and teaching.

Inaugural ISCU-WDS Data Stewardship Award for Alumnus Dr Xiaogang Ma

Xiaogang Ma

max7@rpi.edu

ITC alumnus Xiaogang (Marshall) Ma received the Inaugural ISCU-WDS Data Stewardship Award at SciDataCon2014, New Delhi, India, on 4 November 2014.

The World Data System (WDS) of the International Council for Science (ICSU) supports long-term stewardship of quality-assured scientific data and data services across a range of disciplines in the natural and social sciences and the humanities. The WDS Data Stewardship Award highlights exceptional contributions to the improvement of scientific data stewardship by early-career researchers through their engagement with the community, academic achievements, and innovations. Coordinated by the Committee on Data for Science and Technology (CODATA), the WDS, interdisciplinary committees of ISCUS, and the Indian National Science Academy, the award ceremony was held on 4 November 2014 at SciDataCon2014, New Delhi, India.

Marshall graduated from ITC in 2011 with a PhD degree, under the supervision of Professor Freek van der Meer and Dr John Carranza. He is now an associate research scientist at Tetherless World Constellation, Rensselaer Polytechnic Institute, USA, and is working on Semantic eGeoscience. Marshall's research highlights a semantic eScience framework, which deploys Semantic Web methodologies and technologies to support data-intensive researches, especially those in earth and space sciences. His earlier work on geoscience vocabulary encoding and visualization was applied to enhance the feature of online geoscience data service and lower the barrier for layman users. His recent work on the provenance of global change information addresses a crucial need for transparent scientific workflows and credible scientific findings, as global change information becomes both more abundant and increasingly important. Moreover, well-curated

provenance information also facilitates informed and rational policy and decision making. Marshall's work was used in the Global Change Information System of the U.S. Global Change Research Program to enable provenance tracing. ■

Marshall did not attend the ceremony in person owing to visa issues, and he delivered an award lecture remotely. Slides of his lecture *Why Data Science Matters* can be accessed at: www.slideshare.net/MarshallXMa/why-data-science-matters.

"Data interoperability: Data should be discoverable, accessible, decodable, understandable, and usable, and data sharing should be legal and ethical for all participants"

(Ma et al., Nature Geoscience (2011).





ITC Alumni



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How is everyone? How has being to ITC impacted on your life??

Manager's Choice

Patrick Kimeu

Director, R & D at Mapping systems Services

Comments



John Van Genderen

Emeritus Professor.

Came to ITC as a young graduate in 1966, and my whole life since then has been influenced by ITC! After my M.Sc. at ITC I worked at University of Sheffield in U.K., for a UNESCO course, and visited ITC with my students every year for joint field work for seven years. Whilst working at Fayrey surveys Mapping Company in Maidenhead U.K., I was involved with ITC Projects and consultancies, especially as consultant for the series of four Decision-Making Seminars on Remote Sensing in Malaysia, Colombia, Enschede in the 1970's early 80's. In 1986 came back as full time staff member, and since 1991 as Professor of Remote Sensing. Since retiring in 2009, have been Emeritus Prof for 5 years. A fantastic career, having the chance to work and visit in more than 140 countries all over the world!



Valerio Spagna

geologist at self employed

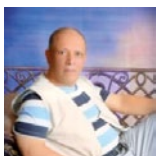
I meet you at the beginning of your career. Do you remember? The Crati Valley in Calabria. After that it was my ITC Course in Delft and then applied geomorphology always with aerial photointerpretation. At the end of my activity I tried to resume it with a volume titled "Geologia delle frane" edited by Flaccovio Ed. in 2013 september. www.darioflaccovio.it/pdfdescr/845-DF0187.pdf



Rudiger Gens

Remote Sensing Scientist at UAF - looking for new opportunities

I was funded by a European Research Network and did my PhD at ITC (defended in 1998). Had a fantastic time. Plenty of fond memories. Most multi-cultural place I ever worked at. And I met my wife at ITC.



Noori Noori

Head of Coordination and Followup at MWE

In 1986, I traveled to ITC Enschede with many feelings and emotions. During the Christmas holidays I bought nice shoes (black & white), and I traveled back to Yemen to attend my wedding ceremonies. a few days later, I carried my new wife with wedding dress and flight back to ITC. As a young couple and students, we spent the happiest months in our life. I learnt a lot a lot a lot. I will not forget my colleagues from Africa, Asia, Brazil, Iraq, Iran, Qatar, Saudi Arabia, Egypt, Indonesia and Malaysia. I advise all young people to start their first steps to independent and successful life in the ITC -Netherlands.



FIND FELLOW ALUMNI ON ITC LINKEDIN UNIVERSITY PAGE

Have you already checked out the ITC LinkedIn University page? A great opportunity to find fellow alumni and students! Your LinkedIn profile will be automatically added to the page if ITC is mentioned under Education in your LinkedIn profile. How? See here: www.linkedin.com/edu/alumni?id=431368&trk=edu-up-nav-menu-alumni.

Spatial Statistics: Emerging Patterns

9-12 June 2015 | Avignon, France

Alfred Stein

a.stein@utwente.nl

The third Spatial Statistics conference will be held in Avignon, France, from 9 to 12 June 2015 under the theme *Emerging Patterns*. Earlier conferences held in Enschede (2011) and Columbus, Ohio, were both very successful, attracting large audiences.

Spatial statistics is a rapidly developing field involving the quantitative analysis of spatial data and the statistical modelling of spatial variability and uncertainty. Spatial statistics is of critical importance to the use and interpretation of VGI, web services, remotely sensed data, and further processing within a GIS environment. Applications of spatial statistics are found in agriculture, geology, soil science, hydrology, ecology, oceanography, forestry, meteorology and climatology, as well as in socio-economic disciplines, human geography, spatial econometrics, epidemiology and spatial planning. The availability of GIS systems and affordable geospatial databases has fuelled interest in the statistical analysis of geographical data. The theme, *Emerging Patterns in Spatial Statistics*, will highlight trends in various topics, such as new sources of spatial data; predictive modelling; disease mapping; hazards, disasters and risks; climate change; and tipping points.

It is a significant opportunity for you to hear from leading scientists in the field and to network with colleagues in industry and academia to ensure that you keep abreast of recent developments in this fast-evolving field.

Conference Topics

- Space-time statistics (e.g. point pattern models, estimation methods, large dimensions, scale issues)
- Spatial data quality and uncertainty
- Parameter estimation in PDEs
- Stochastic geometry, tessellation, point processes, random sets
- Spatial econometrics
- New spatial data sources (e.g. big data, social media, Google, citizen science, crowd source maps)
- Image analyses (e.g. satellite image time series, DNA data, nano particles, nervous systems)
- Predictive modelling
- Tipping points (e.g. sea-level rise, socio-economic shifts)
- Hazards, disasters and risks (e.g. tsunamis, earthquakes, landslides, air pollution levels)
- Global change (e.g. stochastic weather generators)
- Health, medical and epidemiology
- Plant and animal epidemiology (emerging epidemics)
- Ecology (e.g. dispersion, migration, colonization and invasion of species). ■



SPATIAL STATISTICS SOCIETY



Greetings from...

NAME:

Jorge
Fernandez
Galarreta

JOB DESCRIPTION:

International intern at Esri
under the Technical Marketing
department team for the Disaster
Response Program (DRP)

ACTIVITIES:

On a daily basis my tasks are very
dynamic and changeable. My main
focus is to develop a portfolio of
the UAV/drone applications for Esri



Project work

My main assignment is to develop a portfolio of all the applications on which Esri should focus some of its resources in the future. UAV/drones are a huge developing market and, although flying a drone privately is not yet allowed in the USA, it's necessary to be ready for whatever may happen. This involves a lot of research and development. I have to be aware of what's out there and figure out how Esri can implement all the applications within its existing software.



This main project used to overlap with activities focused more on marketing, such as promoting new products or setting up demonstrations. Lately I've been working on a project where my department is trying to promote an online template called GeoForm, a non-map-centric approach to adding data into a map.

Besides all that, every member of the DRP department must be always alert. When a disaster occurs, the entire department focuses all the resources on supporting the disaster response activities (creating ArcGIS online organizational accounts, dashboard support, etc.).



Social Events

The work environment is great. There are many young people and it's very easy to hang out with everyone. I have a very nice group of friends and we have travelled quite a lot: we've camped in Joshua Tree National Park, surfed at San Onofre beach, visited San Diego, celebrated Thanksgiving in San Francisco visiting old ITC friends, and more. Besides all these trips we are always doing things in Redlands. Local breweries are pretty popular here

and skateboarding is just part of the culture – plus the weather is awesome so you can always be outside.



Conclusion

This internship has been a great opportunity. I am learning tons of things, and not only technical stuff. I am also learning a lot about how the private sector works. Redlands is a great place, a small city but with a big young community and a lot of

people sharing the same passion for GIS and remote sensing. From my experience so far, I would like to highlight the fact that everyone takes my opinions very seriously. Although I'm an intern, ITC students are highly valued here and our opinion counts.

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| ✓ Addressing Technology | ✓ Dynamic Mapping | ✓ Image Analysis | ✓ Remote Sensing |
| ✓ Aerial Imagery/Photography | ✓ Earth Observation | ✓ INSPIRE | ✓ Risk Management |
| ✓ Asset Management | ✓ Emergency Services | ✓ Integration | ✓ RTK (Real Time Kinematic) Surveying |
| ✓ Bathymetry | ✓ ENC - Electronic Navigation Chart | ✓ Interoperability & Open Standards | ✓ Satellite Imagery/Navigation |
| ✓ Big Data | ✓ Environmental Monitoring | ✓ Land Information Systems | ✓ Scanning Technology |
| ✓ Business Geographics/ Analytics | ✓ Galileo | ✓ Laser Scanning | ✓ SDI - Spatial Data Infrastructures |
| ✓ Cadastral Mapping | ✓ Geo-ICT | ✓ LBS | ✓ Smart Grids |
| ✓ Cartography | ✓ Geodesy | ✓ LiDAR | ✓ Software |
| ✓ Climate Change | ✓ Georeferencing | ✓ Mapping Software | ✓ Surveying Instrumentation |
| ✓ Computing in the Cloud | ✓ Geosciences | ✓ Marine Tracking & Navigation | ✓ Surveying Technology Sensor |
| ✓ Crime Mapping/ Modelling | ✓ Geospatial Image Processing | ✓ Mobile GIS/Mapping | ✓ Telematics |
| ✓ Data Capture/Collection | ✓ GIS | ✓ Municipal GIS | ✓ Topographic Mapping |
| ✓ DEM- Digital Elevation Model | ✓ GIS in Agriculture & Forestry | ✓ Navigation | ✓ Total Station |
| ✓ DGPS - Differential GPS | ✓ GLONASS | ✓ Network Topology | ✓ Tracking & Route Planning |
| ✓ Digital City Models | ✓ GMES | ✓ NSDI | ✓ Transport |
| ✓ Digital Mapping | ✓ GNSS | ✓ Open GIS | ✓ Utilities GIS |
| ✓ Digital Rights Management | ✓ GPS | ✓ Photogrammetric | ✓ Vehicle Tracking & Navigation |
| ✓ Disaster Management/ Monitoring | ✓ GSDI | ✓ Photogrammetry | ✓ VRS - Virtual Reference Station |
| ✓ DSM - Digital Surface Model | ✓ Hardware | ✓ Point Clouds | ✓ Web Mapping |
| | ✓ Hydrography | ✓ Property Information Systems | |

Sectors covered:

- | | | | |
|-------------------------------------|----------------------------|-------------------------------|------------------------------|
| ✓ Aerospace | ✓ Defence | ✓ Healthcare | ✓ Public Safety/Works |
| ✓ Agriculture | ✓ Education | ✓ Infrastructure Protection | ✓ Retail |
| ✓ Archaeology & Heritage | ✓ Emergency Services | ✓ Insurance | ✓ Shipping |
| ✓ Architecture | ✓ Energy Utility | ✓ Manufacturing | ✓ Software Development |
| ✓ Biosecurity | ✓ Engineering | ✓ Marine | ✓ Technical Services |
| ✓ Business Security/Service | ✓ Environmental Management | ✓ Military | ✓ Telecommunications |
| ✓ Central/Local/Regional Government | ✓ Environmental Monitoring | ✓ Mining | ✓ Tourism/Travel |
| ✓ Construction | ✓ Financial Services | ✓ Natural Resource Management | ✓ Training |
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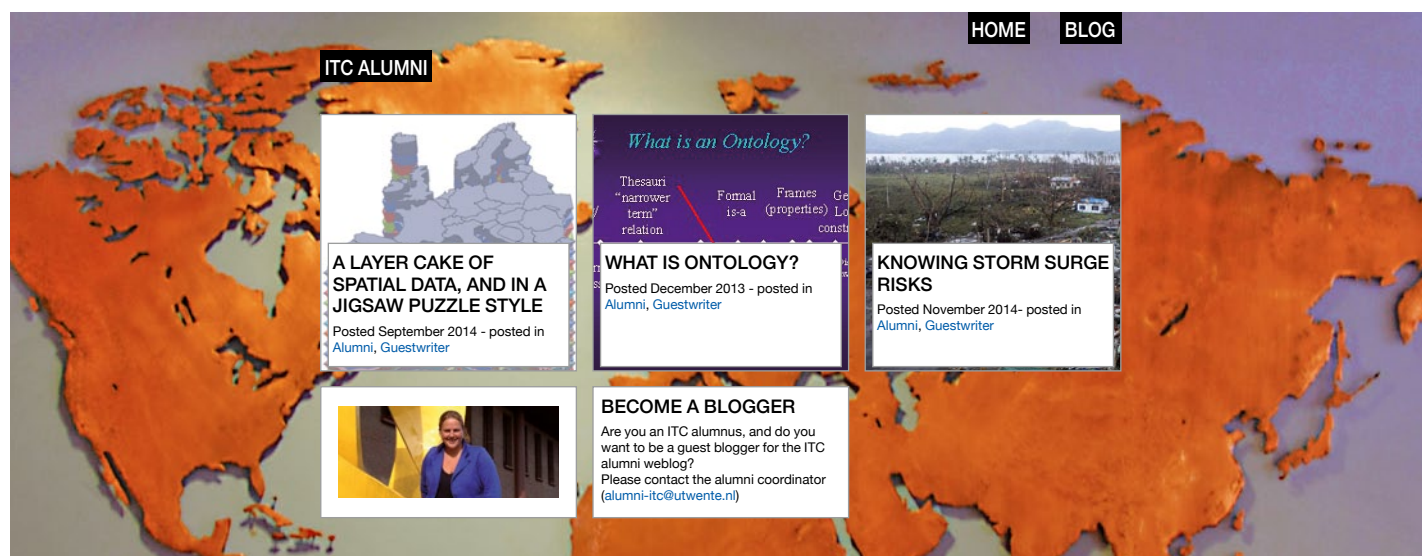
LIFE AFTER ITC



Alumni Blog: Open Science in an Open World

Guest blogger: Xiaogang (Marshall) Ma

I began to think about a blog on this topic after I read a few papers about open codes and open data published in *Nature* and *Nature Geoscience* in November 2014. Later on I also noticed that the editorial office of *Nature Geoscience* had compiled a cluster of articles themed on transparency in science (www.nature.com/ngeo/focus/transparency-in-science/index.html), which really created an excellent context for further discussion of open science.



A few weeks later I attended the American Geophysical Union (AGU) Fall Meeting in San Francisco, CA. This used to be a giant meeting with more than 20,000 attendees. My personal focus is presentations, workshops and social activities in the group Earth and Space Science Informatics. To summarize the seven-day meeting experience with a few keywords, I would choose Data Rescue, Open Access, Gap between Geo and Info, Semantics, Community of Practice, Bottom-up, and Linking. Putting my AGU meeting experience together with thoughts after reading the *Nature* and *Nature Geoscience* papers, now it is time for me to finish a blog.

Besides the incentives for data sharing and open source policies of scholarly journals, we can extend the discussion of software and data publication, reuse, citation and attribution by shedding

more light on both the technological and social aspects of an environment for open science.

Open science can be considered a socio-technical system. One part of the system is a way to track where everything goes, and another is a design of appropriate incentives. The emerging technological infrastructure for data publication adopts an approach analogous to paper publication and has been facilitated by community standards for dataset description and exchange, such as DataCite (www.datacite.org), Open Archives Initiative-Object Reuse and Exchange (www.openarchives.org/ore) and the Data Catalog Vocabulary (www.w3.org/TR/vocab-dcat). Software publication, in a simple way, may use a similar approach, which calls for community efforts on standards for code curation, description and exchange, such as the Working towards Sustainable

Software for Science (<http://wssspe.researchcomputing.org.uk>). Simply minting digital object identifiers to codes in a repository makes software publication no different from data publication (see also: www.sciforge-project.org/2014/05/19/10-non-trivial-things-github-friends-can-do-for-science/). Attention is required to code quality, metadata, licence, version and derivation, as well as metrics to evaluate the value and/or impact of a software publication.

Metrics underpin the design of incentives for open science. An extended set of metrics (called altmetrics) was developed for evaluating research impact and has already been adopted by leading publishers such as the Nature Publishing Group (www.nature.com/press_releases/article-metrics.html). Factors in altmetrics include how many times a publication has been viewed, discussed, saved and cited.

On my flight back from the AGU meeting, it was very interesting to read some news about funders' attention to altmetrics (www.nature.com/news/funders-drawn-to-alternative-metrics-1.16524) in the 12/11/2014 issue of *Nature* that I'd picked up from the NPG booth in the AGU meeting exhibition hall. For a software publication, the metrics might also count how often the code is run, the use of code fragments, and derivations from the code. A software citation indexing service – similar to the Data Citation Index (http://wokinfo.com/products_tools/multidisciplinary/dci/) of Thomson Reuters – can be developed to track citations among software, datasets and literature and to facilitate software search and access.

BECOME A BLOGGER

Are you an ITC alumnus, and do you want to be a guest blogger for the ITC alumni weblog? Please contact the alumni coordinator (alumni-itc@utwente.nl).

Open science would help everyone – including the authors – but it can be laborious and boring to give all the fiddly details. Fortunately fiddly details are what computers are good at. Advances in technology are enabling the categorization, identification and annotation of various entities, processes and agents in research, as well as the linking and tracing among them. In our 06/2014 *Nature* article on climate change, we discussed the issue of provenance of global change research (www.nature.com/nclimate/journal/v4/n6/full/nclimate2141.html). These works on provenance capture and further extend the scope of metrics development. Yet incorporating these metrics in incentive design requires the science community to find an appropriate way to use them in research assessment. Progress has recently been made: NSF has renamed the Publications section as Products in the biographical sketch of funding applicants and allowed datasets and software to be listed (www.nsf.gov/pubs/2013/nsf13004/nsf13004.jsp). To fully establish the technological infrastructure and incentive metrics for open science, more community efforts are still needed. ■

To read more posts from the ITC alumni blog: <http://blogs.itc.nl/alumni/>

"I am finally a *Doctor* today!"

Salma Anwar

salmaaries@hotmail.com

Looking back over all the years I have spent in the Netherlands pursuing higher studies, I feel blessed that life has given me big challenges and, at the same time, the courage to overcome them. During all those years I was over-challenged, not only because of the stressful nature of the research, but also because of the big changes that happened in my personal life during studies – most importantly the birth of my children.

At times, coping with all these challenges left me feeling totally exhausted and extremely uncertain as to whether my struggle would ever end successfully. I would always get insufficient time for studies, and whenever I did get some time I would be too exhausted both mentally and physically to think about the research. Very often I needed to compose myself in order to concentrate on work. Mostly I used to work at night, after putting my children to bed.

My journey on the PhD road began one day when my husband proposed the idea of applying for the scholarship for MS-leading-to-PhD in European countries offered by the Government of Pakistan. At first, I was strongly reluctant to embark on such a big venture, as I did not consider myself ready for another big change in life so soon after my marriage. Later, however, I applied for the scholarship, was selected after an exam and an interview, and finally got the scholarship to

Dr Salam Anwar.





I am finally a *Doctor* today.

study abroad. By the time we landed in the Netherlands, I had made up my mind and was quite excited about studying there. Living in the Netherlands was a huge but pleasant cultural shock for me. At the same time, it was a big challenge for me to cope with my studies with the arrival of my first child two months after I started my MS studies at ITC – with another child one year later! However, I managed to finish my MSc studies, with distinction in research, with only a two-month delay.

After the MSc, I started my PhD, working on spatial point process modelling of land use and land cover change. My first study in this respect was spatial point process modelling of earthquake epicentre loca-

tions of the aftershocks of a huge earthquake that hit Pakistan on 8 October 2005. The population in the affected region was still struggling with rehabilitation after the huge loss of life and infrastructure. This strongly motivated me to study and analyse how such a huge earthquake could happen in Pakistan. The study ascertained that the occurrence of the earthquake and its aftershocks was largely determined by the presence of a boundary between the Eurasian and Indian tectonic plates and the presence of co-seismic faults within the study area.

My next research project focused on analysing the land use and land cover change patterns in Brazilian Amazonia.

Deforestation of the world's forests, and particularly of the Amazonian tropical forest, is a big issue in today's world because of its adverse effects on global climate and ecosystems. In terms of determining the human contribution to bringing about changes in land cover, deforestation in Brazilian forests served as an ideal case study. I investigated the root causes of deforestation and discovered that selective logging is one of the major instigators of the problem. My research thus focused on analysing the location of selective logging in my study area and determining the relevant factors in a spatially explicit way, using spatial point pattern statistics. The study concluded that roads serve as a most prominent factor in the study area, attracting loggers by providing access to the interiors of the Amazonian forests.

As a reward for all the sleepless nights that I spent working on the above research ideas, I am finally a *Doctor* today, with an MSc degree in Geo-informatics too. I am thankful to my MSc teachers for always being kind and considerate, and to my PhD promotor and supervisor, Professor Alfred Stein, for all his patience and encouragement that motivated me to overcome the many difficulties on my way to becoming a doctor. ■



Salma Anwar obtained her doctorate at the ITC Faculty of the University of Twente on 6 November 2014. Her doctoral thesis is entitled Spatial point process modelling of land use and land cover (LULC) change. Her thesis supervisor was Professor Alfred Stein and her assistant thesis supervisor Dr Wietske Bijker. You can find the full version of her thesis at: www.itc.nl/library/papers_2014/phd/anwar.pdf

THE ITC RESEARCH PROGRAMME defines the scientific scope of knowledge development, which is underpinned by the scientific expertise of ITC and tailored to the international research agenda. The research of Dr. Salma Anwar is conducted within the research theme Acquisition and quality of geo-spatial information.

Acquisition and quality of geo-spatial information (ACQUAL)

Developments in sensor and web technology have led to an increase in earth observation data from many sensors. Advanced methodology is needed to make the most out of the data and to integrate the large amounts of data such that they are easily and rapidly available for decision making. The users require high speed image analysis to almost continuously monitor global and local geo-spatial processes. We distinguish handling uncertainty in earth observation data and acquisition of topographic information from imagery and point clouds. Emphasis is on the development and applicability of methodology. The research is conducted in three overlapping fields focusing on geometric modelling, process modelling and semantics.

FOR MORE INFORMATION on the projects within this theme: www.itc.nl/ACQUAL

MY TOUCH PREDICTING EARTHQUAKES



EFFIE PAVLIDOU,
MASTER'S STUDENT GEO-INFORMATION SCIENCE AND EARTH OBSERVATION AT ITC

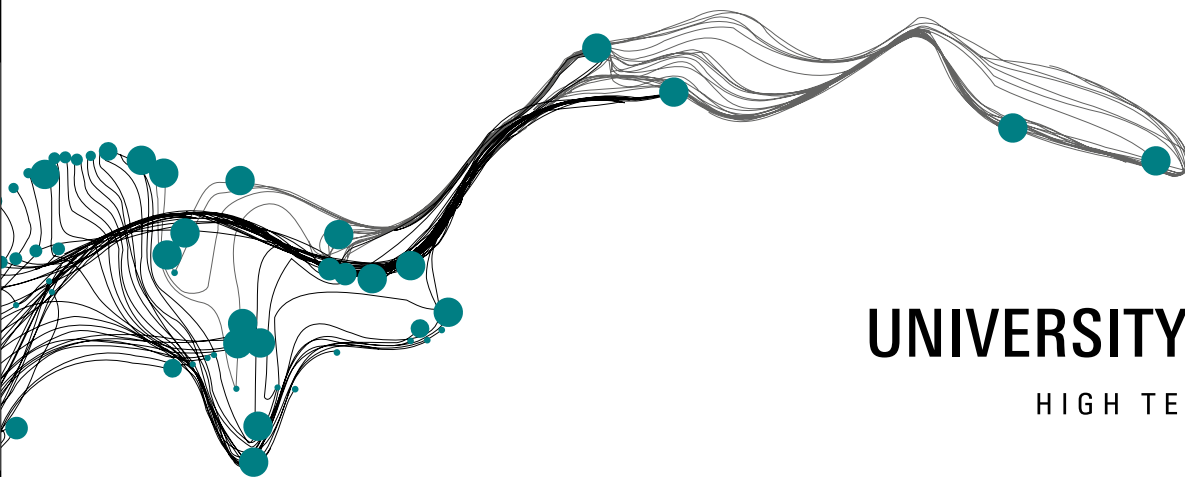
"I chose ITC because it's the best, or one of the best institutes for studying remote sensing worldwide. I focus on earthquakes. I already became fascinated by this subject during my master's programme. Ultimately, I hope that we can use the method I am developing to predict earthquakes, but otherwise there are many other applications for my work."

As Effie Pavlidou has discovered, the faculty of Geo-Information Science and Earth Observation (ITC) of the University of Twente in Enschede, the Netherlands, is one of the world's foremost education and research establishments in the field of geo-information science and earth observation. We offer a wide range of the world's best degree courses in the following fields:

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