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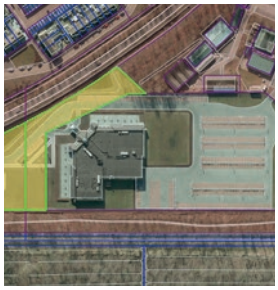
Trends in Spatial Domain Standards

Developing a Second Edition of the Land Administration Domain Model

GEOHAZARD MANAGEMENT ON THE CANADIAN NATIONAL RAILWAY CORRIDOR

INTERVIEW WITH STEVEN XU, CEO, HI-TARGET

LEAPFROGGING URBAN PROBLEMS WITH 'SMART CITIES'



On the front cover, a close-up of an area in the Po Valley, Italy, showing Pavia (centre) and the confluence of the Ticino and Po rivers. This is a subset from the first image from the Sentinel-2A satellite acquired on 27 June 2015 (just four days after launch) processed using the high-resolution infrared spectral channel. The satellite's instruments will provide key information on crop type and health, assisting in food security activities. (Image courtesy: ESA)

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Future

In this last issue of *GIM International* for 2015 we are once again bringing you a wide array of feature articles stemming from all corners of the globe. First of all, I would like to draw your attention to this month's interview. Our editorial manager Wim van Wegen interviewed Steven Xu, CEO of Hi-Target, one of China's fast growing companies in the field of geomatics (see page 12). Mr Xu shares his views on developments in the Chinese surveying market and also internationally. He advises surveyors to adapt by moving from front stage – day-to-day surveying in the field – to backstage: analysing, monitoring and interpreting data. He also sees that where surveying used to be a relatively isolated industry, more and more combinations with other industries are transforming the business. Touching on the decline in growth figures for China and the simultaneous shift from an industrial to a service economy, Mr Xu paints an exciting picture of the future.

Another glimpse of the future can be found in the article on 'UAS Experiences in Africa' by Marius Schröder on page 21 of this issue. The author describes a survey carried out in the African country of Benin. In scorching heat and a terribly dusty environment, the survey on the savannah using a UAS shows that – despite those circumstances being hazardous for the sensitive sensors on the unmanned aerial vehicle – larger areas can be surveyed faster. A cadastral plan was subsequently prepared, delineating property boundaries on the imagery material acquired by the UAS. With respect to securing tenure rights, this is a perfect example of fit-for-purpose land administration that could be applied in lots of places in the near future.


Photography: Arie Bruinsma

▲ *Durk Haarsma, publishing director*

Contributing editor Fréderique Coumans explores the topical issue of urbanisation in her article on 'Leapfrogging Urban Problems with Smart Cities' on page 32. She focuses on India where, in 15 years' time, 600 million citizens will live in cities (compared to 350 million today). In anticipation of that major shift, the Indian government is thinking about ways to smooth the process and design 'smart cities' for the future. Spatial information is the foundation of all planned activities and informed decision-making in knowledge-based and policy-driven smart cities – from a city-planning perspective to services offered to the citizens. Therefore, a spatial data infrastructure (SDI) must be the platform for spatial data creation, exchange and use. India's national government intends to support 100 cities in their transformation into 'smart' and has launched a competition to find suitable candidate cities.

It is good to see that there's still so much future in geomatics that almost every article in this issue holds a promise for the application of geoinformation for the betterment of citizens' lives all over the world. As we're now on the brink of a new year, I promise you that we will continue to bring you similar stories in 2016 and beyond!

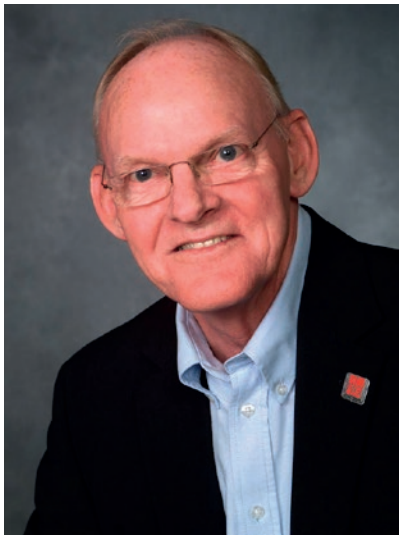
Facing the Post-2015 Global Agenda

The current global agenda as set by the Millennium Development Goals (MDGs) is due to expire at the end of this year. Designed to reduce poverty and improve the lives of poor people, this agenda has served the world well as a focal point for governments. The progress in meeting the goals has been monitored and published yearly as a global incentive. For example, the 2014 progress report shows that the extreme poverty rate has been halved. Hence, Goal 1 has been met at a global scale, albeit with huge regional deviations. For example, the Sub-Saharan Africa region is lagging far behind.

The MDGs are now being replaced by the Sustainable Development Goals (SDGs) with a new, universal set of 17 goals and 169 targets that UN member states are committed to use to frame their agenda and policies over the next 15 years. The goals are action-oriented, global in nature and universally applicable. Targets are defined as aspirational global targets, with each government setting its own national targets guided by the global level of ambition but taking into account national circumstances. The goals and targets integrate economic, social and environmental aspects and recognise their interlinkages in achieving sustainable development in all its dimensions.

While the MDGs did not mention land directly, the new SDGs include six goals with a significant land component. In Goal 1, for example, which calls for ending poverty in all its forms everywhere, Target 4 states that by 2030 all men and women will have equal rights to ownership and control over land and other forms of property. Similarly the land component is clearly referred to in Goal 2 on ending hunger, Goal 5 on gender equity, Goal 11 on sustainable cities, Goal 15 on life on land, and Goal 16 on peace, justice and strong institutions.

These goals and targets will never be achieved without good land governance and



▲ *Stig Enemark.*

well-functioning, countrywide land administration systems. Land governance and administration is basically about people – it is about the relationship between people and land and about the policies, institutions and regulations that govern this relationship.

Against this backdrop there is a strong requirement for basic and fit-for-purpose land administration systems in developing countries, where often less than 10 percent of the land is included in the formal systems. There is a need for reliable and robust data for devising appropriate policies and interventions for the achievement of the SDGs and for holding governments and the international community accountable through monitoring and assessment. This calls for a 'data revolution' for sustainable development to empower people with information on the progress towards meeting the targets.

The continuing challenge will be innovation in the mindset of land professionals to cope with new, integrated approaches and a demand for interaction across generations of land professionals to ensure implementation of a holistic approach to sustainable development over time.

Most shared during the last month from www.gim-international.com

1. Lidar Scanning by Helicopter in the USA - http://bit.ly/1l11h2R
2. How Big is Global Insecurity of Tenure? - http://bit.ly/1l11iDY
3. Mapping Liquid Water on Mars - http://bit.ly/1k9lF7f
4. Sweden Excels in Public Use of 3D in Smart City Applications - http://bit.ly/1VAUtd3
5. Aerial Mapping Project on Impact of Vegetation on Electricity Network - http://bit.ly/1k9kNiX

Lead'Air Launches New Aerial Lidar Platform

MIDAR-H system.

Lead'Air, manufacturer of Track'Air aerial survey products, has announced the availability of one of its newest products, the MIDAR-H. The MIDAR-H is a newly designed aerial platform for concurrent capture of Lidar point cloud data and tri-view imagery for corridor and powerline mapping applications. Particularly adapted to low-level flight, the system is capable of delivering up to 300 megapixels per second of 0.25-inch (0.6cm) GSD colour imagery. Coupled with the RIEGL VUX-1LR capturing an effective measurement rate of up to 750,000 measurements per second, the MIDAR-H captures a complete view of the corridor from both forward and back views in a single pass.

http://bit.ly/1kqYGoR

Leica Extends Deformation Monitoring Solution

Leica Geosystems has announced two new additions to its deformation monitoring solution, Leica GeoMoS: GeoMoS AnyData and GeoMoS API. Since it enables powerful sensor data fusion from applications such as air or water quality monitoring and construction or building management, users can now create comprehensible visualisations and customisable reports. With GeoMoS AnyData and GeoMoS API, multiple open interface standards are accessible to provide more information to projects than just classic geodetic monitoring applications. As a result, Leica Geosystems presents the GeoMoS software as a more flexible and open solution, capable of automatically acquiring, processing and distributing intelligent information locally or via the internet in real time.

http://bit.ly/1kqYC8u

A Refreshing Approach to Geomatics

The conference committee of the GIM International Summit has announced a refreshing list of inspiring and original speakers who will give a keynote at the inaugural edition of the event. Among the confirmed speakers is Hans Rosling, world's most famous statistician and one of the most influential public speakers on global change. Other top speakers are Ed Parsons, geospatial technologist of Google, and Morten Jerven, the author of *Poor Numbers: How We Are Misled by African Development Statistics and What to Do about It* and his latest work *Africa: Why Economists Get it Wrong*.

The list of speakers further includes Daniel Steudler of the Swiss Federal Office of Topography (swisstopo), Vanessa Watson of the African Center for Cities, Joyeeta Gupta of the UNESCO-IHE Institute for Water Education, Pier Vellinga, professor of climate change at Wageningen University and at the VU University Amsterdam, and Geert Bouckaert, president of the International Institute of Administrative Sciences (IIAS).

Three interactive days

The input from the keynotes and the outcomes of the interactive workshops will be summarised in the GIM International Summit Declaration, which will be officially signed and subsequently submitted to high-level and global policymaking institutes. With speakers and presenters from outside the traditional geomatics world, all of whom are true experts in their own field, the conference committee aims to create a closer link between society's needs and geospatial solutions.

The workshop programme is taking shape, with topics that are well connected with the keynotes. For example, one workshop will be hosted by Pierre-Philippe Mathieu, Earth Observation Applications Engineer in the Earth Observation Science & Applications Department of the European Space Agency. Mathieu and the workshop participants will explore together how data – in particular from Copernicus satellites – can support climate science, adaptation, mitigation and disaster risk management. In another workshop, Prof Arnold Bregt of the Wageningen University and Amsterdam Institute for Advanced Metropolitan Solutions will encourage and inspire delegates to join him in exploring the future role of geoinformation from the perspective of urban planning and in identifying gaps in the current state of technology.

The GIM International Summit will culminate on Friday 12 February in the participants' constructive thoughts and ideas being summarised in a final declaration. This document will then be officially presented to an influential international policymaker (whose name will be revealed at a later date).

▲ *Hans Rosling.*

▲ *Ed Parsons.*

More information on the workshops:
www.gimsummit.com/programme/workshops
For a comprehensive overview of the full conference programme:
www.gimsummit.com/programme

Internet of Things Partnership between Esri and Microsoft

The Internet of Things (IoT) inspires new ways of thinking about how we work with and share information and enterprises are now getting ready to intelligently consume the IoT's large data streams in real time. To help with this, Esri is working with Microsoft to integrate location services and spatial analytics to the Microsoft Azure IoT Suite. The Esri and Microsoft collaboration will rapidly enable IoT scenarios by offering customers and partners a set of highly capable platform services as ready-to-use, preconfigured solutions. This forthcoming integrated offering is the next step in Microsoft's and Esri's long-standing alliance to spatially enable the enterprise.

▸ **http://bit.ly/1kqYXrF**

OGC and ASPRS to Collaborate on Geospatial Standards

The Open Geospatial Consortium (OGC) and the American Society for Photogrammetry and Remote Sensing (ASPRS) have agreed to work together more closely in the application and promotion of standards and best practices for the location and geospatial industries. The advancement of standards and best practices in areas such as point clouds benefits from the partnership of key organisations, said Mark Reichardt, OGC's president and CEO, who is deeply appreciative of the recently established alliance with ASPRS. He believes that the partnership will encourage the members of both ASPRS and OGC to join forces in collaborative activity that will result in benefits for the whole global community as photogrammetry and remote sensing grow in importance.

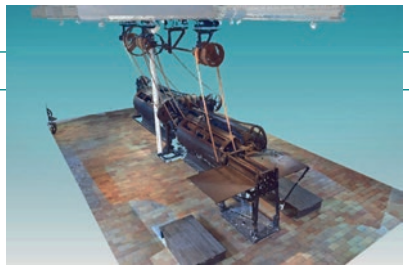
▸ **http://bit.ly/1kqZ1Yq**

3D Interactive Maps to Help Cities Visualise the Future

CyberCity 3D, a smart 3D building expert, has developed a 3D Smart Cities mapping platform to help municipal authorities and planners visualise their towns and cities in 3D. Existing and future city plans, proposed developments and schemes can all be visualised together with relevant data using a simple, out-of-the-box solution, with streaming to any web-connected device. The CyberCity 3D Smart City maps can be used for a host of applications including planning, transport, environment and tourism. The models are fully interoperable and will perform on most proprietary software applications such as GIS and 3D design packages and can be streamed via the web. The live streaming uses Cesium open architecture, a cross-platform virtual globe designed for dynamic data visualisation, allowing the 3D models to be viewed on tablets, smartphones, desktops and laptops.

▸ **http://bit.ly/1kqYINt**

3D Smart Cities.

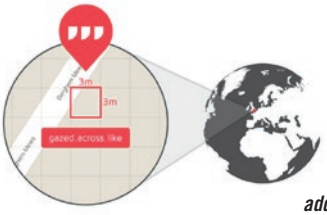


RealVisuals scanned the historic turbine.

Recreating Museum Artefacts as 3D Models

RealVisuals is bringing historical artefacts to life with interactive 3D computer models created from laser scanner data generated using Pointfuse software. The Belgium-based technology company has pioneered the use of Pointfuse for heritage applications, scanning and producing models of complex museum collections including pieces from the Flax Museum 'Texture' at Kortrijk in Belgium. Working with Arithmetica, the company behind Pointfuse, RealVisuals has created a number of 3D models, the latest of which is of a historic turbine recently included in the list of best museum pieces in Flanders.

▸ **http://bit.ly/1RQgSTg**



what3words address system.

what3words Provides Three-word Address System to Esri ArcGIS

what3words has announced that it will be providing its innovative three-word address and location reference system to the ArcGIS platform. what3words is an Emerging Business Partner in the Esri Startup Program, a three-year programme designed to empower small companies to solve big problems with the use of geospatial technology. what3words is an addressing and location reference system based on a global grid of 57 trillion squares of 3mx3m. Each square has a unique pre-assigned 3 word address. For example, crayon.giants.liking is a perfect spot in the Grand Canyon to take a picture of the Kaibab Suspension Bridge across the Colorado River.

▸ **http://bit.ly/1kqZj1E**

Global 3D Mapping Platform to Visualise Location-based Services and Interiors

eeGeo 3D mapping platform.

eeGeo, a UK-based 3D mapping company, has launched a geospatial meta-mapping platform which enables organisations to build interactive mobile applications to deliver content and location-based information. The eeGeo platform enables businesses across a range of sectors to easily visualise complex datasets on a geospatially accurate representation of the interior and exterior world. The platform is disrupting the industry by enabling customers to deliver engaging, compelling and differentiated 3D map experiences.

http://bit.ly/1kqZyJX

ISPRS and UN-GGIM Launch National Mapping and Cadastre Agency Forum

The International Society for Photogrammetry and Remote Sensing (ISPRS) and the United Nations Initiative on Global Geospatial Information Management (UN-GGIM) have announced the First ISPRS – UN-GGIM National Mapping and Cadastral Agency Forum. National Mapping and Cadastral Agencies (NMCAs), many of them organised within UN-GGIM, form a significant group of members of ISPRS, acting as the ISPRS Ordinary Member for many countries. NMCAs play an important role in their countries, providing geospatial data of various levels of detail, types and scales, which form the basis of today's geospatial data infrastructure – an indispensable national asset for sustainable development of the respective country and many other applications.

http://bit.ly/1kqZFFt

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Hybrid UAS

Unmanned airborne systems (UASs) – aircraft which fly without human pilots on board – have soared in popularity as surveying devices. Today they are applied in a wide variety of 2D and 3D mapping, inspection and monitoring tasks. A UAS is steered wirelessly by remote control, or follows a pre-specified air path. Whether it flies autonomously or is controlled remotely, the flight path is guided by a global navigation satellite system (GNSS) coupled with an inertial measurement unit (IMU). After flight, the recorded GNSS and IMU data is usually used to georeference the sensor data. The sensors on board include RGB cameras, near-infrared (NIR) cameras, thermal infrared (TIR) sensors and Lidar. Some UASs allow two or more sensors on board so that NIR images and Lidar points can be recorded at the same time. The rapid rise of the UAS ensued from a once-in-a-decade convergence of developments. Micro-electronics, auto-piloting, wireless communication, super-materials that are strong yet lightweight, compact digital cameras, image processing software, miniaturisation of GNSS and IMU systems, high-charge batteries – they all come together in a UAS. Markedly, the progress of power capacity of high-charge batteries is just 7% per year and, compared to the other UAS components, the battery notably adds to the payload. Supported by the accomplishments in artificial intelligence and computer vision, today's photogrammetric software enables high automation of the chain from flight planning, self-calibration of consumer-grade cameras and aero-triangulation up to the creation of DEMs and orthomosaics as well as their confluence: 3D landscape and city models.

In *GIM International*'s UAS Special 2014 I grouped UASs into two broad categories: fixed wings and multicopters. The first type uses the uplift abilities of its wings to reduce energy consumption and thus to stay airborne for longer than a copter with similar dimensions. The wings also enable high-speed flying and the capture of larger areas per flight. A fixed wing is thus better suited for 2D and 3D mapping of extensive areas than a copter. So, why use a copter? Copters are more manoeuvrable, they can hover and, in contrast to fixed wings, they can take off and land in small spaces as they can ascend and descend vertically. Hence, a copter is ideally suited for capturing single buildings and small areas. So is the choice limited to either a fixed wing or a copter, as my categorisation indicates? No, as a result of recent advances I have to readjust my grouping into two types and add a third category: the hybrid. Aerolution, a Berlin-based company specialising in developing and marketing UASs for professional purposes, has recently launched the Songbird 1400. This UAS combines the pros of both the fixed wing and the chopper in one and the same aircraft. Basically the aircraft is a fixed wing but the four rotors are not mounted rigidly on the wings; the blades can rotate from the vertical pose, normal for a fixed wing, to horizontal. The horizontal pose provides the aircraft a vertical take-off and landing (VTOL) ability as if it were a copter. With a wing span of over 3 metres and maximum take-off weight (MTOW) of 7.8kg the UAS can take flight with wind speeds up to 6 Beaufort (13 m/sec) and stay in the air for over one hour, provided that the copter facility is only used for launch and landing. Hovering and other copter-like manoeuvres during data capture consume the same amount of energy as a copter, reducing air time. Unlike other fixed wings, the hybrid does not require a runway, catapult or parachute. This reduces the risk of damage to on-board sensors and other components. The UAS can carry two sensors, e.g. a TIR sensor and an RGB camera, simultaneously. During Intergeo 2015 held in Stuttgart, Dr Hans-Peter Thamm, one of the founders of Aerolution, provided a convincing outdoor demonstration.

GIM INTERNATIONAL INTERVIEWS STEVEN XU, CEO, HI-TARGET

Looking **Far Beyond** the Horizon

These are exciting times in the geomatics industry. Innovative solutions are being developed, integration is the main keyword and the big players are acquiring smaller companies that add a new dimension to their portfolio. Europe, Japan and North America are traditional strongholds of geomatics, but several very ambitious companies from China are doing their utmost to catch up with the frontrunners. At Intergeo 2015 in Stuttgart, Wim van Wegen took the opportunity to meet Steven Xu, CEO of Hi-Target, who was more than happy to share his thoughts and expectations with *GIM International*.

▲ *Steven Xu.*

Hi-Target was established in Guangzhou, China, in 1999. What were its ambitions in the early years?

Hi-Target started out as a small company. The chairman, Mr Liao Dinghai, founded the company after he graduated from Dalian University. Mr Liao served for a period in the national navy as a hydrographic surveyor before Hi-Target was founded. At that time he had the opportunity to take part in some big hydrographic survey projects in China but the equipment they used for surveying was very old and difficult to operate, even dangerous at times. Slowly and surely Mr Liao realised it was his ambition to manufacture more advanced equipment on his own to change surveying conditions in China, but it remained a dream for a while. Then, he received a chance to work on another big project, this time for Nansha island exploration. The Chinese government spent lots of money to import GPS devices for this project. Mr Liao was one of the first people to use GPS for surveying. He quickly learnt how GPS devices work, and took every opportunity to attend industry events to help him develop advanced surveying technology. Mr Liao established Hi-Target in 1999. Today, Hi-Target successfully promotes RTK production localisation implementation and occupies the leading status in China.

What are your present ambitions, both nationally and internationally?

Now that's what you call a big question! But I would like to put it simply: in our domestic market, we want to be the number one. There is a unique opportunity since the Chinese market is huge with enormous potential. We are currently making great strides so things look very promising for Hi-Target in China.

When it comes to the international market, our ambition is to become one of the most respected premium brands. We dream of being mentioned in the same breath as Trimble and Leica Geosystems. When people think of 'Made in China' they traditionally associate it with copies, low quality or even worse. But this is clearly changing nowadays. Many Chinese companies already have their own core technology. But I am keen to stress that we also believe the international market offers a lot of potential for Chinese software. Without linguistic and cultural barriers, software developed by Chinese companies will be increasingly widely used in different countries. Therefore, we think there are great opportunities on the horizon in the survey industry

Which major developments do you foresee in GNSS technology, and what are the implications of these developments on the surveying profession in general and the manufacturers of receivers in particular?

Future GNSS technology should be developed to be more compatible, easier to use and more cost-efficient. In view of the global growth of satellites, GNSS technology should be highly compatible with various satellite systems. Furthermore, satellite-based

augmentation systems, providing signal corrections and information about the quality, should become ever-more convenient and popularised so that people can get enhanced signals in different accuracies through various channels. It is also essential to improve cost-efficiency in order to promote the use of satellite navigation technology – and especially high-precision technology – in more industries.

In terms of the implications of these developments on the surveying profession, I expect high-precision GNSS surveying data to gain in popularity. At the same time, GNSS will be combined with other surveying technology and information technology, such as geographic information technology, total stations, 3D laser, UAV and so on. The use of mass data for surveying will lower the barriers to market entry for high-precision data. And for the manufacturers of receivers, the implications are actually quite simple: there are chances but also challenges for us. GNSS technology will be used in other industries and the market demands will increase rapidly. We, the manufacturers, have to conduct research into core technology and promote our applications to more fields, beyond just surveying – otherwise we may be out of the game.

Technology and societal needs are rapidly changing. What are your thoughts on how surveyors around the world should adapt to these changes?

Surveying used to be a relatively isolated industry but it now combines with other industries. It has become easier to enter the market for professional surveying in the open air, and some manual survey activities have been replaced by unmanned aerial vehicles, 3D laser scanning, etc. However, the working standard of data processing is higher. Therefore, surveyors should adapt by moving from front stage to backstage. In other words, surveyors should learn to use high-end equipment like unmanned aerial vehicles, better understand the demand for industry applications and improve their ability to analyse data for industry solutions.

Total stations, which have now been on the market for over half a century, have evolved into sophisticated systems packed with electronics. Which developments can surveyors expect to see in the next five years?

Future total stations will be loaded with multi-sensors, highly precise, intelligent and miniaturised. RTK and unmanned aerial vehicles will replace total stations for general measurement activities. Total stations are becoming increasingly high-grade, high-precision and advanced. They will mainly be used for large-scale and sophisticated engineering surveys, construction lofting, monitoring, track surveys, etc.

How does your company keep pace with – or even stay ahead of – changing technology and societal needs, particularly in terms of R&D?

Hi-Target is a company relying on technological innovation for long-term development. Since becoming listed, Hi-Target has been focused on speeding up the layout of the R&D team, promoting and developing technology innovation constantly with the aid of capital strength. In fact, the annual investment in R&D is more than 11% of our total revenue, we have more than 1,600 staff, over 30% are R&D engineers, and over 10% of them are professors or hold PhDs. In recent years we established several research institutes and even overseas R&D centres to research the international advanced technology and achieve successful breakthroughs in technical challenges. Now we have already mastered the core technology in satellite navigation, high-end marine and 3D laser scanning industry. We have also established a specialised R&D team and subsidiaries for those high-end business and launched more and more high-end products with proprietary intellectual property rights. Examples of such products are multibeam echosounders, 3D laser scanners, mobile mapping systems, etc. In this way, Hi-Target keeps seeking technology innovation and promoting R&D strength to keep pace with the technological developments and societal needs.

Another important trend is the convergence of mobile and geodetic applications. How is Hi-Target anticipating this development?

Location-based services are opening up several new market opportunities. One is that mobile devices with different levels of accuracy will increasingly be appearing on the market. Another great opportunity is based on mobile mapping systems for street-view data. Actually the application of location information is now becoming ever-more important for wide usage.

Some people say that high precision is no longer the privilege of surveyors and that today's GNSS advances, smartphones and other low-cost equipment mean that decimetre accuracy is available to people without qualifications and specialist knowledge. What's your reaction to this? How should the profession adapt?

The key thing is to keep pace with industry developments relating to geography and location information services. What we suggest is firstly apply new technology, address the market demand with rapid low-cost access to information, update data, master the real measurement technology and try to develop the highest-grade technology possible. Secondly, in near future the surveying and mapping operation will become increasingly simple. The current mode of working will be replaced by the mode of quickly acquiring large amounts of data. Therefore, measuring personnel should focus more on the data processing and application side of things rather than how to survey in the field.

Are you working with universities to develop solutions through scientific research?

Yes! We have collaborative partnerships with Southwest Jiaotong University, Wuhan University, Central South University, Chinese Academy of Sciences, etc. In one example, our Zhejiang office has cooperated with Southwest Jiaotong University to develop a 3D technology platform for 3D pipeline development. Zhu Qing, a professor at Southwest Jiaotong University, and his team are engaged in long-term research into a 3D geographic information system and virtual geographic environment. The R&D cooperation between Hi-Target and Southwest Jiaotong University is also focused on service to develop an integrated visual geographic information solution with mass geographic data applications. The system will process true 3D data, real-time input and dynamic observations into forecasts and warnings, facilitating optimisation and control.

There are many different manufacturers of survey equipment in China today. Western countries have seen a process of consolidation over recent decades. Is the situation similar in China? In other words, are some manufacturers looking to join forces or merge with other companies, either in China or abroad?

I would say yes, the current industry in China can be likened to what Western countries have gone through in the past decades; China is experiencing a process of integration. After

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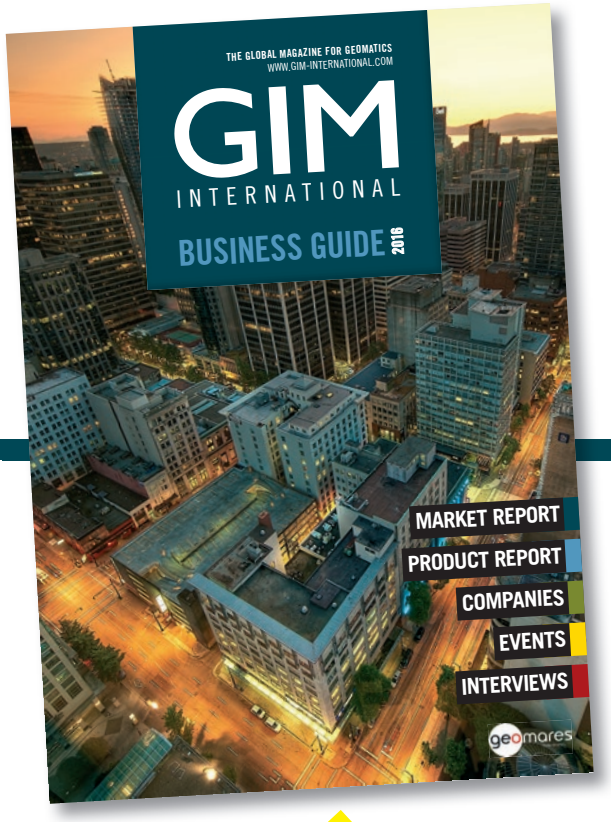

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becoming listed on the stock market in 2011, Hi-Target merged with many businesses to expand its product lines and research abilities, such as 3D laser, indoor positioning, total stations and ocean survey. Today, we're also interested in cooperating with research centres and universities abroad, perhaps even merging with a research team.

Your company operates worldwide. What is your business model in terms of dealer and service networks around the globe?
Yes, we are active worldwide. We mainly export surveying devices through our authorised dealers in the various countries around the world. Hi-Target currently has more than 100 dealers in 70 countries. To improve our after-sales service, we have set up a maintenance centre in Hong Kong to provide services for Southeast Asian countries, and in Europe we have just opened a Czech maintenance centre. At the end of this year, we will launch a maintenance centre in America to provide better services for customers in both North and South America.

What type of company will Hi-Target become over the next five years in terms of products, services and customer base?
Over the next five years, Hi-Target will evolve and specialise in devices, system integration, data services and suchlike, providing what we call "comprehensive industry solutions" including product hardware, industry application software and support services. Examples are entire and various solutions from devices to services for 3D laser scanning, high-end sounding and positioning marine applications, and BDS applications for precision agriculture, etc.

China's economic growth is diminishing. How will that affect the geomatics industry in China?
Our country's economic development is transforming and upgrading from an extensive high-speed model into a quality service model. Urban construction has declined compared with previous decades but the standard of living is improving so people gradually need better quality and services. Companies with a single, laggard product may be feeling considerable pressure, but at Hi-Target we have our own R&D team and comprehensive product lines and we provide system integration solutions and services, so for us there are more chances than challenges. Extra competition will stimulate development of the whole industry, just as it has in Western economies.

▲ *Hi-Target headquarters in Guangzhou, China.*

Looking ahead at the geomatics industry in general, do you foresee any 'rising stars' that will significantly change the industry, like UAVs have done over the past five years?
To discuss the future of the geomatics industry, we must consider its development in conjunction with other related technologies such as geographic information technology. With the emergence of new technology, people can now get more rich geographic information to meet their demands for geomatics-based industry applications. As we all know, UAVs, 3D laser scanning, oblique photogrammetric and remote sensing technology are being widely used and are changing the traditional geomatics approach from small-range to large-range surveying, from earth to air and from single pieces of equipment to efficient, integrated systems which greatly improve the speed and efficiency of measurements.

I expect satellite technology to be a new rising star since small-satellite and high-resolution remote sensing technologies are rapidly maturing. As launching costs drop, they will soon become very important tools for highly efficient data acquisition. All these advanced technologies are making outside field work much more convenient. People can obtain basic data more easily and also with better quality, so the focus of development and competition should be on the interior workflow and data processing ability. I think these aspects will be increasingly important in the industry's future development. ◀

Acknowledgement
With thanks to Mathias Lemmens for question development.

Steven Xu

Steven Xu is CEO of Hi-Target Surveying Instrument. He graduated from Wuhan University, Surveying and Mapping Institute, having mastered the basic theory and key technology of geodesy, engineering surveying, satellite positioning and navigation. With more than 15 years' experience in GNSS, GIS, 3D laser scanning, and marine technology research, Steven Xu remains committed to the satellite navigation and positioning industry. Steven Xu also serves as director of the Chinese national satellite positioning technology association, director of Wuhan University's Surveying and Mapping Institute (Guangdong alumni branch) and director of the Chinese national instrument industry association (surveying and mapping instruments branch).

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A MULTI-SENSOR APPROACH

Geohazard Management on the Canadian National Railway Corridor

In Western Canada, substantial lengths of the transportation corridors are located within steep mountainous terrain and deeply incised river valleys. This is also the case for the Canadian National (CN) rail lines, which traverse the Rocky Mountain, the Cascade and Coastal ranges from Edmonton, Alberta, to the ports of Vancouver, British Columbia (BC). Along this corridor the railway infrastructure is exposed to various slope geohazards including landslides, debris slides and rockfalls, all of which are problematic for the safe and efficient operation of the railway. In a recent case of rock slope failure along the CN rail line in BC, a multi-sensor approach was undertaken to identify other potential threats in the area, to monitor stability of the rock slope during remediation work and to aid in the planning of rock scaling and blasting.

Managing geohazard risks is challenging due to complex slope topography, limited access to remote sites, the large number of geohazard sites and the length of the corridor. Since 2012, in addition to track-level and aerial inspections, a series of high-resolution gigapixel images – from terrestrial laser scanning (TLS), aerial laser scanning (ALS), ground-based photogrammetry and oblique aerial photogrammetry (from helicopter and unmanned aerial vehicle (UAV) platforms) – has been collected at known geohazard locations. This effort is part of the Railway Ground Hazard Research Program, a collaborative project between industry, government and universities [1] to identify and characterise geohazards, assess susceptibility and assist in the prioritisation of mitigation works.

ROCKSLIDE ALONG THE RAILWAY LINE

On 9 February 2015, a rockslide occurred along the CN rail line passing Seton Lake between Lillooet and Pemberton, BC. In places the railway follows the shoreline of Seton Lake, adjacent to steep rock cliffs. The run-out of the rock slope failure blocked the tracks and exposed an overhanging, unstable rock wedge. Consequently, the railway line was closed as the risk to railway operations was too high. Initial remediation work consisted of bolting a portion of the unstable rock wedge and scaling of loose material. During this initial work, displacement and cracking of the rock wedge was observed, prompting the collection of 3D data to aid the remediation work and for slope stability assessment. Starting on 23 February 2015, a three-week drill and blast programme was undertaken to remove the unstable rock wedge (Figure 1).

Figure 1, CN railway line at Seton Lake, British Columbia. On 9 February 2015 a rockslide occurred, exposing an overhanging, unstable rock wedge.

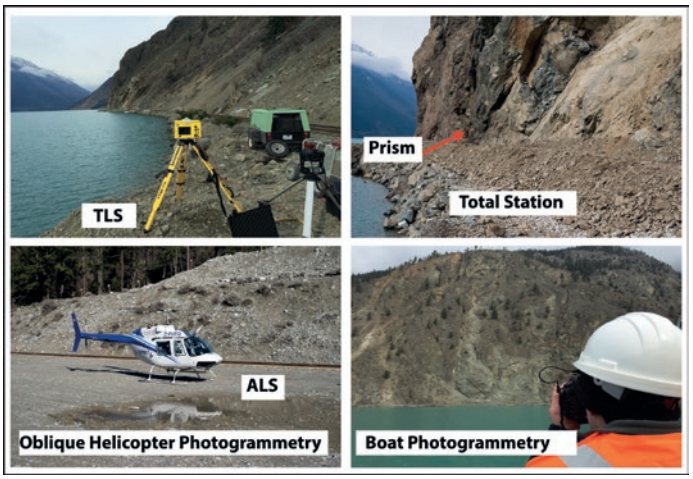

Figure 2, Multi-sensor data collection – TLS and total station monitoring of failure area, ALS survey of 4km² area and helicopter and boat-based photogrammetry of the surrounding mountain.

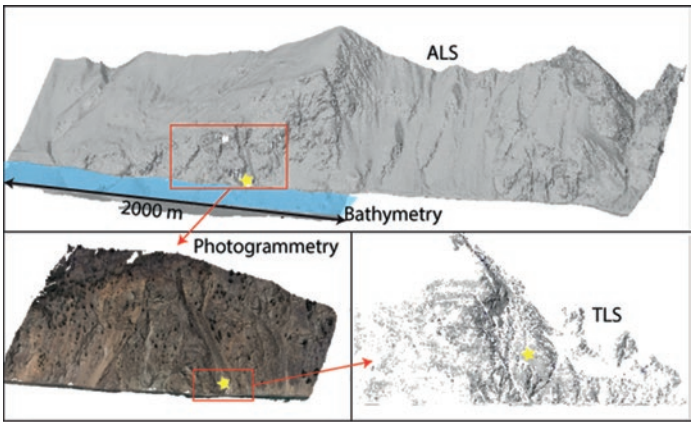

Figure 3, Outline of data collected. The yellow star marks the failure location.

DATA COLLECTION

A multi-sensor, multi-temporal remote data collection campaign was conducted to monitor slope displacement and stability of the wedge during remediation work, to estimate the volume to be removed, to calculate the volumes of rock removed during scaling and blasting and to assess the rock joints and potential source zones where future failures might occur. Data collection consisted of an ALS survey of the region, oblique photogrammetry from a helicopter and boat, TLS and photographic monitoring of the unstable wedge during remediation work, total station monitoring of a location on the unstable wedge and multi-beam sonar data to map the underwater rock slope underlying the railway (Figures 2 and 3).

ALS AND OBLIQUE PHOTOGRAMMETRY

ALS data was collected from a helicopter covering a 4km² area along the rail line to obtain 3D data of a large area surrounding the rock slope failure. ALS data allows the mapping of discontinuity surfaces within the rock mass and identification of hazard source zones. The georeferenced accuracy of the ALS data in this study was in the 10cm range: too high to be used for monitoring slope displacements in this case.

ALS data is collected in a downward-looking manner, meaning that vertical rock slopes are occluded from the point cloud. To fill in the data gaps along the vertical rock slopes, and to obtain a photorealistic model of the slope surrounding the failure source zone, oblique photographs were taken from a helicopter and a boat. A total of 1,000 photos were taken, using a Nikon D800 camera equipped with a 35mm prime lens and camera-mounted GPS, from parallel lines looking perpendicular at the slope at various elevations. Photos were taken with greater than 60% overlap between photos and between passes, allowing for model construction using structure-from-motion software.

The camera-mounted GPS provided initial georeferencing and scale, but was later improved by fitting the constructed photogrammetry model to the ALS data using a scale-adjusting best-fit algorithm. Photos collected from the boat allowed for the construction of a more detailed model of the area directly surrounding the failure compared to the photos collected from the helicopter. The combined ALS and photogrammetric model allowed for better characterisation of the rock mass by reducing occlusion bias and provided a detailed photorealistic model of the slope surface surrounding the failure source zone.

TLS AND TOTAL STATION, PHOTO MONITORING

Monitoring with TLS commenced on 23 February 2015 using an Optech Ilris enhanced-range laser scanner at a frequency of 2 to 5 scans per day. Data was collected from two survey stations, one located 300m away from the rock slope at a bend in the track and the other across the lake, directly opposite the failure, at a distance of 1,000m.

TLS has the benefit of collecting millions of data points on the slope surface in a short period of time and can be used to detect 3D displacements when sequential datasets are compared. However, on average, it is limited to centimetre-range accuracy. For this reason a total station was used to monitor a single prism located at the base of the wedge with millimetre accuracy. Photographic modelling using high-resolution images was conducted twice per day for the purpose of monitoring the development of new surface cracks.

Collection and multi-temporal comparison of the TLS data provided a high-resolution point cloud of the failure area. When combined with the photogrammetric model, the data permitted the calculation of the volume of unstable rock to be removed. Sequential datasets were also analysed to monitor slope displacements, to identify any threat to remediation workers and to provide early warning of rock slope deformation.

BATHYMETRIC SURVEY

An initial multi-beam sonar survey of the rock slope under the railway line to the lake bottom was conducted on 17 February 2015. The primary purpose was to examine the rock slope directly beneath the railway line. Following completion of the scaling and blasting work, a second sonar survey was conducted on 10 March 2015 to detect changes to the rock slope below the railway line as a result of the remediation efforts.

The combination of surface data and sonar data allowed changes above and below the water level (above and below the railway line) to be monitored. No significant deformation was detected with either TLS or the total station monitoring during the site remediation programme, giving confidence that the rock

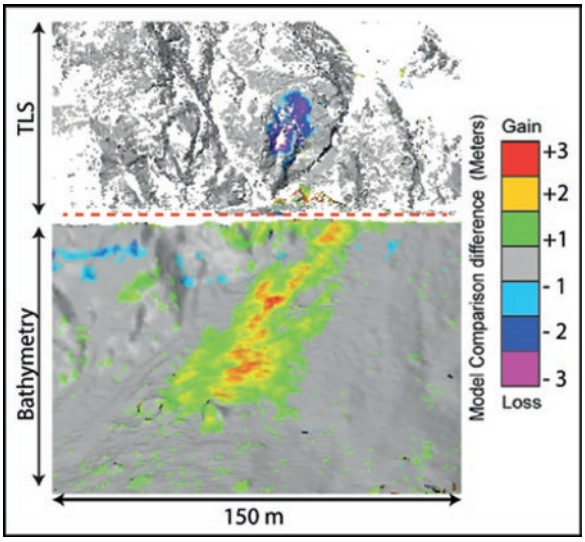

Figure 4, Change detection of the slope above and below water level, due to blasting on the slope and construction work on the railway line, using multi-sensor monitoring.

slope was stable. Figure 4 illustrates changes on the rock slope above and below the railway line as a result of the rock slide remediation and work to rebuild the railway line.

MULTI-SENSOR APPROACH FOR RISK MANAGEMENT

As shown in this case, the use of multiple remote sensing technologies provides real-time data in a monitoring programme. The deployment of multiple technologies provides the full dataset needed for slope stability monitoring and assessment. Although ALS can provide 3D data for a wide area, it is downward looking and data gaps exist in vertical (oblique) surfaces. To fill in the gaps, photogrammetric models can be constructed from oblique photos taken from a helicopter or UAV. ALS and photogrammetric models can be compared on a multi-temporal basis providing information on slope change. However, these technologies lack the accuracy provided by terrestrial survey methods such as TLS and total station surveying. The latter techniques are required to obtain very detailed models of slopes and for monitoring small-scale slope deformation to provide warning of potential failure.

A multi-sensor approach is currently being investigated for other applications along the CN railway line. In general, ALS has provided data for identifying and delineating hazards over a larger area and has recently been used to monitor change. TLS has been used to characterise hazards at the slope scale, identify and monitor areas of deformation and quantify slope change. Photogrammetric models are constructed for sites where TLS collection is not possible and for rapid assessment of the extent of rock slope failure. Further research will focus on refining workflows, determining optimum data collection frequency and integrating space-borne remote sensing methods.

Acknowledgements to Trevor Evans (trevor.evans@cn.ca) for his participation in data collection at the field site.

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More information
[1] www.carrl.ca/RGHRP

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HEAT, DUST AND DISTRUSTFUL LOCALS

UAS Experiences in **Africa**

When conducting surveys in countries near the equator, environmental conditions can be harsh. Heat, dust and humidity may disrupt sensitive equipment, while distrustful locals may obstruct the undertaking. The author shares experiences of carrying out a UAS survey on the savannah of Benin, West Africa.

Germany-based Spectair Group offers multiple aerial services including video recordings from unusual perspectives, support services to police, firefighters and rescue teams, inspection of industrial plants, solar roofs and buildings, and mapping and surveying services. In July 2014, the company was commissioned to conduct a UAS survey to produce orthoimages and 3D landscape models of a peri-urban savannah area of 20km^2 in Benin, West Africa. Before advancing urbanisation, this was an agricultural area. Today, many parcels are unused and awaiting urban development (Figure 1). The survey was an initiative of AFC Consultants International and carried out as a bilateral project between the Benin Ministry of Agriculture through the FI-ProAgri investment and funding programme and the German Ministry for Economic Cooperation and Development.

SECURING RIGHTS

One of the tasks was to create a cadastral plan delineating property boundaries to secure the rights of peasants. The agricultural plots are cultivated by individual peasants and their families. The peasants do not own the parcels but have a right to use the land based on customary law. The land is owned by the community the peasants form part of. The rights are not formalised in registers but are instead memorised by the elders and

Figure 1, Peri-urban savannah area in Benin.

Figure 2, An indigenous peasant getting acquainted with the flying object.

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▲ *Figure 4, Part of the 3D landscape model created from DSM and orthomosaics.*

◀ *Figure 3, Launch of the fixed-wing UAS.*

chiefs and passed down from one generation to the next orally. Now, as urbanisation advances, land value is steadily rising and strangers are settling in the midst of formerly close-knit communities. The Benin Ministry of Agriculture set out to transfer the peasants' land use rights into property rights to provide tenure security. It was decided to delineate land use and property boundaries on orthoimages acquired by UAS.

UAS

A fixed-wing UAS – wingspan 1.18m – equipped with a 12MP Canon 220-HS camera and a GNSS receiver was chosen to conduct the aerial survey (Figure 2). The weight including camera is 1.2kg and the maximum speed is 90km/h. The battery capacity limits the maximum time in the air to 25 minutes. Surveys are usually conducted with a speed of 50km/h. In other words, during one flight, a 20km-long strip can be captured. In case of loss of signal from the remote control the UAS will navigate autonomously back to the launch site.

SURVEY

The maximum height difference of the slightly undulating terrain is 50m. The UAS flew autonomously following pre-specified flight paths. GPS initialisation before the start took about one minute. To guarantee safe flights and high-quality positioning, signals from at least six GNSS satellites must be tracked. During this survey an average of 13 GNSS satellites were tracked. One pilot took care of launch and landing (see Figure 3) while a second pilot assisted during the flight. 2,000 images were captured in five flights over the course of three days. For georeferencing purposes, 20 ground control points were established and measured with GNSS. The UAS flew at a height of 250m above ground level resulting in a ground sample distance (GSD) of the true colour images of 2cm. Using Agisoft Photo Scan Professional, a digital surface model (DSM) with a grid spacing of 4cm (although 10cm was requested by the customer) and an orthomosaic were created. By superimposing the orthomosaic on the DSM, a 3D landscape model was created (Figure 4). The vast amount of data was stored on a 2TB hard drive, which was secured in an external case. For taxation purposes a soil inventory was conducted. The entire project, from set-up of the survey to creation of orthomosaics and the 3D landscape model, took 10 days.

HEAT AND DUST ARE SEVERE THREATS FOR THE SENSITIVE DEVICES USED IN A UAS SURVEY

CHALLENGES

The approvals from the Ministry of Agriculture and the military were difficult to obtain. However, the biggest challenges were not so much related to legal permission, custom clearance and other regulatory issues but instead primarily concerned the harsh environmental conditions. Heat and dust are severe threats for the sensitive devices used in a UAS survey. The air temperature reached 55°C and the remote control and other devices reached temperatures of up to 65°C when lying in the sun. The shrink tubing covering the suspension brackets of rudders and ailerons had to be exchanged after every flight as it almost melted. Furthermore, the team faced some local resistance. Initially the indigenous people were not cooperative as they feared the imaging aircraft would bring evil into their community. It took the crew a day to convince the chiefs in the area that the survey would actually benefit the population. ◀

FURTHER READING

www.spectair.com

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Marius Schröder received a BA in Management, Business & Administration from New College Durham in 2007 and an MA in International Management from FH Münster in 2010. He became sales and marketing manager at Spectair Group in 2015.

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DEVELOPING A SECOND EDITION OF THE LAND ADMINISTRATION DOMAIN MODEL

Trends in **Spatial Domain Standards**

The Land Administration Domain Model (LADM) facilitates the efficient set-up of land administration and can function as the core of any land administration system. LADM is flexible, widely applicable and functions as a central source of state-of-the-art international knowledge on this topic. LADM is of one of the first spatial domain standards. Some future trends in the domain and the maintenance of the standard are presented and discussed here. These trends may be relevant for the development of a second edition of the LADM over the coming years.


INTERNATIONAL STANDARD

ISO 19152

First edition
2012-12-01

Geographic information — Land Administration Domain Model (LADM)

Information géographique — Modèle du domaine de l'administration des terres (LADM)

Reference number
ISO 19152:2012(E)

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▲ *Figure 1, The Land Administration Domain Model Edition I was published in 2012 (ISO 19152). Initial preparations have started for the Edition II.*

The use of information and communication technology (ICT) in society will continue to advance and develop. The authors expect that by the year 2025 meaningful information exchange between different domains or disciplines will be possible at a global, national and local level. This information exchange will be based on several well-established and harmonised domain standards, such as the LADM (see Figure 1). The information infrastructure will provide society with integrated and seamless access to several data sources from different domains. Furthermore, the information infrastructure will provide the environment in which these sources can be maintained in a consistent manner.

INFORMATION INFRASTRUCTURE

Domains will have links with other domains, which require that updates take care of consistency with related registrations. For land administration systems, as the cornerstone of the information infrastructure, these links with other registrations are numerous and include persons, buildings, rights or topography, for example. Satellites can monitor changes, providing information for linking to 'RRR-SpatialUnit' and other data layers ('RRR' stands for 'Rights, Restrictions and Responsibilities'). Inclusion of land administration in global spatial data infrastructures is under debate – among others within the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM). A characteristic of all these registration issues is that people, spatial objects or spatial phenomena are important, and so too are the relationships between them.

FOURTH DIMENSION

The increasing complexity and flexibility of modern land use requires that land administration systems will need an improved capacity to manage spatial units in three dimensions, i.e. not only in two dimensions as a representation of parcels on a conventional cadastral map. A temporal (fourth) dimension can be integrated with the spatial dimensions, or as separate attributes. In the long term, for future versions of LADM, an integrated 4D registration of all objects will be the most effective solution. The 4D integrated space/time paradigm, as a partition of space and time without gaps and overlaps (in space and time), is a very generic and solid basis.

SEMANTICS

The differences in legal and other concepts, terminology and languages which are used in the various land administration systems still limit the access to and understanding of land administration data in an international context. However, as with all other kinds of knowledge, legal concepts of the different countries will be formalised using semantic web technology. These formalised semantics are used in mapping between the concepts and terminology from different countries,

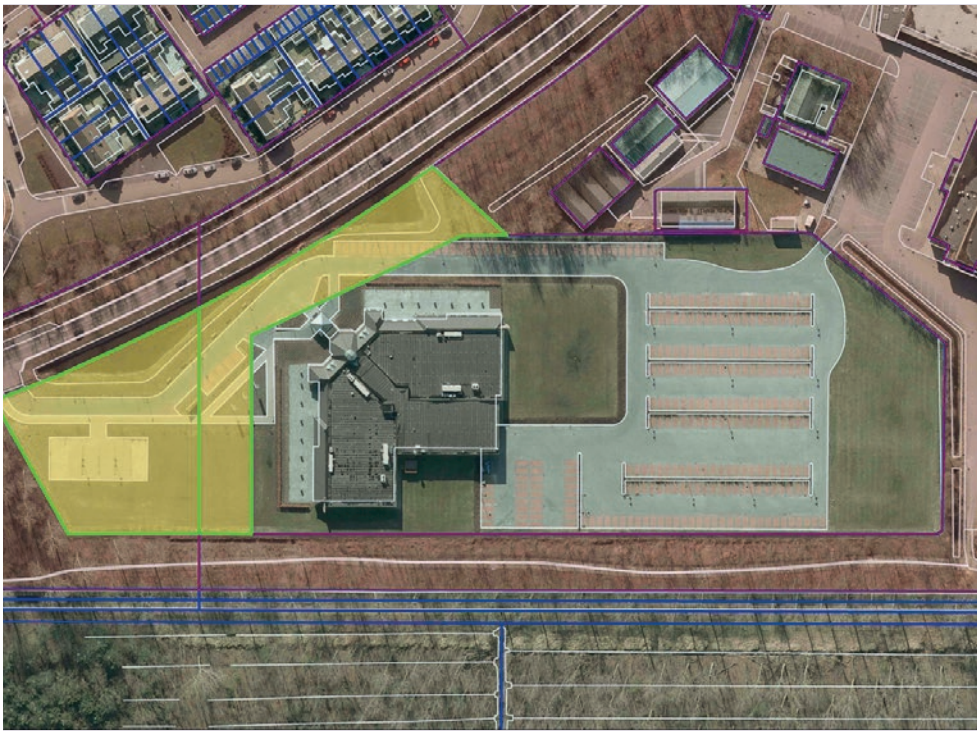

Figure 2, The use of high-resolution imagery will become more and more relevant in relation to land administration. (Image courtesy: Kadaster)

allowing users to access all information in an unambiguous and understandable manner. Therefore by the year 2025, thanks to these semantic translators, 'outsiders' such as foreigners – and even machines – will be able to understand and rely on the contents of a land administration system just as easily as natives do.

SPATIAL DEVELOPMENT LIFE CYCLE

When considering the complete development life cycle of rural and in particular urban areas, many related activities should often also support 3D (and temporal) representations. Not just the cadastral registration of the 3D spatial units associated with the correct RRRs and parties, but also activities such as spatial planning, designing, permitting, financing, construction, maintenance and suchlike should be conducted in full 3D. Furthermore, information should be shared among the various phase of the life cycle without too much effort and without information losses. Therefore, several of these activities and their information flows need to be structurally upgraded from 2D to 3D representations. Because this chain of activities requires good information flows between the various actors, it is crucial that the meaning of this information is well defined – an important role for standardisation. Relevant are ISO 19152 LADM and ISO 19156 Observations and Measurements. Also closely related and partially overlapping is the scope of the OGC's LandInfra Standards Working Group, with more of a focus on civil engineering information, e.g. the planned revision of LandXML: InfraGML (to be aligned with LADM). 3D cadastre registration is being tested and practised in an increasing number of countries. For example, for buildings (above/below/on the surface or constructions such as tunnels and bridges) and (utility) networks, the overlap between LADM and InfraGML is clear (in the context of full life-cycle support). LADM is focused on the spatial/ legal side, which could be complemented by civil engineering physical (model) extensions. It is important to reuse existing standards as a foundation and to continue from that point to ensure interoperability in the domain.

COMMUNITY-DRIVEN CADASTRAL MAPPING

The currently established update procedures are expected to be simplified in the future. For example, to split and sell a part of a parcel requires professionals, such as notaries, surveyors and registrars, each performing certain sub-tasks. Based on authenticated identification of persons and trusted reference material (e.g. high-resolution and up-to-date georeferenced imagery - see Figure 2), via web services, seller and buyer draw the new boundaries of the split part of the parcel and complete the transaction. Spatial units that are not yet included can be added in this type of infrastructure – e.g. fit-for-purpose (FFP) approaches are facilitated. The required web services and protocols are currently being developed and implemented, e.g. based on web feature transaction (WFS-T) services. The accuracy of digital reference material will become so high that there is no need to perform an external survey. The reference material can also include the 3D aspect, e.g. in The Netherlands the completed elevation dataset was available in 2012 with an accuracy of 2-3cm, about 10 points per m^2, with nationwide coverage. Integration of outdoor geoinformation with indoor spatial information and building information modelling is underway. The role of local authorities will be to provide the required infrastructure and links to other parts of the geoinformation infrastructure and to perform quality control and validate transactions. Community-based cadastral mapping can be integrated into LADM implementations by its functionalities for source documents for spatial and non-spatial data.

LADM DEVELOPMENT

With LADM and also its specialisation the Social Tenure Domain Model (STDM), information-related components of land administration can be registered worldwide in a standardised way. The standard focuses on flexibility based on a variety of continuums. This concept has several dimensions:

- it recognises that a continuum of tenure exists in terms of social tenure relationships, ranging from formal ownership to occupancy, usufruct, informal

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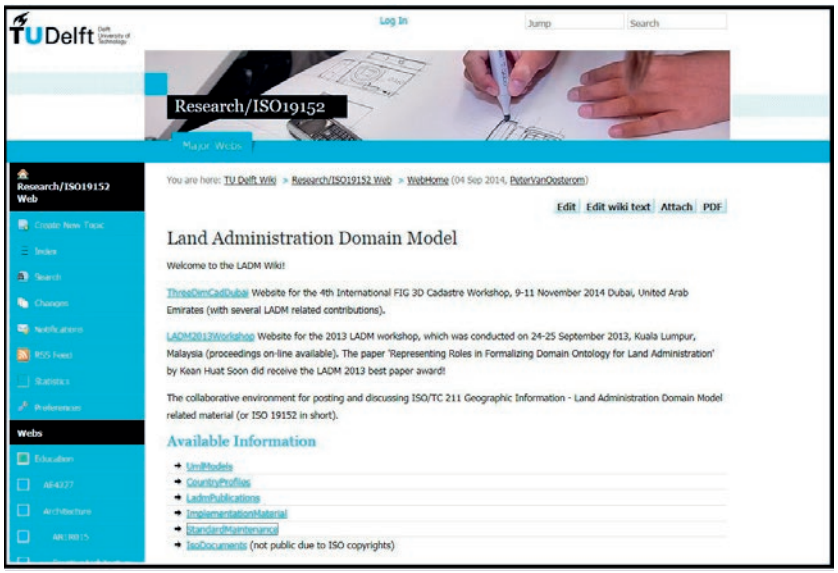
rights, customary rights, indigenous right and nomadic rights
- in the same way, parties holding the rights may not only be natural or legal persons, but could be a family, tribe, community, village or a farmers' cooperative
- the spatial unit may not only be a 2D area (polygon), but can also vary according to where the rights and social relationships apply, e.g. a point cadastre rather than a parcel boundary or 3D volumetric parcel, or it could be text based or photo based
- similarly, one may talk about a continuum of data acquisition methods or technologies that will include what could be called a 'continuum of accuracy'
- another dimension could be a continuum of land recording and credit accessibility, ranging from informal land offices in an informal settlement to a governmental land registry.

This is needed for implementation of FFP approaches in land administration. For example, the FFP approach could use large-scale aerial or satellite imagery or aerial photos showing how land is divided into spatial units (parcels and plots) for specific use and occupancy. The FFP approach focuses on the purpose of the systems such as providing security of tenure for all and managing the use of all land. The land administration system can then be upgraded and incrementally improved over time.

MAINTENANCE AND DEVELOPMENT OF STANDARDS

The LADM standard, as introduced by ISO towards the end of 2012, is now being used and it is inevitable that further issues will arise. These may range from detecting and correcting simple textual errors or omissions to further extension of the standard, e.g. extension of the legal model. These could also include valuation/taxation extensions or moving informative code list values to normative parts of standards, possibly including semantic technologies for more precisely defining code list values, e.g. a semantic hierarchy. Within the standardisation processes there are different methods for handling these issues/requests: the corrigendum for fixing small mistakes, or revisions of the standard for significant changes and extensions by the TC211 of the ISO. In the meantime the LADM Wiki at isoladm.org (see Figure 3) functions as a collective memory.



▲ *Figure 3, The LADM Wiki.*

CONCLUDING REMARKS

It is the vision of the authors that, as we advance towards the year 2025, access to land-related information will be enabled for everybody (via the internet), creating a 'spatially enabled society'. Many ICT-related developments will strengthen the relationship between land administration and other registrations, such as building, address, company and population registrations. Options such as data integration will be aligned with institutional strengthening and development. The highlighted developments can provide the foundation for further development of LADM, where needed. ◀

More information
isoladm.org
www.isotc211.org
www.fig.net

FURTHER READING

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A DEDICATED PHOTOGRAMMETRIC CONFERENCE HELD IN MEXICO

From **Imagery** to Map

The 15th Int'l Scientific and Technical Conference *From Imagery to map: digital photogrammetric technologies* was held from 26-29 October 2015 in Yucatan, Mexico, attracting 70 participants from 30 public and private organisations in 16 different countries. It was the first time on the American continent for the event, which is held in a different location each year, reflecting the area's rising influence on the geomatics market.

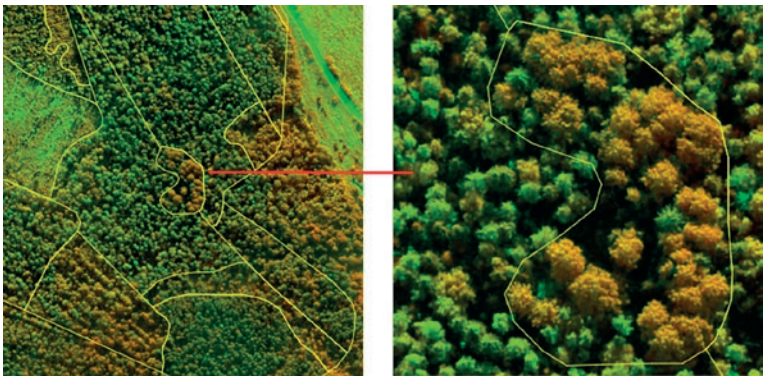
The event was organised by Racurs, which was founded in Moscow, Russia, in 1993. The main business activities of the company are the development of Photomod digital photogrammetric systems (DPWs), photogrammetric processing of airborne and space-borne imagery, distribution of remote sensing data in Russia and the CIS countries and R&D in the field of remotely sensed data processing software, hardware and methods.

PHOTOMOD LITE

The event was opened by Victor Adrov, managing director of Racurs and one of the four co-founders. After the opening Prof Gottfried Konecny, Leibniz University Hannover, Germany, discussed the UNGGIM-ISPRS study on the status of mapping in the world. He concluded his presentation with the words: "Technology is easy, management of humans is difficult". Gabriela Alvarez Parma from the National University San Juan, Argentina, discussed Photomod Lite as a photogrammetric learning tool. This free software package has all the features of the professional Photomod DPW but limits the size of input data and output data, e.g. per project a maximum of 40 images can be processed, 500 vector objects at most can be created, the number of grid cells of a DEM is limited to 800 x 800 and the orthomosaic should not exceed 50 MP. The Lite version is thus well suited for use in small scientific and educational projects. The software is not intended for commercial use and there is no technical support provided. Sandra García shared the experiences of GeoCuba in using professional Photomod DPW in Cuba. A total of 36 papers were presented over two days, including one by the author of this article on 'Point Clouds from Lidar and Imagery – status and trends'.

AIRBORNE MAPPING

Yuri Raizman, Israel, discussed various aerial surveys conducted around the world using VisionMap's A3 Edge camera system, including two projects carried out in Russia: 3D mapping of St. Petersburg and mapping of boreal forests (see May 2015 edition of GIM International). He noted that Europe is clearly the trendsetter in innovative applications and announced that VisionMap has started to cooperate with Cyclomedia, a mobile mapping company based in The Netherlands. Dmitry Chernikhovskii, director of the remote sensing research centre for forestry, detailed a project using VisionMap technology: a newly developed method for forest stand inventory using aerial stereo images acquired by the A3 camera system. The manual method relies on the knowledge and skills of human operators who use basic visual interpretation clues such as colour, shape, shadow and depth of forest canopy to identify and characterise individual trees and groups of trees. Added to the visual interpretation, the sizes of tree crones and the gaps between tree crones are measured in stereoscopic view using Photomod. This software is also used to delineate homogeneous tree groups as vector objects (Figure 1).



▲ *Figure 1, Orthoimage, scale 1:5,000, of a forest on which homogeneous tree groups are delineated and detailed (right).*

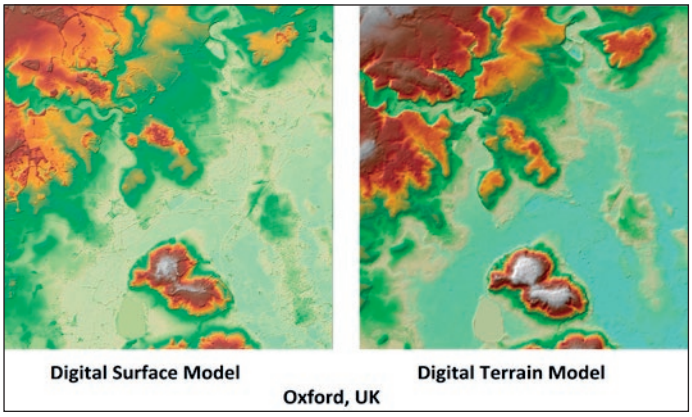
AERIAL SURVEYS IN LATIN AMERICA

Wolfgang Kost, former employee of Hansa Luftbild, gave an overview of the equipment including Lidar systems and cameras used by Mexico-based GeoAir. The company's managing director also covered the equipment of the 8 other aerial photogrammetric companies operating in Mexico. The first digital aerial flight over Mexico City was carried out in 2008 with the Vexel UltraCamD for cadastral purposes. The company also captured the 200km trajectory between Mexico City and Querétaro from the air. The resulting orthoimages form the basis for selecting the optimal route for a high-speed train connection between the two cities. When selecting the route, the environment, topography and logistics are considered and examined. Other specular surveys were conducted in the context of the Panama Canal expansion project which aims to double its capacity by 2016 (Figure 2). One of the main problems for aerial survey companies in Latin America are the delays introduced by legislation and licensing.

WORLDDEM

Airbus Defence and Space was represented by Bruno Bertolini and Matthieu Besnard. Precise elevation data is a necessity for creating accurate geodata products. Mr Besnard reported on status and features of the global bare ground elevation data WorldDEM DTM, commercially available since April 2015.

▲ *Figure 2, Aerial image of Panama Canal, June 2010, GSD: 9cm – near infrared, true colour captured by GeoAir, Mexico.*



▲ *Figure 3, WorldDEM (DSM and DTM) of Oxford, UK, and parts of the Cotswolds Hills; the heights range from 45m to 180m above sea level. (Courtesy: Airbus Defence and Space)*

The digital terrain model (DTM) is derived from WorldDEM by removing vegetation and man-made objects using a method which preserves characteristic terrain features such as ridge lines and mountain crests. WorldDEM, which is the first global, single-source, high-precision digital surface model (DSM), is based on data acquired by the high-resolution radar satellites TerraSAR-X and TanDEM-X. These satellites started synchronous data acquisition in December 2010 and had completed coverage of the Earth's entire land mass twice over by mid-2013. Orbiting at an altitude of 514km, the satellites covered more complex terrain areas with a third and fourth acquisition campaign. To date, WorldDEM DTM covers over 80 million km² of land mass with a relative vertical accuracy of 2m and an absolute vertical accuracy of 4m. The DSM will be available for the entire land mass of the Earth (150 million km²) within the next three years. In addition to the raw output of interferometric processing which contains radar artefacts and voids, an edited DSM is available to warrant hydrological consistency, i.e. water bodies are flat, rivers flow from high to low and shorelines are edited. Figure 3 shows a WorldDEM DSM and DTM of the same area.

WORLDVIEW

Ilya Yudin, sales manager for Russia and CIS regions, presented the DigitalGlobe constellation of five operational high-resolution satellites, four of which – GeoEye-1, WorldView-1, WorldView-2 and WorldView-3– have a ground sample distance (GSD) of 50cm or better. DigitalGlobe previously had six satellites in orbit; QuickBird acquired its last picture on 17 December 2014 and re-entered Earth's atmosphere on 27 January 2015 but its archived images remain available. WorldView-3 has the same spectral characteristics as WorldView-2 (see Table 1) but acquires the images with a higher GSD: 31cm instead of 46cm in the panchromatic (Pan) mode and 1.24m instead of 1.85m in the multispectral (MS) mode. All figures refer to nadir. The yellow band makes colour appear more natural and the additional near-infrared (NIR) band allows discrimination between vegetation types such as irrigated (parks) and non-irrigated grasslands. The ultraviolet band allows better differentiation of features in coastal zones. Compared to WorldView-2, WorldView-3 adds 8 shortwave infrared (SWIR) bands with a GSD of 3.7m and 12 CAVIS (Clouds, Aerosols, Vapors, Ice and Snow) bands with a GSD of 30m to its spectral sensing abilities. The coverage capacity of WorldView-2 is 1 million km² per day and for WorldView-2 this figure is 680,000 km². In other words, the increase of GSD by a factor 1.48 decreases the daily coverage with by same factor. The constellation of the four satellites with a GSD better than 50cm allows 60% of the Earth's surface to be captured monthly and intraday revisits of the same areas. Table 2 provides some further specifications of the four satellites.

CONCLUDING REMARKS

The past 15 editions of the conference have successfully focused on providing business opportunities to senior managers of public and private organisations in an inspiring and relaxed ambiance. Over the years, 1,500 Photomod licences have been sold to users in 70 countries. To support continued evolution of the event and encourage knowledge sharing, future editions can draw on an ever-growing pool of real-life users who are willing and able to contribute their experiences and ideas. ◀

More information
www.racurs.ru

	µm
Pan	0.45 – 0.80
MS	
Coastal	0.4 – 0.45
Blue	0.45 – 0.51
Green	0.51 – 0.58
Yellow	0.585 – 0.625
Red	0.63 – 0.69
Red Edge	0.705 – 0.745
NIR1	0.77 – 0.895
NIR2	0.86 – 1.04

▲ *Table 1, Spectral bands of WorldView-2 and WorldView-3.*

Feature	GeoEye-1	WorldView-1	WorldView-2	WorldView-3
Altitude	681km	496km	770km	620km
Spectral bands	Pan + 4 MS	Pan	Pan + 8 MS	Pan + 8 MS + 8 SWIR + 12 CAVIS
GSD Pan	41cm	50cm	0.46cm	0.31cm
GSD MS	1.64m	N/A	1.85m	1.24m
Swath width	15.3km	17.7km	16.4km	13.2km
Single-pass mono coverage (30° off-nadir)	45km x 112km			
(3 strips)	111km x 112km (6 strips)	138km x 112km (8 strips)	69km x 112km (5 strips)	
Single-pass stereo coverage (30° off-nadir)	15km x 112km			
(1 pair)	51km x 112km (3 pairs)	63km x 112km (4 pairs)	28km x 112km (2 pairs)	

▲ *Table 2, Specifications of DigitalGlobe's four satellites with a GSD of 50cm or better.*

OCULAR ROBOTICS

The World's Most Dynamic Eye

Ocular Robotics is an Australia robotics company based in Sydney which designs, develops, manufactures and markets the world's most dynamic sensor platform: RobotEye. The simultaneous speed and precision delivered by the patented RobotEye platform enable the Ocular Robotics family of sensors to capture precisely registered data with unmatched speed. RobotEye drastically increases the operational performance, safety and efficiency of systems that rely on sensors in markets as diverse as robotics and automation, security and surveillance, aerospace and defence, mining and resources and precision agriculture.

RobotEye's unique ability to guide light to any sensor payload allows the sensor itself and much of the rest of the mass normally associated with directing the view of a sensor to remain stationary. This means that regardless of the size and weight of a sensor, from 5 grams to 5 kilograms, RobotEye can direct its view about multiple axes at ultra-high speeds while simultaneously maintaining excellent precision. RobotEye has been built for all environments, and thanks to its natural immunity to shock and vibration it can be deployed on land, in the air and at sea.

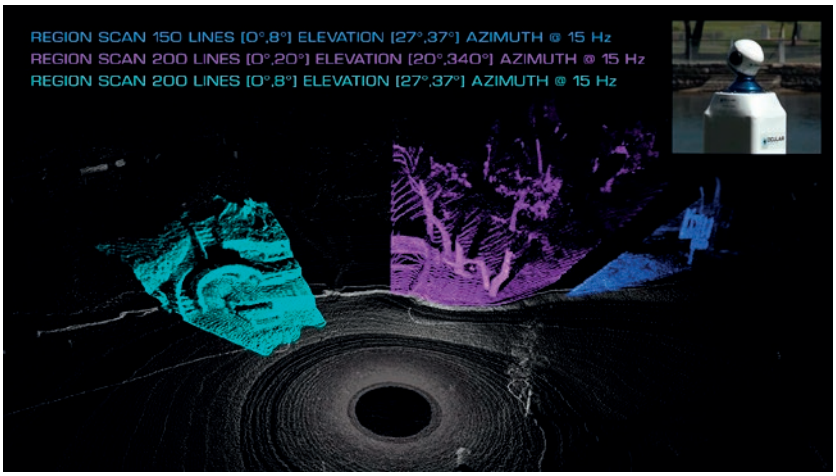
CEO and founder Mark Bishop explains why RobotEye was born: "One of the most pressing needs of modern GIS is the provision of timely information of the highest quality. While the RobotEye solution was initially applied to enable timely decision-making by a robotic platform, I soon realised it can solve a myriad of sensing problems." Ocular Robotics' family of ultra-high-performance sensors all share the RobotEye platform and include 3D Lidar, Vision, Thermal and Hyperspectral.

Every month ***GIM International*** invites a company to introduce itself in these pages. The resulting article, entitled Company's View, is subject to the usual copy editing procedures, but the publisher takes no responsibility for the content and the views expressed are not necessarily those of the magazine.

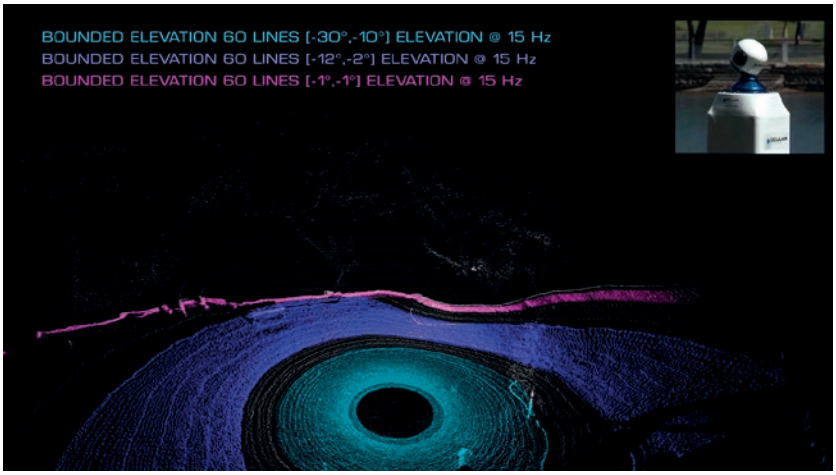
ADAPTIVE 3D LIDAR

Ocular Robotics' adaptive Lidar scanners deliver 3D information from the requested region in space and at the desired resolution by directing RobotEye's view about two axes with ultra-high speed and precision. This is achieved through three programmable scanning modes. The full-field scanning mode covers 360 degrees in azimuth and 70 degrees in elevation. Bounded elevation captures a defined band in elevation, while region scanning allows the user to image a rectangular region anywhere within the scanner's field of view. The system can seamlessly request an on-the-fly change in behaviour through the RobotEye C++ library which allows a new scanning behaviour to be fully specified in a single command. In addition to enabling the scan mode to be changed, all modes allow the user to adapt on-the-fly scan rate, scan resolution, sample rate and sample averaging. This degree of versatility permits a mobile platform to collect all the information it requires for obstacle avoidance, navigation, localisation, dense 3D mapping and object manipulation using a single 3D laser scanner. This novel capability won Ocular Robotics' 3D Lidar the 'Best Next-generation Game-changer Award' at RoboBusiness 2015.

The adaptive nature of the RobotEye Lidar scanners has also made them the sensor of choice for mobile mapping applications, landing them on a number of 'celebrity' robots. ROVINA robots are archaeology robots that have been built as part of a European consortium for the exploration,



▲ *RobotEye 3D Lidar in region scanning mode.*



▲ *RobotEye 3D Lidar in bounded-elevation scanning mode.*

▲ *RobotEye RE05 unit mounted on a ROVINA robot for autonomous archaeological exploration.*

▲ *RobotEye RE05 unit mounted on a FOXIRIS robot and taking part in the Total ARGOS Challenge.*

digital preservation and visualisation of archaeological sites which are difficult to access and survey by traditional means. Examples of such sites may include caves, catacombs or even archaeological sites which have become inaccessible due to conflict. RobotEye 3D Lidar scanners are used by these robots for both navigation tasks and to acquire the high-resolution 3D maps used to build the digital models.

Another celebrity robot is FOXIRIS, developed by Spain's GMV and competing in the Total ARGOS Challenge. This three-year competition is encouraging the creation of autonomous robots to operate on oil and gas sites under extreme conditions. RobotEye 3D Lidar is being used by FOXIRIS for navigation tasks, while simultaneously enabling the robot to identify and manipulate objects as part of its inspection tasks.

ACTIVE VISION AND THERMAL

As 'the world's fastest eye', RobotEye Vision and Thermal sensors deliver unique imaging capabilities. The latest addition to the Vision range is an automated rapid 360-degree panorama capture system which has the ability to acquire and immediately display gigapixel panorama imagery, all in less than one minute. RobotEye Vision and Thermal also have the ability to track extremely fast-moving objects or even track multiple objects simultaneously with a single camera. A single RobotEye not only has the capability to replace multiple cameras within a network, but its unique dynamic capabilities also enable instant and detailed scrutiny of any static or mobile object. Their stabilised variant even makes it possible to monitor several objects while simultaneously stabilising on an erratically moving platform.

HYPERSPECTRAL

RobotEye Hyperspectral systems provide the plug-and-play capability to transform any single-point spectrometer into a mapping hyperspectrometer. These hyperspectral mapping systems couple the wide field of view and pointing precision of the RobotEye with any commercial, off-the-shelf single-point spectrometer to achieve rapid imaging with both high spatial and high spectral resolution. The majority of Hyperspectral customers come from the mining and precision agriculture sector and use the systems in applications where a traditional imaging hyperspectrometer may be cost-prohibitive.

MULTI-ROBOTEYE FUSION

A natural consequence of collecting precisely registered data is the ability to couple the output of multiple RobotEyes for sensor data fusion. "Our precision of acquisition has enabled computationally efficient fusion across our entire sensor range, delivering unparalleled depth of information to our customers in real time," says Dr David Wood, CTO at Ocular Robotics. This capability is utilised frequently by Ocular Robotics' customers in automation, mining and precision agriculture to drastically increase their target detection and classification.

CUSTOMERS AND MARKETS

The RobotEye family of products is currently deployed in areas including autonomous navigation, robotics, 3D mapping, mine automation, situational awareness, emergency response, port automation, critical infrastructure and border protection. Ocular Robotics' commercial director Dr Ramin Rafiei comments on the endless RobotEye applications: "RobotEye is a true platform capability and the diversity of our customers is testimony to the limitless number of applications possible for this technology. Now, with RobotEye as a contender for a space-based project, the sky no longer limits its applications." With ambitious growth plans, Ocular Robotics is currently expanding its global distributor network across North America, Asia and Europe. Ocular Robotics also prides itself in working closely with OEM partners and integrators to design and build customised RobotEye solutions. "In bringing new products to market, we are always listening to our customers and are inspired by them," says Dr Rafiei. ◀

More information
www.ocularrobotics.com

PRESERVING WELL-BEING AND ECONOMIC GROWTH IN INDIA

Leapfrogging Urban Problems with 'Smart Cities'

The upsurge in urban population in Indian cities will intensify societal challenges on every conceivable level. To improve the quality of life and attract investment in cities, proactive measures are now essential for government agencies. They will inevitably become increasingly dependent on (geo)ICT in order to develop and manage their assets and infrastructures more efficiently and effectively. This facilitates – and also demands – elimination of 'silos' within city authorities. In 2016, India's government will select 100 municipalities to turn substantial parts of their urbanisations into 'smart cities'.

The pace of urbanisation is so high that in 15 years' time more than 600 million Indian citizens will be living in cities (compared with 350 million today). As studies of urban population growth by The World Bank and other agencies show, demand will increase in fundamental humanitarian areas: water, food, energy, infrastructure, sanitation, transport, education, employment and housing. The urban space must be kept liveable and economically sustainable and must therefore undergo a dramatic upgrade in all segments, not least to sustain the growth of the Indian economy. Cities are the powerhouses of economic growth of every nation, and India is no different.

Nearly 31% of India's current population live in urban areas and generate 63% of India's GDP (source: Census 2011). In view of increasing urbanisation, urban areas are expected to house 40% of India's population and generate 75% of India's GDP by 2030. This requires comprehensive development of the physical, institutional, social and economic infrastructure. Working towards smart cities is a step in the right direction.

▲ *Delhi is the world's most polluted city; India has the dubious honour of being home to 13 of the world's 20 most polluted cities. Each smart city proposal must include a pan-city dimension such as an intelligent traffic management system to reduce commuting times. (Courtesy: indiatransportportal.com)*

Spatial information is the foundation of all planned activities and informed decision-making in knowledge-based and policy-driven smart cities – from a city-planning perspective to services offered to the citizens. Therefore, a spatial data infrastructure (SDI) must be the platform for spatial data creation, exchange and use.

NATIONAL COMPETITION

In 2016, the Indian central government's Smart City Mission will support 100 cities in their transformation into smart cities, with a focus on the existing 'brownfield' cities. (The term 'brownfield' describes land previously used for industrial purposes that has become contaminated with hazardous waste or pollution. Once cleaned up, such an area can become a site for urban or commercial development.) The Indian prime minister launched an intra-state competition aimed at compiling a shortlist of candidate smart cities. Those on the shortlist will be required to prepare their proposals for participation

in the 'City Challenge'. Each proposal will be expected to have details of the proposed retrofitting (city improvement – 500 acres), redevelopment (city renewal – 50 acres), greenfield development (250 acres, in a previously vacant area) or a mix thereof. Additionally there must be a pan-city dimension with 'smart solutions', such as an intelligent traffic management system to reduce commuting times, or a wastewater recycling and smart metering system for better water management in the city.

The Smart City Mission provides about USD75 million per city over five years in grants, with a matching contribution from the respective states in India. Hence the total funding available per city is USD150 million over five years. However, this is clearly not sufficient to transform a whole city. Therefore, the smart city projects must be developed as 'lighthouse' projects, i.e. as inspiring examples for the whole city. Furthermore, cities must take a 'smart' approach to their project budget and couple the funding with other schemes such as financing, multilateral funding or user fees.

▲ *Redevelopment in a smart city model envisages an area of more than 50 acres, with mixed land use and high ground coverage. An example is the Saifee Burhani Upliftment Project in Mumbai. Mumbai has the largest population of slum dwellers in India: 41% of the city's 20.5 million inhabitants. (Courtesy: SBUT Office & Information Center)*

A STEP OR TWO AHEAD

Prime Minister Narendra Modi defines his own vision of urban development as one "which is a step or two ahead of people's aspirations". Of course, in view of India's problems – insufficient electricity and water supply, limited affordable housing, high traffic congestion and a high crime rate – one could wonder whether it would not be better to focus first on the basic infrastructure before aspiring towards developing smart cities. But there is also respect for the fact that, instead of setting his mind on providing these basic amenities, the prime minister is striving to achieve a greater goal. He is trying to follow the best practices from across the world and implement them in his country. He is convinced that designing smart cities will also result in the basic amenities for citizens, aided by facilities such as supervisory control and data acquisition (SCADA) systems, GIS mapped infrastructure, water and electricity leakage detection systems, smart parking and traffic management systems, solid waste management systems and wastewater management systems. Other elements mentioned by the prime minister included walk-to-work and cycling schemes. His smart city is sustainable, with equal importance placed on the preservation of the environment and reduction of greenhouse gas emissions.

LIMITED SPATIAL FRAMEWORK

This government programme is good news for the Indian IT industry in general and it especially offers many opportunities in the geo-ICT sector. India does not yet have an authoritative spatial foundation framework. All the government authorities need to organise their infrastructural assets in such a manner that they are 'GIS ready'. It will be challenging to create a single GIS data warehouse of countless sets of available survey data, maps, images, tabular geotagged development data, cadastral data, etc. For instance, although most of the private utility companies operating in cities have their own GIS data warehouse, the same cannot be said for the city-owned utilities.

IT WILL BE CHALLENGING TO CREATE A SINGLE GIS DATA WAREHOUSE OF COUNTLESS SETS OF AVAILABLE DATA

Furthermore the cities have not been surveyed and mapped accurately. While many of them have initiated a city survey for purposes such as property tax, utilities mapping and suchlike, this is usually neither comprehensive nor consolidated. Another important component involves periodically updating the information at predefined intervals.

Every department within the city has so far done its own mapping, so there is now a strong need for single-source location data that can be cross-leveraged by multiple departments. There are already some good examples. In New Delhi, for example, SDI has been used effectively for sustainable development and it has received legal support from the Delhi government in the form of the SDI Act. A few cities, like Bangalore, Hyderabad, Delhi and Kanpur, have a very strong property tax management component built on top of a robust GIS database. They have been using this effectively for years now and other cities are now in the process of setting up a similar system. However, the problem is that the GIS applications and data are maintained for a specific problem/service and are not available holistically for the entire city.

The biggest challenge each Indian city faces today is the lack of the technical capacity to plan, implement and monitor IT-driven or embedded projects. In the creation of this capacity, it is extremely important to understand the lifecycle value of the projects. They should be designed in such a way that they can be evaluated on functional outcomes and not just on cost. The workflow analysis should ensure that there is no duplication of effort and that the evaluations are a shared resource for all the departments involved.

ACKNOWLEDGEMENTS

Thanks are due to PwC India for its contribution to this article. ◀

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No 2789

6th Partners' Meeting of the Global Land Tool Network

The 6th Partners' Meeting of the Global Land Tool Network (GLTN) was held at the UN Gigiri Complex in Nairobi, Kenya, from 3-5 November 2015 and was attended by about 70 GLTN partners. FIG vice president Dr Diane Dumashie represented FIG as GLTN partner during this biennial event.

During a pre-conference multi-stakeholder workshop, a fit-for-purpose (FFP) Land Administration Guide was introduced and discussed. The FFP approach provides a new, innovative and pragmatic solution to land administration. The solution is directly aligned with country-specific needs, is affordable and flexible to accommodate different types of land tenure, and can be upgraded when economic opportunities or social requirements arise. The Guide provides structured guidance on building the spatial, legal and institutional frameworks in support of designing the country-specific strategies for implementing fit-for-purpose land administration.

The main goals of the 6th Partners' Meeting of GLTN were to strengthen partnership collaboration in the network and to increase the visibility of land and tenure security in the ongoing global development process. Achievements of GLTN were discussed in alignment with strategies for implementation of the network's land tools at country level.

The land and tenure security issue was placed in the context of the global development processes: the Sustainable Development Goals of the United Nations, the New Urban Agenda (Habitat III) and FAO's Voluntary Guidelines on the responsible Governance of Tenure of Land, Fisheries and Forests. The discussions revolved around the impact of these processes on the work of GLTN, identified the roles and opportunities for the partners to engage in these global processes and proposed a way forward.

▲ *Oumar Sylla, the new Land and GLTN Unit leader at UN-Habitat, addresses the 6th Partners' Meeting of GLTN. (photo: Eric Gachoka, UN-Habitat)*

GLTN partners are grouped into five logical clusters: bilateral organisations, international professional bodies, international training and research institutions, multilateral organisations and rural and urban international civil societies. FIG's president Prof Dr Chryssy Potsiou was elected as representative for the 'professional bodies' cluster and will represent it in the International Advisory Board of the GLTN.

The session on the latest thinking on GLTN land tools was particularly dynamic. During an interactive market-place session, a total of 13 tools were presented in great detail with an opportunity for the partners to engage. Land tools are practical ways to solve a problem in land administration and management. It is a way to put principles, policies and legislation into effect. The term covers a wide range of methods: from a simple checklist to use when conducting a survey or a set of software and accompanying protocols to a broad set of guidelines and approaches. The emphasis is on practicality.

Another impressive aspect of the meeting was the visit to the Mashimoni informal settlement where the Social Tenure Domain Model (STDM) is implemented. STDM supports residents in organising the community and helps in gathering evidence in land tenure and in the legitimacy of people-to-land relations in litigation and negotiation. Members of the community experience STDM as an alternative way of managing land information which has led to reduced conflict, for example, in cases as double or triple selling of structures.

The 6th Partners' Meeting of GLTN was concluded by Oumar Sylla, the newly appointed GLTN head, who addressed the partners and highlighted his vision for the network. ◀

More information
www.gltn.net
www.fig.net


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GSDI Marine/Coastal SDI Best Practice Project

The GSDI Association funds a limited number of SDI-related research and implementation projects each year. The latest project to be approved for funding, from November 2015 through to the end of 2017, is the Marine/Coastal SDI Best Practice Project led by Dr Jade Georis-Creuseveau and Prof Dr Joep Crompvoets. They will be assisted by GSDI secretary-general, Roger Longhorn, who represents GSDI on the International Hydrographic Organization's Marine SDI Working Group.

MARINE/COASTAL SDI

Marine/coastal spatial data infrastructures (SDIs) facilitate sharing and use of spatial data across a broad range of stakeholders and environments (land and sea) by promoting data and metadata harmonisation and services interoperability to support integrated coastal zone management (ICZM) and maritime spatial planning (MSP). These issues impact on societies and economies globally, including on climate change. To better understand how these SDIs are being developed, an assessment of the worldwide developments of existing marine and coastal geoportals of SDIs or similar web services is required.

IDENTIFYING AND MONITORING MARINE GEOPORTALS

A first international web survey of 81 national coastal and marine geoportals was undertaken by the project leaders in 2014 to identify trends in development and issues. To monitor their development, 12 characteristics were measured for each geoportal in November 2014, March 2015 and November 2015.

In September 2015, a questionnaire was sent to the geoportal managers to gather their feedback about the usage of the geoportal in terms of users (e.g. the main geoportal's target, the number of visitors, etc.) and in terms of data (e.g. the most frequently downloaded dataset, the purpose of this dataset for the users, etc.). Based on the preliminary results, four types of geoportals were identified: Atlas-like, Hydrographic Office, Oceanographic/Marine Data Centre and Hybrid geoportals. The preliminary results indicate that geoportals allowing access to a wide range of data related to marine, coastal and land territories are not commonly found. True data harmonisation and services interoperability, the underpinning principles for SDIs, need to be improved. Preliminary results were presented at a Marine/Coastal SDI Best Practice workshop held prior to the CoastGIS 2015 Conference in Cape Town, South Africa, in April 2015 and also at the INSPIRE GSW 2015 Conference in Lisbon, Portugal, in May 2015.

▲ *Research on the development of marine and coastal SDIs supports ecosystems.*

STRATEGIC RESEARCH AREAS

The GSDI project will focus on the following strategic areas:

- frameworks for marine and coastal geographic data, services and infrastructures
- use of marine and coastal geographic data, services and infrastructures
- governance structures for management use of the data
- comparative benchmark assessments on marine and coastal geographic data/SDI issues
- a repository of marine and coastal SDI good practices
- capacity building on issues related to coastal and marine geographic data/SDI issues.

PROJECT DELIVERABLES

All GSDI part-funded projects require a number of concrete deliverables, which include:

- a contribution to research on the development of marine and coastal SDIs in support of marine and coastal ecosystems management, from local to global scales
- additional web surveys on various aspects of marine and coastal geoportal developments and issues (including global, national and local geoportals)
- development of an assessment framework of the marine and coastal SDIs to identify good practices
- development of a webinar promoting fundamental knowledge about marine and coastal SDIs and targeting decisions-makers, employers and researchers
- development of new content about marine and coastal SDIs for the GSDI SDI Cookbook wiki
- a written report about the development of marine and coastal geoportals.

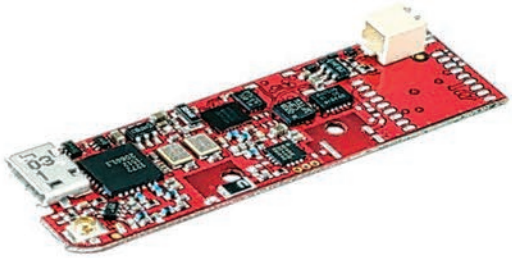
The first reports from the project are due in April 2016, so watch this space! ◀

Dr Jade Georis-Creuseveau is from LETG-BREST GEOMER, Plouzane, France, and Prof Dr Joep Crompvoets is from KU Leuven, Belgium. Both organisations are members of the Association.

More information
www.gsdi.org

KCS TraceME

KCS TraceME TM-900 / N1C1
GPS/RF-module / OEM-version



The TM-900 / N1C1 is a budget product line member of KCS' advanced TraceME track and trace modules. The TM-900 is targeted for remotely tracking and tracing a variety of objects, even livestock, and for personal use.

The TM-900 offers excellent long range RF coverage and is equipped with a low-power GPS receiver.

The module is equipped with multiple on-board sensors, low-level I/O-connectivity and a solar (*) rechargeable integrated battery. It offers accurate location based position data to be connected to any existing worldwide server application.

Key Features

- Excellent satellite coverage
  - GPS
  - Glonass/GPS (*)
- Very small, only 49.6 x 15mm
- Lightweight: 3.4 grams for a fully equipped PCB
- Standby battery lifespan of more than 10 years.
- OEM version
- Excellent GPS accuracy, internal antenna.
- Integrated 2.45GHz. radio for special functions and peripherals.
  - Short range, up to 30m (*)
  - Long range, over 1 km range, line of sight
- LoRa™ technology, up to 10km, line of sight
- Excellent indoor and outdoor performance with accuracy up to 1.5m
- 3 LEDs for user interaction.
- 1 switch for user interaction.
- Onboard sensors:
  - Temperature sensor (±0.5°C)
  - 3D accelerometer up to 16g.
  - Humidity sensor (*)
- Wide operating range: -20 °C … +85°C
- Multiple watchdog levels for maximum stability.
- Solar cell powered (*)
- Versatile interfacing:
  - Digital I/O
  - Serial, 3V
  - iButton™ / 1-Wire™
- Buzzer
- Event based free configurable module to fit any job.
- Remote maintenance. Both firmware and configuration files can be updated over the air.
- Runs local user scripts via .src files.
- Supports integration into third party networks.

Applications

- Object protection, up to 10 years of standby on a single lithium AAA-battery.
- Logistics, M2M
- Animal tracking, asset monitoring
- Security and surveillance
- Remote control and diagnostics
- Anti-theft

(*) Optional, please contact sales for more details.

www.Trace.ME

No 2924

Ordem e Progresso (3): New Faces on the Executive Committee

Continuing the theme of Ordem e Progresso ('order and progress') from the previous two ICA pages in *GIM International*, this month's contribution introduces the new vice presidents of the International Cartographic Association, elected to serve for the 2015-2019 period. Needless to say, Ordem e Progresso is also the motto of the place where they were elected: Brazil.

The results of the competitive elections showed a distinct widening of opportunity for female cartographers as well as maintenance of ICA's global reach. As mentioned in last month's column, the new president (Kraak), the continuing secretary-general & treasurer (Zentai), the past-president (Gartner) and one continuing vice-president (Liu) remain from the 2011-2015 Executive Committee (EC). Thus six new committee members were elected as detailed below, each becoming a vice-president of ICA.

Sara Fabrikant (Switzerland) boasts an impressive international research record, specifically in areas of cognition, and hopes to strengthen ties between ICA and her own country. In fact, although Switzerland was the birthplace of ICA, it is now represented on the EC for the first time in over 50 years. Her strong links with the GIScience research community will ensure ICA's leadership in this area is maintained.

David Forrest (United Kingdom) is based at the University of Glasgow, one of the most pre-eminent worldwide educational establishments in cartography. Having been a regular UK delegate to ICA's General Assembly over many years and vice-chair of a very active Commission on Use and User Issues, David has long-standing experience of ICA's methods and business.

The election of Pilar Sánchez-Ortiz Rodríguez (Spain) ensures that governmental mapping activity is still recognised within the EC. Having worked at the Spanish National Geographic Institute (Ministry of Public Works) since 1991, Pilar has been primarily responsible for the National Atlas of Spain, both in paper and digital form. Her ICA interests have been in children's cartography and she has served as secretary of the Spanish Society for Cartography, Photogrammetry and Remote Sensing from 2003 to date.

Monika Sester (Germany) is from another nation which has not been represented on the EC for many years. ICA will benefit from her diverse research interests in cartography and geoinformatics, especially automation in generalisation, data integration, data interpretation, VGI, space-time-modelling and trajectories. From an internal ICA perspective, she has interests in promoting publications of all ICA activities and in international education.

Lynn Usery (USA) has an important role as the conference director of the next International Cartographic Conference (ICC) to be held in Washington DC in 2017. With a long history of service to the US National Committee for Cartography, Lynn has also experienced a varying career in a number of educational and governmental cartographic establishments.

▲ *(Top row) Sara Fabrikant, Lynn Usery and Pilar Rodríguez; (Bottom row) Monika Sester, David Forrest and Vít Voženílek.*

Last but not least Vít Voženílek, nominated by the Cartographic Society of the Czech Republic, is a senior academic at his home university in the city of Olomouc. As a member of many societies, academic boards and editorial committees, Vít's organisational skills will be wisely used in the new EC. The new president and the ICA community as a whole anticipate expert advice and guidance from this new team of enthusiastic cartographers over the next four years. ◀

More information
www.icaci.org

Women in the International Society for Photogrammetry and Remote Sensing

The topic of Women in ISPRS was addressed in 1999 by a Special Issue of the *ISPRS Journal of Photogrammetry and Remote Sensing* (Vol. 54 Issue 4), guest-edited by Dr Marguerite Madden (USA), Dr Monika Sester (Germany) and Dr Thelma Krug (Brazil). Its intent was to feature research in geomatics conducted by women and men in articles first-authored by women, in the hope of encouraging more women to participate in ISPRS. The Foreword of this Special Issue explored historical involvement of women in ISPRS and discussed gender balance in the fields of photogrammetry, remote sensing and spatial information systems. Since more than 15 years have passed since this issue was published, it is appropriate to reassess the status of women in ISPRS.

▲ *The ISPRS Council (2012-2016).*

From a historical perspective, Ms Aino Savolainen from Finland was one of the first women to obtain a degree in photogrammetry in 1948. She performed topographic mapping in the 1950s and held a position in the Department of Photogrammetry at the Technical University of Helsinki from 1960 until the late 1980s. She also has the distinction of being the first female member of the ISPRS Council, serving as Treasurer (1976-1980), and she was chair of the ISPRS Financial Commission (1980-1984) and secretary of Commission III (1980-1984 and 1984-1988). Ms Savolainen was recognised as an Honorary Member of ISPRS in 1988 for her contributions to photogrammetry and remains the only woman with this distinctive honour to this day. The second female member of the ISPRS Council was Dr Giovanna Togliatti from Italy. Dr Togliatti was ISPRS treasurer (1984-1988) and chair of the ISPRS Financial Commission from 1988 until her untimely death in 1990. She graduated with degrees in applied and pure mathematics from New York University (1953) and Genoa University (1959), respectively. Dr Togliatti led the evaluation of the cartographic potential of metric camera photographs on board the first European Spacelab Mission carried by the US Space Shuttle.

Today, women participate at all levels of ISPRS, from Working Groups to the Council. For example, Ursa Kanjir (Slovenia) serves as chair of the ISPRS Student Consortium (SC) and Sheryl Rose Cay Reyes (Philippines) led organisation of the 13th SC and WG VI/5 Summer School held this year in the Philippines. At the Working Group level, however, only 13% (23 out of 179) of WG chairs/co-chairs are women. There are 25% (2 out of 8) women serving as technical commission presidents (TCPs) this term: Dr Jie Jiang (China) is the TCP of Commission IV, Geodatabases and Digital Mapping, and Dr Filiz Sunar (Turkey) is TCP of Commission VII, Thematic Processing, Modelling and Analysis of Remotely Sensed Data. 33% of the Council (2 out of 6) are women: Dr Marguerite Madden (USA) is 2nd vice president and Dr Lena Halounova (Czech Republic) is the congress director. Considering 13% (27 out of 193) of the total ISPRS officers in Working Groups (chair and co-chairs), Commissions and the Council are women, there is still room for improvement in gender balance within ISPRS. It is hoped that more young women will enter fields of science, technology, engineering and mathematics (STEM) worldwide and will find exciting opportunities for professional activity, recognition and collaboration within ISPRS. ◀

More information
www.isprs.org

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DECEMBER

MMT2015: THE 9TH INTERNATIONAL SYMPOSIUM ON MOBILE MAPPING TECHNOLOGY
Sydney, Australia
from 09-11 December
For more information:
E: jinling.wang@unsw.edu.au
W: www.mmt2015.org

2016

JANUARY

SKYTECH 2016
London, UK
from 27-28 January
For more information:
W: www.skytechevent.com

FEBRUARY

TUSEXPO
The Hague, The Netherlands
from 02-04 February
For more information:
W: www.tusexpo.com

15. OLDENBURGER 3D-TAGE
Oldenburg, Germany
from 03-04 February
For more information:
W: http://bit.ly/1NoX4ox
E: schumacher@jade-hs.de

GIM INTERNATIONAL SUMMIT
Amsterdam, The Netherlands
from 10-12 February
For more information:
E: wim.van.wegen@geomares.nl
W: www.gimsummit.com

EUROCOW 2016 (EUROPEAN CALIBRATION AND ORIENTATION WORKSHOP)
Lausanne, Switzerland
from 10-12 February
For more information:
W: www.eurocow.org

INTERNATIONAL LIDAR MAPPING FORUM 2016
Denver, CO, USA
from 22-24 February
For more information:
E: lhernandez@divcom.com
W: www.lidarmap.org/international

APRIL

INTEREXPO GEO-SIBERIA
Novosibirsk, Russia
from 20-22 April
For more information:
W: www.expo-geo.ru

GISTAM 2016
Rome, Italy
from 26-27 April
For more information:
E: gistam.secretariat@insticc.org
W: www.gistam.org

MAY

FIG WORKING WEEK 2016
Christchurch, New Zealand
from 02-06 May
For more information:
E: nzis@surveyors.org.nz
W: www.fig.net/fig2016

GEO BUSINESS 2016
London, UK
from 24-25 May
For more information:
E: info@Geobusinessshow.com
W: www.geobusinessshow.com

JULY

XXIII ISPRS CONGRESS
Prague, Czech Republic
from 12-19 July
For more information:
E: info@isprs2016-prague.com
W: www.isprs2016-prague.com

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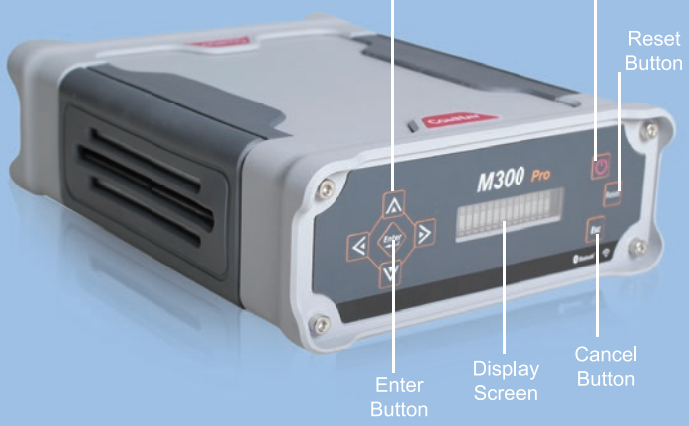

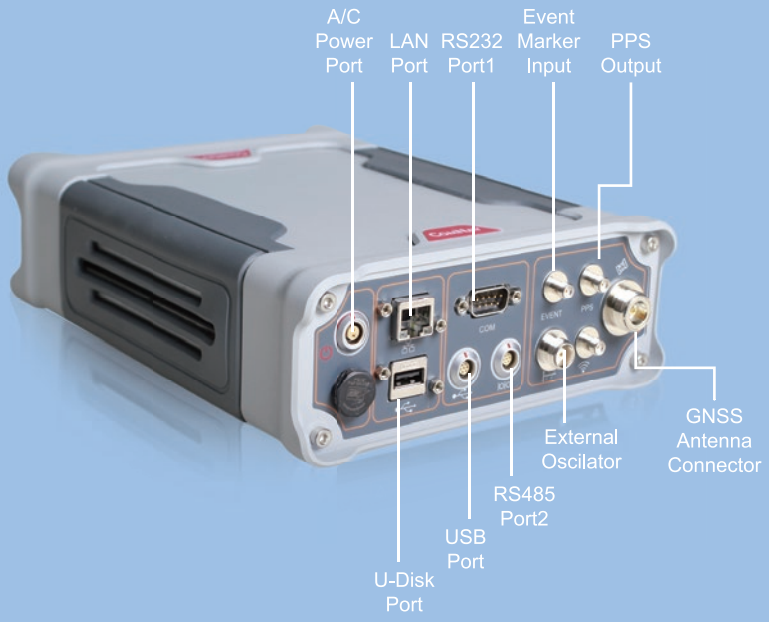

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