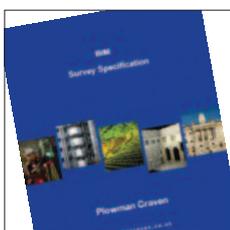


Surveying for geographical and spatial information in the 21st century

Is Revit now the de facto standard for BIM?



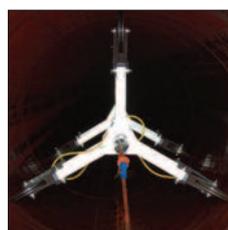
A standard for Discrete Global Grid Systems



Going for gold at HxGN Live 2014 in Las Vegas



A new tool for locating underground utilities



PPP aboard ships could improve satellite altimetry



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Building Construction (BIM)

Topcon's new GLS-2000 is equipped with ultra high speed scanning that provides time saving benefits without compromising accuracy. With a scan range of over 350 meters, a full-dome 360° x 270° field-of-view, and a simple one-touch operation, the GLS-2000 is a rugged and versatile tool that enables you to capture accurate 3D data in all your challenging work environments, across all your applications. The GLS-2000 is an industry-leading scanner that no serious practitioner should be without.

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COVER STORY

With the European LiDAR Mapping Forum and SPAR Europe looming, this laser scanned image is from the Urbanscreen artists group's stunning visual display inside an old gasometer. Read more on page 6.

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The long-awaited specification for surveying of underground utilities was launched recently at the Institution of Civil Engineers.
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Those in the architectural, engineering and construction (AEC) industry are witnessing, and contributing, to a battle of the standards.
- p.18 UltraCam Osprey Prime: a sensor for nadir and oblique imaging**
Michael Gruber and **Wolfgang Walcher** of Microsoft's UltraCam business unit describe the qualities of the latest Osprey aerial camera.
- p.22 Reduct - a new tool for locating utilities**
Sarah Hurley describes another technology for tracing pipelines or ducts at any depth.
- p.24 HxGN Live 2014: workflow infuses services and solutions**
HxGN Live was held in Las Vegas in June for a third consecutive year. It was where everything came together for Hexagon AB, says **Adam P. Spring**.
- p.27 Towards a standard for Discrete Global Grid Systems**
Historically, computational processing facilities have been expensive, data storage limited and large volumes of geospatial data hard to come by, explains Dr **Gobe Hobona**. But today Discrete Global Grid Systems are becoming possible.
- p.29 A free web-based application for displaying survey data**
A new web-based application is capable of transforming and displaying OS grid coordinates onto a range of freely available mapping resources.
- p.31 KL Congress a knock out**
Here, the irrepressible **John Brock** gives his own lively account of the social side of FIG KL, but not before telling us all about his pre-event SE Asia tour.
- p.33 FIG 2014: Geodesy, Point Clouds, Hydrography and Monitoring**
Hundreds of papers were presented at FIG Kuala Lumpur. **Richard Groom** has pulled them together in a review of the science and engineering orientated papers.

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Engineering surveying showcase 2014 ISSUE ONE

Did you get your FREE copy of *Showcase*? RICS members in the UK are entitled to receive a free copy upon registration or request. Just drop us an email with your full postal address and we'll pop a copy in the post to you. Overseas readers can still view the latest issue by going to: <http://www.pvpubs.com/DigitalEdition/Showcase>

NEXT ISSUE The next issue of *GW* will be November / December 2014. Copy dates are: Editorial: **6 October** Advertising: **23 October**

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The UK needs to define the geospatial job category, says one of our European colleagues. He's on the money there for sure and chartered surveyors need to be in the vanguard.

We must engage with government

With the steady improvement of the UK economy many survey firms are reporting difficulty in recruiting personnel. They have to compete with offshore industries where higher pay lures many graduates, even if not working conditions. In a recent RICS survey circulated to TSA member firms many have identified the same skills deficiencies amongst both new recruits and existing staff. Top of the list are knowledge and understanding of BIM, engineering and measured surveys, with self management and basic business skills close behind.

Whilst disappointing the results are not surprising. Since the financial crash six years ago education and training budgets have been cut not just to the bone but well into the marrow. Firms have been in survival mode. It's easy to point the finger at schools, academia too. But a fundamental problem with the British economy was recently highlighted by **Karl Donert** from the European geographer's group, EUROGEO.

Speaking at last May's GEO Business Donert identified that there is no 'geospatial' job category in Britain. "So we do not know how many people work in geospatial occupations or how many will be needed in future" he observed, continuing, "Without this identity or relevant statistics, how can we build capacity, plan university courses, or encourage potential students?" A shocking indictment of UK Plc.

He contrasted the UK with The Netherlands, which has had a campaign to promote the geospatial industry, including an inspiring four-minute video you should see (don't worry, it's all in English!) at:

<http://geo-pickmeup.com/why-we-need-geographers-the-go-geo-campaign/>

New report

The conclusion seems obvious. We need change and we need to engage with government. The industry should come together and research a report similar to those produced by ConsultingWhere's *UK Market Assessment* in 2009, the 2008 *Place matters: The Location Strategy for the UK* and the report by OXERA *The economic contribution of Ordnance Survey*. The latter identified 15 years ago that OS geographic information underpinned at least £100 billion worth of UK business. It may well be double that today.

A new report should identify likely demand for geospatial skills over at least the next decade. Following the gathering and analysis of the data, the report should reach some bullet point conclusions that politicians, business leaders and senior academics can grasp quickly as agenda for action.

Chartered surveyors need to explain

But it needs to be promulgated widely. Every senior chartered surveyor should have the arguments and facts to hand to explain to clients what a professional surveyor does and why they're needed to oversee the geospatial aspects of projects rather than some other profession or a generalist. This view is backed by one of the written-in comments to the RICS survey. The writer suggested that even very senior staff have limited commercial experience with the consequence that clients only understand the 'cost of everything but the value of nothing' and regard the survey industry as a commodity service rather than a professional one.

On the menu this issue

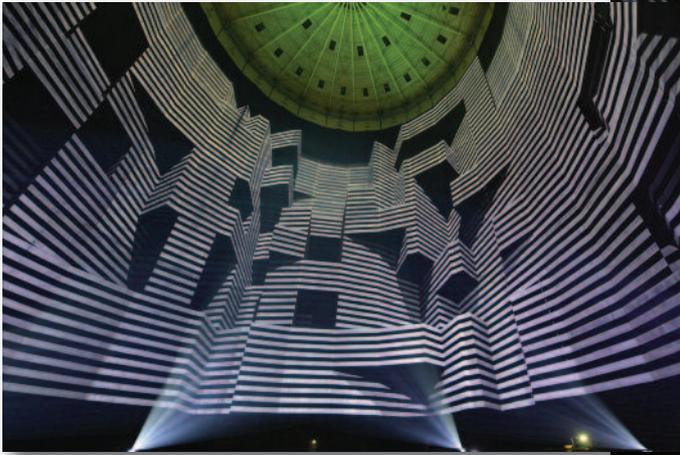
Meanwhile, I hope you enjoy this issue. We seem to have something for everyone. In addition to reviewing the new PAS 128 spec, **Richard Groom** has done his usual thorough job of analyzing the FIG papers for readers, although you'll need to go to our online version to read his full report. **John Brock** has done a similar job on the FIG social scene and **Adam P. Spring** has covered the massive HxGN Live event in Las Vegas in June. I am also delighted to publish a short article by one of Loughborough University's MSc students on a simple web-based program for displaying survey data. On the high-tech side, two experts from Microsoft's UltraCam business describe their latest aerial camera and **Sarah Hurley** from surveyors MJ Rees describes the Reduct, an interesting location technology for underground services. Lastly, **Andy McKay** of Plowman Craven poses the question, is Revit the de facto standard? Read on.

Enjoy! as everyone versed in the English language seems to say these days except the British!

Stephen Booth, Editor

The editor welcomes your comments and editorial contributions by e-mail: editor@pvpubs.demon.co.uk or by post:
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Precise spatial data creates the perfect illusion



Do you fancy a trip to an old gasometer in the Ruhr? Well, that may not sound like the best invite of the year so far but there is a big surprise awaiting visitors to this vast piece of industrial heritage. The Urbanscreen artist group from Bremen in Germany has plunged the Gasometer into a light illusion as part of the giant multimedia installation "320° Licht". The precise measurement of space is the basis for this digital art. But this has only been possible thanks to survey technology provided by Leica Geosystems. Since 2012 the company has provided the group with the latest laser scanners like the ScanStation P20 to make this unusual and highly visual art mode possible.

The gasometer in Oberhausen was a landmark of the coal, iron and steel industry and is still an emblem of the region. Since 1994 it has been an exhibition hall and has made a name for itself in the world of art. But it has always been a constant challenge to fill the empty space above the actual exhibition area, with the

dome's dimensions rising to a height of more than 100 metres and its diameter to 60 metres. However, the space provides the perfect projection area for the media art of Urbanscreen.

The creators of the light show of the Sydney Opera House in 2012, use 21 projectors to bring shapes and moving patterns to the inner areas of the gasometer to fuse virtual art with real space. To achieve this, the images must be precisely distorted and then adjusted to the shape of the room. The virtual projection surfaces come alive as a result of the surfaces being precisely measured by a laser scanner. Thorsten Bauer, comments: "The people at Leica Geosystems are our heroes because they've developed devices that succeed in transforming enormous spaces into a digital illusion in incredible detail," adding, "We validate reality with the device, transfer it to the digital world, edit it there and then bring it back to reality."

The 320° Licht media installation will be in the Gasometer in Oberhausen until 31/12/2014. More at <http://www.urbanscreen.com>

Apprenticeships and skills crisis

The *Daily Telegraph* reported that a cross-party project has been launched by think-tank Demos to examine vocational training across all sectors. Analysis by the Construction Industry Training Board (CITB) has found that the industry needs 120,000 apprentices over the next five years to fill an emerging skills gap. The research also shows that the number of people completing construction apprenticeships has plunged by almost 75% since the financial crisis, with just 3,760 apprentices completing training in 2012-13, compared with 14,250 four years ago.

The news comes on the

back of a quiz by RICS to TSA member survey firms on how they see skills deficiencies in new recruits. Weakness was found in key areas like GNSS, engineering and measured surveys as well as "self management" and basic business skills. Respondents believe that educational establishments need to pick up on these gaps with typical pleas from survey firms like "Please can we bring back the HNC in Land Surveying." Many identified weaknesses in applied maths and report writing skills. One respondent observed that there is a "lack of commercial acumen at senior survey level. Recent interviews have shown very senior staff in their current

operations have limited commercial experience and this leads to clients understanding the 'cost of everything but the value of nothing'. This all leads to. . . the survey industry is perceived as a commodity service rather than a professional one."

Commenting on the survey, **James Kavanagh** director of the RICS Land Group, concluded, "any of you FIG Young Surveyors need a job come to the UK!"

GSA research

A recent cost benefit analysis funded by the European GNSS Agency (GSA) has shown that satellite technologies could be useful for improving signalling, safety and train

management on Europe's low density rail lines. Cost / benefit ratios range from 1.07 to 3.89 depending on the type of line, characteristics and current infrastructure. Other areas of GSA research include aviation, driverless taxis, agriculture, low-cost geo-referencing and cadastre planning in Brazil, vessel management in ports, and a public transport route finder called SMART-WAY. Visit: <http://www.gsa.europa.eu/>

Open Modelling Interface Standard

The Open Geospatial Consortium membership has approved the Open Modelling Interface Standard Version 2 (OpenMI) as an OGC

standard. This standard defines a means by which independently developed computer models of environmental processes, or indeed any processes, can exchange data as they run and hence facilitate the modelling of interacting processes. This could change the modelling market from one for complete systems into one for components and services. It could make it much easier for products to be brought to market, widen participation and dramatically drive up the rate of innovation.

US UAV integration delay

Geospatial World reports that the FAA is unlikely to meet its 2015 deadline for integrating UAVs into the National Airspace System, as the agency grapples with a number of significant safety and certification issues, according to a report by the Department of Transportation. The FAA is making some progress in meeting UAV-related goals spelled out in the FAA Modernization and Reform Act of 2012, however the report notes, "but the agency is significantly behind schedule in meeting most of them, including the goal of achieving safe integration by September 2015". More at:

http://geospatialworld.net/News/View.aspx?ID=29354_Article#sthash.ME3AvsaK.dpuf

Maltese quality workshop

Experts in spatial data and map quality are being invited to take part in an international workshop being held at the Old University, Valletta, Malta from 20 to 21 January 2015. The workshop is co-organised by EuroGeographics Quality Knowledge Exchange Group, the European Location Framework (ELF) Project, International Organization for

Standardisation (ISO), OGC and EuroSDR. Papers on a range of topics including quality evaluation, certification and standards are sought by the programme committee. Abstracts should be submitted by 12th September.

CityGML Interoperability Experiment

The CityGML Data Quality Interoperability Experiment (CityGML QIE) aims to provide implementation recommendations for CityGML data based on data specification and a conception of the validation workflow. Another goal of the Interoperability Experiment is to provide a suite of essential quality-checking tools to carry out quality assurance on CityGML data. Organisations and individuals are invited to participate in the activity by providing CityGML test data and/or test tools, defining requirements, or carrying out tests using a variety of different test tools. Participants need not be OGC members. The experiment's initiators plan to start with a kick-off meeting on 9-10 September 2014 at the Kadaster office in Amsterdam. Contact: CityGMLQIE@lists.opengeospatial.org

GGRF endorsed

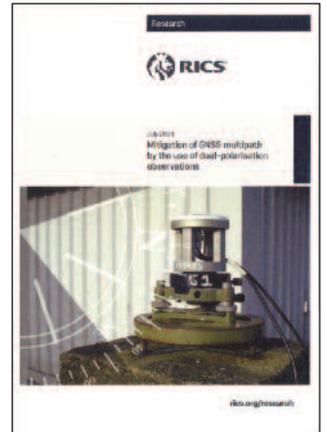
The United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) meeting at the UN Headquarters in New York in August endorsed a draft Resolution on the Global Geodetic Reference Frame (GGRF) as a mandate. The draft Resolution will now pass to the Economic and Social Council (ECOSOC), UN-GGIM's parent body and the United Nations' central platform for reflection, debate, and innovative thinking on sustainable development.

Mitigating multipath

The RICS has published a report of research into GNSS multipath, which was conducted by Dr Kirill Palamartchouk, Prof Peter Clarke and Dr Stuart Edwards of Newcastle University.

Mitigation of multipath effects has been a research area for GNSS manufacturers for some time and a number of receivers are marketed as 'multipath-resistant', but the authors question the efficiency of the current mitigation techniques. They propose the use of dual-polarisation GNSS equipment for tracking the direct signal and the multipath signal separately. The signal to noise ratio of the reflected signals can then be used to weight the direct signals.

Their results improve the position RMS by an impressive factor of 2 to 3, and should enable equipment manufacturers to develop receivers with stronger multipath resistance. RICS members can download the report from the RICS website. Topcon loaned equipment for the research.



The intent is for ECOSOC to then refer the Resolution to the General Assembly later in the year.

... and a call for common standards

The Committee of Experts also called for the adoption of common standards, so that geospatial data can be seamlessly shared and used around the world. Their guide, entitled Guide to the Role of Standards in Geospatial Information Management, lays down in very simple terms, some of the guidelines necessary for the adoption of common standards. The Committee of Experts recognises that different countries are at different stages on the journey towards standardisation and so endorses a phased implementation – a structure laid out in the Guide.

and now UN-GGIM:Europe

On 7th August 2014, the European Regional Committee of the United Nations Global Geospatial Information Management (UN-GGIM: Europe) was

created. This significant action is the third and final stage in a formation process that began in November 2012. This endorsement confirms the UN-GGIM: Europe's mandate to have increased and close cooperation and coordination with UN-GGIM at a global level and also with other existing institutional structures in Europe. UN-GGIM: Europe will hold its first meeting in Chisinau, Moldova on 1st October 2014 at which time the initial Executive Committee will be elected and a draft work programme agreed

Get GeoVating

GeoVation is Ordnance Survey's open innovation programme that challenges communities to generate innovative ideas to solve problems using geography, against a specified challenge. These challenges are open to entrepreneurs, developers, community groups, government and individuals. This year OS is working with Land Registry to launch the next GeoVation Challenge in September 2014. It will

SPOT 7 launched



Airbus Defence and Space has published the first images obtained from the SPOT 7 satellite only three days after its launch on 30 June. SPOT 6 and SPOT 7 are phased at 180 degrees in the same orbit, and together with the very-high-resolution twin satellites, Pléiades 1A and 1B, will offer a high level of detail across wide areas and a highly reactive image programming service. The image featured shows part of Reunion Island in the Indian Ocean, east of Madagascar.

focus on improving community resilience with regard to long-standing housing issues. OS will invite ideas, to be submitted online, that provide solutions to well identified problem statements. Visit: <https://www.geovation.org.uk/>

South China Sea

Borderlines newsletter from The International Boundaries Research Unit (IBRU) at Durham University gives the latest news on border disputes currently proceeding through the courts. The Philippines started proceedings against China in January 2013 and submitted its 'Memorial' in March 2014. The court has issued a deadline of 15 December for China to submit its 'Counter-Memorial'. However, China rejected the Philippines initial notification of proceedings and it seems unlikely that it will participate in the process. Vietnam is reported to be considering a similar move against China. Visit www.durham.ac.uk/ibru/news

Wrong move for Galileo

The European Space Agency (Esa) has confirmed that the latest two satellites for its 26-

satellite Galileo constellation are in incorrect orbits. The agency is examining the implications but declined to comment on whether their trajectories could be corrected. "They have been placed on a lower orbit than expected. Teams are studying the impact this could have on the satellites", commented a spokesman. Meanwhile, the fifth and sixth satellites launched from French Guiana on Friday are under control.

BUSINESS NEWS

SCCS adds echo sounder range

Following discussions at GeoBusiness 2014, leading Leica Geosystems distributor SCCS is to represent Ohmex's SonarMite range of hydrographic echo sounders for Leica users in the UK. SonarMite is the world's first survey grade echo sounder to be truly portable and to use Bluetooth technology to communicate directly with the Leica Viva controller. SCCS are offering a comprehensive range of supply, service and hire rental for the echo sounders.

The single beam echo sounder fits on to a detail

pole and effectively acts as a rod extension, providing an easy-to-use survey method for rivers, lakes and estuaries. The instrument is already used extensively in the UK for river surveys in conjunction with Leica robotic total stations and bespoke 4Site software from AiC.

US county permit for Trimble UAV

Trimble has announced that Mesa County in Colorado has received a Certificate of Authorization (COA) that will allow the Public Works Department to operate its Trimble UX5 Aerial Imaging Solution throughout the county. Mesa County has received multiple COA's since 2008 from the FAA for public safety purposes. This is the first COA that will be used specifically for aerial mapping on surveying and engineering projects, in partnership with the Public Works Department.

NM buys Leica cameras

Network Mapping Group has selected three sets of its latest Leica RCD30 aerial medium format 80MPx cameras as a multi-angle colour and near infrared camera system to capture infrastructure assets with the highest quality. These systems have been added to an existing airborne sensor suite to execute high-quality helicopter-based corridor mapping. The cameras have been integrated successfully with NM's new LiDAR sensor to create a data capture system for delivering the company's NM-ARROW program to electrical utilities.

Search for MH370

The Australian Transport Safety Bureau (ATSB) has awarded Fugro an additional contract for the deployment of two specialist vessels, equipment and expertise in the deep-water search for the missing Malaysia Airlines flight 370 (MH370). Fugro

Equator and Fugro Discovery, both are fitted with specialist deep tow survey systems, will be mobilised. Since June, the Fugro Equator has been involved in a bathymetric survey of the search area.

Fugro and ATSB expect the Fugro Discovery to begin the deep tow search in late September with Fugro Equator joining shortly thereafter. The search is expected to take up to twelve months but will end if the missing aircraft is found. The Australian Government has allocated AUS \$ 60 million to the ATSB to carry out the search for MH370.

DigitalGlobe

In the wake of WorldView-3, which was launched on 13th August, DigitalGlobe, has announced plans to accelerate the launch of WorldView-4 (previously named GeoEye-2) to mid-2016 to meet demand from the company's direct access and other commercial customers. A significant catalyst for this increased opportunity was the US Department of Commerce's recent decision to allow DigitalGlobe to sell imagery with resolution of up to 25 cm. WorldView-3 will be supplying imagery at 31 cm resolution.

Getmapping+Bluesky award

Aerial mapping companies Getmapping and Bluesky have been awarded a multi-million pound three-year contract for the supply of geographic data to central UK government organisations. The contract, awarded by the Department for Environment, Food and Rural Affairs (DEFRA), covers high resolution aerial photography, detailed 3D height models and colour infrared imagery for the whole of England, Wales and Scotland. Under the new Aerial Photography for

Great Britain (APGB) contract Getmapping and Bluesky can also provide training, consultancy and workshops to contract members.

Technology centre starts

Topcon has announced the ground breaking of its Technology Innovation District in Concordia, Italy. The project scope consists of a 169,000 square metre campus, of which nearly 45,000 will function as head-offices for Topcon-affiliated organisations, Tierra and Infomobility. The plans include constructing offices, logistics facilities and construction and agricultural machine control testing areas. The remainder of the land will be dedicated to technical business services and activities commercially connected to Topcon. The initial phase is expected to be completed by the latter part of 2015, with the entire project finished within four years

BRIEFS

UAV trends and technology will be amongst the focal points at INTERGEO, the world's leading trade fair and conference for geodesy, geoinformation and land management, in Berlin on October 7-9, 2014. Other geo topics on the agenda are expected to be open data, the EU INSPIRE initiative, geodata for infrastructures and of course the latest technology developments for geo data capture.

Hexagon has acquired Geodata Diffusion, a provider of network RTK correction services through its Orphéon network of GNSS permanent stations. The Orphéon network covers the whole of France and its overseas territories.

Topcon has announced a new German distribution company - Topcon Deutschland Positioning GmbH (TDP) by

joining IBS GmbH with Topcon Deutschland GmbH.

Over 85 million square kilometres of fresh basemap imagery from Airbus Defense & Space will be available from the end of September 2014 in ArcGIS Online. The move provides access to select sets of the company's imagery including near global coverage from the SPOTMaps 2.5m seamless mosaic product as well as very high resolution 50cm Pléiades imagery over major cities worldwide.

RAHMS National Collection of Aerial Photography (NCAP) became the official custodian of 1.5 million aerial photographs created for the Directorate of Overseas Surveys (DOS) in late 2012.

More at:
<http://ncap.org.uk/feature/directorate-overseas-surveys-dos> for information and video interviews about the collection.

Graduation Day for the TSA Surveying Course was held on Friday 25th July 2014, at The Survey School at Worcester. TSA President, **Graham Mills**, presented **Daniel Whitby** of Maltby Land Surveys with the Best Student Award. Daniel also received the Leica shield from **Tim Badley**. **Matthew Ullett** of Sitrine Ltd won Best Assignment. Twenty four students graduated from Courses 32 and 33.

The annual general meeting of the Defence Surveyors' Association takes place on Thursday 11th September at Hermitage. Between the AGM and dinner, Gordon Corrigan will give a talk on 'The Great War'. Contact Tony Keeley – 01635 204244

Japan's Daichi-2 (ALOS-2) was launched on May 24th and has captured initial L-Band Radar images during its verification stage. DAICHI-2 observation data is expected to contribute to

understanding damages from disasters, monitoring deforestation, and to more efficiently understanding farming areas.

The University of Edinburgh is introducing a new MSc programme in Earth Observation and Geoinformation Management in September 2014. This programme sits alongside the School of Geosciences's MSc in GIS and draws on a critical mass of staff and significant research expertise in the area of Earth observation and remote sensing.

Ordnance Survey's annual report reveals that the organisation has a 51% stake in Astigan Ltd which is researching new ways of remote data collection. The company was set up in February 2014 and includes as a director **Andrew Elson**, who holds a recent patent for launching a high altitude UAV.

Corporation as European business development manager for monitoring. Emery will be responsible for supporting the expansion and growth of Topcon monitoring business activities, working closely with the subsidiary companies and distributors.

New UN-GGIM Bureau

The new Bureau to lead the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) has been elected by the Member States. The election took place during the fourth session of the UN-GGIM from 6-8 August 2014 at the United Nations Headquarters in New York.

Below: New UN-GGIM Bureau (left to right: Dr Li Pengde, Co-Chair from China, Dr Eduardo Soja, Co-Chair from Mexico, Dr Vanessa Lawrence CB, Co-Chair from United Kingdom, Mr Sultan Mohamed Alya, Rapporteur from Ethiopia)

PEOPLE

Development manager for Topcon

Chris Emery joins Topcon



EVENTS CALENDAR 2014

• SEMINARS • CONFERENCES • EXHIBITIONS • COURSES

GW welcomes advance details of events of interest to the Geomatics community.

Details to: editor@pvpubs.demon.co.uk

RSPSoc 2014 Annual Conference

2-5 September, Aberystwyth:
<http://rspsoc.aber.ac.uk/en/>

Training Days: Total Stations

8 & 9 September, Stevenage
www.pvpubs.com/Training

Training Days: GPS/GNSS

10 September, Stevenage
www.pvpubs.com/Training

AGI - BIG Data

30 September, London
www.agi.org.uk

Location Intelligence World 2014

7-8 October London UK
www.locationintelligenceconference.com

20th Intergo 2014

7-9 October, Berlin Messe
<http://www.intergeo.de/>

AGI - Policy

9 October Cardiff
www.agi.org.uk

Training Days: Total Stations

13 & 14 October, Stevenage
www.pvpubs.com/Training

Training Days: GIS Data Collection

15 October, Stevenage
www.pvpubs.com/Training

Trimble Dimensions 2014

3-5 November, Las Vegas, Mirage Hotel
www.trimbledimensions.com

GEO Comm: The changing face of Geo

11-13 November, nr Warwick
www.agi.org.uk

Training Days: Total Stations

24 & 25 November, Stevenage
www.pvpubs.com/Training

Training Days: GPS/GNSS

26 November, Stevenage
www.pvpubs.com/Training

European LiDAR Mapping Forum 2014

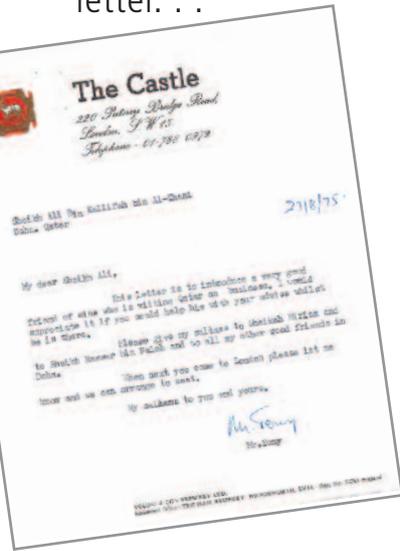
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www.sparpointgroup.com/europe/



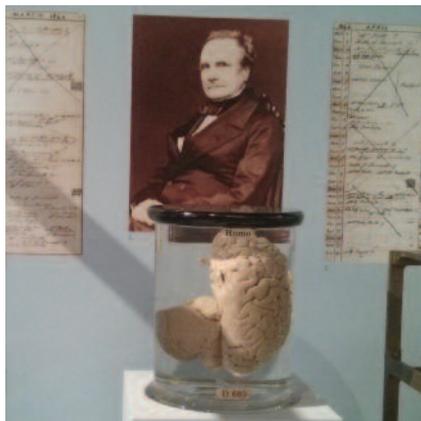
It's quite simple really

by Malcolm Draper, Rentalength

Difference engines, sheikhs, Brunsvigas and an interesting letter. . .



Below: Babbage and half brain. **Bottom:** Also spotted in the Science Museum this beautiful set of Kern instruments.



The Editor, who's writing a history of Leica Geosystems in the UK, has been quizzing me about my early experiences with EDM. I operated several in the 1960s but believe I was the first private surveyor person to buy the Wild D110 Distancer. Launched at the FIG Congress in London in 1969, it was the first practical EDM that really worked. Its predecessors were incredibly heavy and required a backpack (the AGA 6 weighed over 18 kgs without the car batteries needed for power); and in the case of the Tellurometer, you needed a device at each end of the line to be measured.

I found the D110 was accurate and reliable, and Wild had worked out a way of connecting it to a T2 by the time it was commercially available. We were on the way to the total station.

Buying the D110 really got me started as an independent surveyor although work for the D110 was slow at first. I was even in demand by Wild at Chatham to demonstrate the device to other would-be purchasers.

By the mid 1970s my business was looking for opportunities overseas and the Middle East at that time seemed to offer good prospects. But where do you start? I knew that Qatar, then just beginning to enjoy an oil boom, looked like a good prospect. But if I went out there how could I get an introduction to likely contacts? By

a bizarre coincidence the landlord of a pub in Putney I used to frequent actually knew members of the ruling family (the landlord worked at a top London hotel and used to take the sheikh and his family on tours of the capital). He typed me a letter of introduction, which I still have.

He wasn't half brainy

I've always been fascinated by calculating devices. In my early days as a surveyor, in addition to slide rules, I operated Brunsvigas, Facits and the wonderful little hand-cranked Curta. In the early 1970s however our calculations were made a whole lot easier with the arrival of the HP35. Now the Science Museum in South Kensington, London where I whiled away many an hour or three as a lad, has a brilliant collection of calculating devices and machines.

From the humble abacus, a multitude of differently shaped slide

rules, Burroughs machines, Comptometers, right up to the first electronic models with their bright red diodes. But what took my breath away was a much older machine, a difference engine. A difference engine, according to Wikipedia, "is an automatic mechanical calculator designed to tabulate polynomial functions. The name derives from the method of divided differences, a way to interpolate or tabulate functions by using a small set of polynomial coefficients. Both logarithmic and trigonometric functions, functions commonly used by both navigators and scientists, can be approximated by polynomials, so a difference engine can compute many useful sets of numbers." Whew! Now we've got that out of the way.

The museum has several difference engines including a re-creation of the first one by **Charles Babbage** (half of whose brain is on display in the museum. Who's got the other half?). But what took my fancy was by one **Per Georg Scheutz** of Stockholm. What a beautiful piece of engineering, all polished brass and steel cogs, shafts and levers set within a cast iron frame.

Whilst at the Science Museum I was also interested to see an exhibition devoted to **James Lovelock**, the environmentalist whose Gaia hypothesis argues that the Earth is a self-regulating entity with the capacity to keep our planet healthy by controlling the interconnections of the chemical and physical environment. Lovelock is something of a maverick. In his youth he did not show much promise. The exhibition has some of his school reports and, like mine, would not have made his parents happy. But interestingly, he did not go to university but attributes his later success to just that; he believed it made him less of a specialist. The exhibition has lots of his notebooks which are littered with doodles and drawings around the equations. What a fertile mind! So impressed was **Mrs Thatcher** with his ideas she invited him to dinner at Downing Street. It does make you think that perhaps we're all getting too focused on our little bit of the world and ignoring the bigger picture.

What is it corner

Now I know that some of our readers regard this column as the fount of all knowledge on things that are, or might be, to do with surveying. We try our best but sometimes even we are stumped. Reader **Phil Smart** came

across this odd device in a museum in Guernsey. He wonders if it's something to do with gunnery. He may be right. It bears the trademark of Carl Zeiss Jena (just visible near the centre). However, it must be an odd museum if they don't label their exhibits! Nevertheless, we shall try. Having consulted two gurus (thank you **Arthur Allan** and **Jim Smith**) so far we can confidently say. . . we haven't a clue! The instrument in front of the wooden handled device is of course a polar coordinatograph. Any more suggestions from readers most welcome.

Judicial conundrum

Now here's another puzzle, fortunately we don't have to resolve this one. In a Texas town a bar owner began construction of an extension. In response, the local Southern Baptist Church started a campaign to block the bar from expanding - petitions, prayers, etc. About a week before the grand re-opening, a bolt of lightning struck the bar and razed it to the ground.

The church folk were rather smug, bragging about 'the power of prayer' and 'Divine intervention'. The angry bar owner decided to sue the church on the grounds that the church "Was ultimately responsible for the demise of his building, through direct actions or indirect means." Of course, the church vehemently denied all responsibility or any connection to the building's demise. The judge read carefully through the plaintiff's complaint and the defendant's reply.

He then opened the hearing by saying: "I don't know how I'm going to decide this, but it appears from the paperwork that what we have here is a bar owner who now believes in the power of prayer, and an entire church congregation that does not."

Clarification

Are you puzzled by the complex web of Middle Eastern relationships that Britain and the US are involved in? Well, help is at hand for novices. I received the following from one of my contacts.

Are you confused by what is going on in the Middle East? Let me explain.

We support the Iraqi government in the fight against IS (formerly known as ISIS). We don't like IS, but IS is supported by Saudi Arabia who we do like. We don't like Assad in Syria. We support the fight against him, but IS is also fighting against him. We don't like Iran, but Iran supports the Iraqi government in its fight against IS. So some of our friends support our enemies, some enemies are now our friends, and some of our enemies are fighting against our other enemies, who we want to lose, but we don't want our enemies who are fighting our enemies to win. If the people we want to defeat are defeated, they could be replaced by people we like even less. And all this was started by us invading a country to drive out terrorists who were not actually

there until we went in to drive them out.

It's quite simple, really.

Miscellany

I see there's a "Spatial Big Data Roadshow" in Dublin coming up. The venue is the Guinness Storehouse, which should attract plenty of thirsty surveyors.

I've had quite a flurry of amusing photographs, some from the US and others nearer home. Let's start with this one. Full marks to this guy. I really don't believe a woman would be so stupid for making this load absolutely secure until. . . well, would you tell him or just stand back and watch what happens?



What is it? Answers please.



I also like this honest statement. . .

I wasn't planning on going for a run today, but those cops came out of nowhere!

Now this contest I like. My money's on the beer rather than the Budweiser.



Got a tale to tell?

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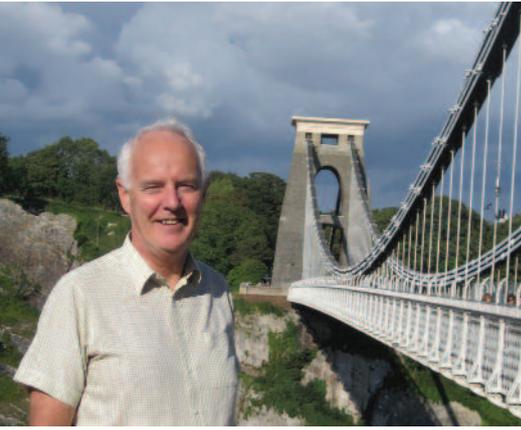
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Step up and get in the public eye

Do we sell ourselves short in the public's eyes?
Chris Preston, chair of the Geomatics Professional Group Board reflects on a summer of sport in which surveying and measurement played a major role.

The past summer period in the UK was marked by several international sporting events and although I did not see "La Tour de France" starting in Leeds, I was fortunate enough to get tickets to see the Commonwealth Games in Glasgow. I went to see some of the athletics and was pleased to see a total station being guided to measure the length of the throws in some of the field events. It struck me as to who had the better job: the official using the total station or those who were driving the radio controlled cars to bring the thrown device back to the athletes? I think I know which one I would have chosen.

However, this does raise the question in my mind: do we as surveyors sell ourselves short in the public's eyes by not publicising our part in this type of event? After all, engineering surveyors would have been involved in setting out the track & field stadium and the track, and are then surely involved in the actual staging.

Get into a class of your own

With some meetings not being held in the summer months it allows time for a little more reading. Having read the London & South East Surveyor journal I was pleased to see a whole page inspiring report explaining about "Class of your own (COYO)," set up by a land surveyor **Alison Watson**, to engage school children with the built environment using the moniker for the programme of "Design Engineer Construct." Moreover the success of this concept needs inputs from all of us, to encourage our businesses to support and sponsor or "adopt" schools in our local area. Further details can be found on <http://www.designengineerconstruct>. The RICS is also happy to "match make" as over 80 schools have indicated they want to take part. Of course such activity is also great for clocking up time for your CPD.

Continuing on my reading theme, it was great to see one of our number recognised in the RICS magazine *Modus*, **Nigel Casswell** working on the Crossrail project in London showed others within RICS what a diverse range of skills our Geomatics members have.

Step up southern surveyors

The International Property Measurement

Standard (IPMS) is now out for consultation and really does seem to be an important document that will be used all around the globe, judging by the number of organisations getting involved. The consultations though have been marked by a reluctance to get involved by land surveyors in some parts of the globe, notably the southern hemisphere. So come on you Aussies, Kiwis and South Africans, how about some input from you too? After all, this standard is likely to be the guide that all property measurements globally will be based upon in the future so please add your views to the melting pot.

For those of you still trying to gain a few hours more CPD try searching out the Business skills podcasts available on the RICS website: <http://www.rics.org/uk/search-results/?sq=podcasts&so=Relevance>

Apps for surveyors

I know that many of us now use iPads for our work and leisure pursuits and I am always amazed by the range of apps that are available. I have seen the following recommended for surveyors:

Plan Grid for viewing and annotating drawings on site.

CamCard for getting business card details into MS Outlook.

Unroll.me for unsubscribing to e-mails.

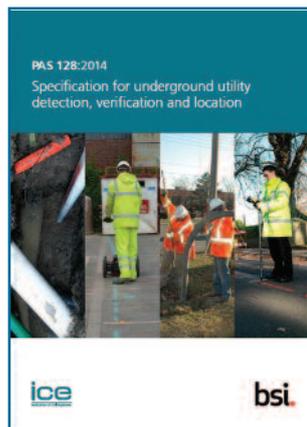
Planimeter for measuring boundaries and areas of plans.

OMTrack for snagging site works and marking up drawings.

I am sure there are plenty more so why not share your favourites with your colleagues via *GW*?

Chris Preston welcomes your comments and thoughts so please email to the following address geochair.rics@gmail.com

“... marked by a reluctance to get involved by land surveyors in some parts of the globe. . .”



PAS 128: a standard for underground utility surveying

By Richard Groom

The long-awaited specification for surveying of underground utilities was launched recently at the Institution of Civil Engineers. There was quite a fanfare: the event even attracted the president of the ICE, **Geoff French**, reports **Richard Groom**.

PAS 128 is the result of two years' work which has been led by the British Standards Institution and sponsored by thirteen organisations including companies, consultants and institutions. Between them they poured £65,000 into the enterprise. Geoff French and **Scott Steedman**, the Director of Standards at BSI, introduced two speakers, **Ian Bush** and **Andy Rhoades**.

A troubled course

Bush, who is vice president of CICES and director of BIM at Black and Veatch took the audience through the development of the specification and its troubled course through four drafts. It went out for consultation twice and attracted over five hundred comments on the first pass and over six hundred on the second, at a point in the process when it should by rights have been cut and dried.

PAS is short for publicly available standard but, as we shall see later, this is not all that it might imply. The standard was born at an event arranged by BSI in January 2012 at which the participants agreed that a specification was needed that was aimed at practitioners - not clients. PAS 128 is the result of a fast-track process, which was programmed to take eighteen months, but in fact took two years. BSI facilitated and it was drafted in accordance with BSI's rules by a team of four, in conjunction with a steering group of interested parties. The Institution of Civil Engineers (ICE) was approached to be the main sponsors and the task was handed over to the joint ICE/CICES Geospatial Engineering panel.

Not quite hierarchical

Readers will probably be familiar with the TSA specification and guidelines, which were published in 2009 and PAS128 has many similarities. Both documents take a hierarchical approach to the types of survey for underground services detection. The survey types specified in PAS 128 are:

- **'D': Desktop study**
- **'C': 'Site reconnaissance'**
- **'B': Detection (particularly using electromagnetic and GPR techniques)**
- **'A': Verification**

But the process is not entirely hierarchical because, according to PAS 128, it is possible to carry out a Type 'B' survey without having

first made a site reconnaissance. Many would contest this, because the detection process should make use of all the available supporting evidence – i.e. utility marker posts etc.

Site reconnaissance includes the identification of utility inspection covers but not lifting them to record pipe sizes and inverts or cable ducting information, which comes under survey type 'A'. Verification was, in earlier specifications, confined to the validation of critical utilities by digging trial holes to prove their position. Lifting of covers to inspect and measure utilities should come at a much earlier stage in the process – and possibly even be included in the topographical survey specification.

This means that, for example, a survey involving the lifting of drainage covers and identification of connections using dye is not covered by the specification, although the results could conceivably be presented in accordance with PAS 128 by attributing the covers as type 'A' and the connections as type 'C' surveys.

Quality attributes

The specification calls for each segment of each utility to be attributed with a quality level which may consist of up to three characters, in accordance with a table. The first character is 'D' to 'A' to indicate the survey type, secondly a digit '4' to '1' to indicate the quality of detection and finally a 'P' to indicate if the survey data (GPR) has been recorded and has been post-processed, rather than interpreted in the field and not stored.

Three niggles

There are three other concerns with this specification. Firstly, under 'Desktop study', the specification calls for the surveyor to "identify known utility owners within the specified survey area". But it is possible to commission third party companies to carry out these searches and they typically offer several options which might, for example, exclude some utility companies that charge for searches, in order to reduce the cost. Yet, frequently, the only way to find out whether or not a utility crosses a site is to search for it, so it is arguable that all searches should be comprehensive.

Secondly, the PAS includes a section (Section 10) on surveying the position of

the detected utilities. This is basically topographical surveying and in this respect PAS 128 is weak. It is particularly disappointing that this part of the specification fails to refer to the RICS measured survey specification, which will be published shortly. It also leaves open the possibility that a company specialising in underground services detection, but without qualified topographic surveyors, will offer to carry out extensive topographical survey work on the back of an underground utilities survey. We know this practice goes on and PAS 128 should not encourage it.

Thirdly, for ease of use, the specification would have benefitted from a proforma survey brief for the client to complete, but it is understood that TSA will be writing a suitable document for this purpose.

Horrific consequences

Andy Rhoades is head of services protection at Heathrow Airport. He was able to draw a direct relationship between the quality of underground services information and the number of utility strikes experienced at the airport. To reinforce the importance of good quality records, he related a story about a contractor installing a lightning rod within a metre of a live high pressure fuel main. Had

lightning struck and the pipeline fractured, the airport could have been closed for many months and the environmental consequences would have been horrific. In another incident, a contractor carrying out road planing, damaged shallow cables, which happened to supply the north runway centreline lights, and severed an 11kV cable that plunged the north side of the airport into darkness.

Just the start

The speakers argued that PAS 128 is an important part of the solution, but that it has to be supported by training programmes and accreditation of underground utilities surveyors. Interestingly, they ruled out accreditation of companies, but arguably this could come from company membership of TSA, or regulation by RICS.

PAS 128 has been endorsed enthusiastically by the RICS, CICES and TSA and there is no doubt that it is a significant step forward. It will be reviewed at two-yearly intervals, when the rough edges can be smoothed.

One final point: if you assumed that publicly available specifications would be free of charge, you would be wrong. PAS 128 is for sale from the BSI website at £70 per copy.

“The specification calls for each segment of each utility to be attributed with a quality level...”

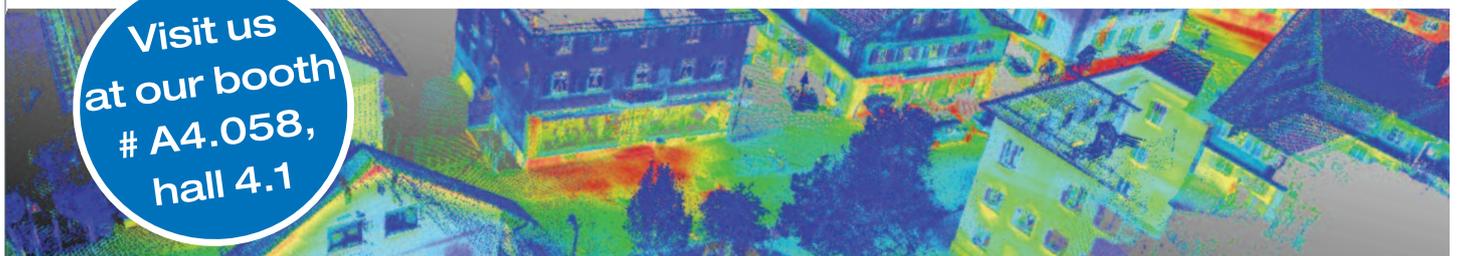


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For BIM-savvy professionals interoperability is currently a hot topic. Those in the architectural, engineering and construction (AEC) industry are witnessing, and contributing, to a battle of the standards. **Andy McKay** of Plowman Craven which has its own standard (see above and GW May/June 2014) sketches out the battle lines.

“Was it the technology that drove BIM or the need within the industry?”

BIM: Is Revit the de facto standard?

By Andy McKay

In a similar vein to the VHS versus Betamax war in the 1970s and 80s, will we eventually see a format win the race due to superior marketing tactics by its proponents, regardless of its superiority from a technical point of view? Perhaps, but with the digital revolution combined with more competition, open source platforms, and not to mention BIM's core value of collaboration, there are many other factors at play.

BIM is evolving and encompasses much more than just 3D parametric modelling. We are now hearing buzzwords such as 4D, 5D, 6D and clash detection but, when it comes to software, “interoperability” is a highly discussed topic and an integral key to the future of BIM. The market is awash with all sorts of ‘BIM compliant’ software addressing specific requirements throughout the industry, however this article aims to explore the emergence of a de facto standard for architects, engineers and contractors, all of whom are surveyors’ clients.

Multi platform approach

As a quality service provider that must remain open and flexible to our clients and industry demands, Plowman Craven cannot afford to choose just one platform and ignore others. Graphisoft's ArchiCAD was the first parametric architectural design tool to hit the market, followed later by Revit from Charles Rivers Software. Autodesk, with a reputation of acquiring existing platforms or software and absorbing them into its various design ‘suites’, purchased Revit over a decade ago. Through heavy marketing and development, Revit has revolutionised the world of BIM with its visual programming capability by adding a fourth dimension: time.

There appears to be a culture within the AEC environment of people and practices sticking to their chosen or preferred software manufacturer; hence opting for the BIM solution it provides. Whilst Autodesk's native AutoCAD format (.dwg) became the industry standard for the 2D environment, it was only natural for subscribers to Autodesk software to step up into the BIM world by using Revit.

Bentley, Autodesk's closest competitor, currently has over 500 software applications which are all very niche for specific environments yet, it was only recently that we started to hear about its BIM solutions. AECOSim is Bentley's latest BIM offering wrapped up into one package which is now being heavily marketed.

It is worth pointing out that Bentley's native

format (.dgn) is in high demand by Plowman Craven's clients in the infrastructure sector, whilst Autodesk's native format (.dwg) is by far the most common for our measured building services work. Both Bentley and Autodesk have developed or have acquired tools to handle and manipulate survey data such as point clouds in their various software applications; and Bentley has acquired Point Tools (a highly regarded point cloud manipulation facility) within its design software. Autodesk meanwhile, has recently released ReCap which is also a very powerful point cloud modification tool.

As a business, we need to respond to client demands. Whilst over 80% of our BIM enquiries request Revit deliverables, only 5-10% of enquiries require a Bentley format, be it AECOSim or .dgn. Less than 5% of enquiries seek other platforms such as ArchiCAD and Vectorworks. It should be noted that these two latter platforms do not, as yet, support point cloud format.

Choosing the preferred deliverable

Plowman Craven built its BIM Survey Specification based heavily on Revit. This approach was largely due to the fact that, at the time of its conception, we considered that Revit was the market leader in the UK for BIM (buildings). We believe it still is. Does this mean it becomes the industry standard? Definitely not, but the way we see it, and based on our client enquiries, it is currently by far the preferred deliverable for a BIM survey. Conversely to this, the Rail and Infrastructure sectors which are rapidly adopting BIM, appear to prefer Bentley software.

It is an interesting discussion when we think back to what came first. Was it the technology that drove BIM or the need within the industry? We believe the answer is not clear cut. In business, we are always looking for ways to progress and improve efficiencies, and in a commercial sense that translates to saving money. As computing technology has advanced at an alarming rate, countless opportunities and industries have spawned from it. The AEC industry has evolved with it to a degree but, relatively speaking, it is far behind the advancement of other industries like manufacturing, aeronautics, automotive, electronics and gaming.

Getting any type of building designed and built is a multi-disciplinary process. Each team or profession has a preferred way of working and this includes the software and technology they use. Therefore the coordination of

information between these entities is no easy feat and the most simple, universally accepted method is what prevails. Whilst a 2D drawing package has historically been the default coordination and hand-over deliverable, BIM changes this not just from 2D to 3D, but also in how the information is presented and stored within these models. This is why interoperability is currently such a hot topic amongst BIM-savvy professionals.

It is the combined data sharing and collaboration principle that is driving BIM software to be interoperable with other platforms. We have started to see Autodesk and Bentley share features such as direct export formats in later releases, and even various plug-ins that help with some interoperability issues.

The perfect collaborative solution?

Autodesk Navisworks and Bentley's iModel can both handle many formats of software to coordinate models, however they are still a long way from creating a perfect collaborative solution. This is where the development of Industry Foundation Classes (IFC) comes into play - to enable various formatted models to be able to 'talk' to each other better. IFC is being constantly developed and managed by an international organisation called BuildingSMART, in which their primary aim is to improve the exchange of information between software applications used in the construction industry.

Whilst IFC is not a perfect, seamless solution yet, it is gaining momentum and has now been registered as an official International Standard. As this is a software neutral solution, the Danish government has now made the use of IFC mandatory on all public building projects. Could this be something we see mandated here in the UK and globally? If so, we could predict the development of IFC to rapidly accelerate, and all BIM software developers refine their platforms to be more IFC compatible.

Whilst IFC develops a feasible solution to the interoperability challenge, this does not however alter the essential requirement for a survey BIM-ready model, and that is the power to modify and/or demolish the existing model. Currently, this can only be done in the native software it was produced in because IFC, Navisworks and iModels are locked/fixed formats. Even though we may start to see surveyors being required to deliver IFC formats, it will still need to be produced in the lead designer's native format.

Whilst the change in culture is still evolving and finding its way, a 'preferred' BIM format will surely be recognised before too long, if it hasn't already. For the survey industry, this means supplying the designers and contractors with information in their preferred format. As far as Plowman Craven's BIM enquiries and projects are concerned, this is clearly Revit.

We have seen the surveyor's role become a lot more involved in the BIM process, including consultative input from feasibility stage right through to the operation and maintenance of a building. But, for construction and through facilities management, Revit is likely not to be the preferred software. We are seeing Navisworks models becoming more and more widely used and defined as the coordination tool and hand-over requirement.

Nevertheless, regardless of the software utilised, we all know that every project is unique and that delivery requirements vary constantly. In order to best advise our clients, geomatics professionals have not only got to be aware of the multitude of software applications, but they also have to understand which is the most appropriate to apply to achieve the best possible results.



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UltraCam Osprey Prime: a sensor for nadir and oblique imaging

Michael Gruber and **Wolfgang Walcher** of Microsoft's UltraCam business unit describe the qualities of the latest Osprey aerial camera.

UltraCam Osprey Prime is the second generation oblique aerial sensor from Microsoft's UltraCam business unit. It was first introduced at the ASPRS in Louisville, Kentucky in March 2014. The design goal – to combine a high quality metric nadir camera and large 45° oblique sensor heads – was modified slightly from the UltraCam Osprey, its predecessor. The upgraded nadir subsystem produces a panchromatic high-resolution image, a true-colour RGB image and a near-infrared image. The four oblique true-colour camera heads are now mounted at an off-nadir angle of 45° and deliver images from all four directions – forward, backward, left and right with respect to the flight path.

The most important design change is the focal length of the sensor system and the new arrangement of the oblique camera cones. The new nadir and oblique lenses show longer focal lengths namely 80 mm for nadir and 120 mm for the oblique camera heads. Thus aerial missions can be conducted from a higher flying level to provide the same ground sampling distance. From an altitude of 1000 metres the camera acquires a nadir ground pixel of 7.5 cm. The other important improvement comes from a newer generation CCD detector array which is used for the oblique camera heads and delivers 60 Mpx at stunning quality. Fast read-out of the detector arrays means that the camera can achieve a 1.8 sec interval between frames, increasing the productivity of the flight mission.

Camera design

The nadir part of the camera collects a high-resolution panchromatic image, true colour and near infrared images. The 45° oblique cameras are designed as single cones and assembled in their viewing direction so that optical prisms are not required.

Productivity increases in the air is one design goal. Using an overlap of 60% in flight direction and 40% between flight-lines the flight plan shows a base length of 225 metres and a line spacing of 525 metres which gives adequate overlap between the oblique footprints. At a flying altitude of 1000 metres and a nadir GSD of 7.5 cm the nadir looking image's outermost

extent covers an area of 2800 × 2800 metres.

The focal length of the four oblique camera heads is 120 mm and fits well to the specs of the nadir camera subsystem. At the 45° viewing angle the object distance is 1414 metres and the GSD varies between 7 cm and 10 cm in the image centre of the oblique images. The oblique cones are equipped with 60 Mpx CCD sensor arrays at a 6 µm pixel size and Bayer Pattern colour filters. The positions of the CCD sensor for the left and right looking heads are in portrait mode and slightly off centred. This gives more cross-track overlap but keeps the outermost footprint extent the same for all four oblique camera heads.

Camera calibration

Each individual cone is calibrated by means of a laboratory calibration in order to compute the parameters of the interior geometry of the cone as well as the lens distortions. This procedure is based on a set of photos taken of a three-dimensional target which is built up in the calibration laboratory. This target has a large number of well surveyed target points covering a field of view of 110°. In order to allow for the larger field of view of the new sensor, the target was expanded. Additional control points are available to cover the oblique cameras to the left and to the right. Tilting the camera by 90° also enables calibration of the forward and backward sensors.

The most specific characteristic of the calibration procedure is the simultaneous

“Each individual cone is calibrated by . . . a laboratory calibration in order to compute the parameters of the interior geometry of the cone as well as the lens distortions.”

Below: UltraCam Osprey prime (left) and cone layout on the bottom of the camera body (right). The four cones of the nadir camera are mounted in the vertical direction, whereas the four oblique cones are easily distinguishable due to their inclined mounting position.





calibration of the nadir and the oblique camera cones. The quality and reliability of the calibration procedure for nadir camera heads is well proven. The nadir cone calibration provides the foundation for calibration of the oblique camera heads and therefore the exterior orientation parameters of those nadir cones are introduced into the setup for the oblique camera orientation parameter computation. This approach improves the redundancy of the adjustment as well as the quality of the eccentricity parameters.

The calibration procedure for the oblique cameras is based on a large number of images taken from 84 shot positions which are a combination of three camera stations and 28 different rotation angles. Thus a highly redundant set of image positions can be automatically measured and introduced into a least squares bundle adjustment procedure. The entire set of measured image positions consists of approximately 10,000 positions taken from the panchromatic nadir camera component and almost the same number of image positions from the four oblique camera heads. The quality of the calibration procedure is at the sub-pixel level.

The calibration procedure for the UltraCam Osprey Prime camera also includes radiometric calibration of the individual camera heads. The colour performance of the nadir colour cone and the four oblique cameras are derived and the respective colour correction matrices are computed. For complete calibration we also determine the behaviour of the individual shutters, offset and gain values of all CCD sensor arrays, as well as the lens vignetting at all supported aperture settings.

Image quality

The sensor technology of the new 60 Mpx CCD sensor arrays supports a dynamic range capable of delivering a digital signal at 12+ bit level. Thus each colour band of the resulting images can resolve more than 4000 distinct intensity levels.

In the spring of 2014 the first UltraCam Osprey Prime images were acquired for Microsoft-internal mapping projects. Results from aero-triangulation, surface modelling and ortho image production were analysed and three dimensional photo-textured models of urban environments were produced. The success of these missions shows the usability and high quality of UltraCam Osprey prime images. This shows the high potential of the UltraCam Osprey Prime, the well-balanced design and the benefit of the high-quality metric nadir sensor component.

Email: {[michgrub](mailto:michgrub@microsoft.com), [wwalcher](mailto:wwalcher@microsoft.com)} @microsoft.com

Below: Cropped portion of a backward view of the historical city of Graz, Austria, taken in June 2014 from 1300m flight altitude. The horizontal ground resolution cross-track is about 10 cm.



Above: The extended calibration laboratory in Graz, Austria and its 3D Structure is the basis for calibration all camera heads of the UltraCam Osprey (left and right oblique and nadir).



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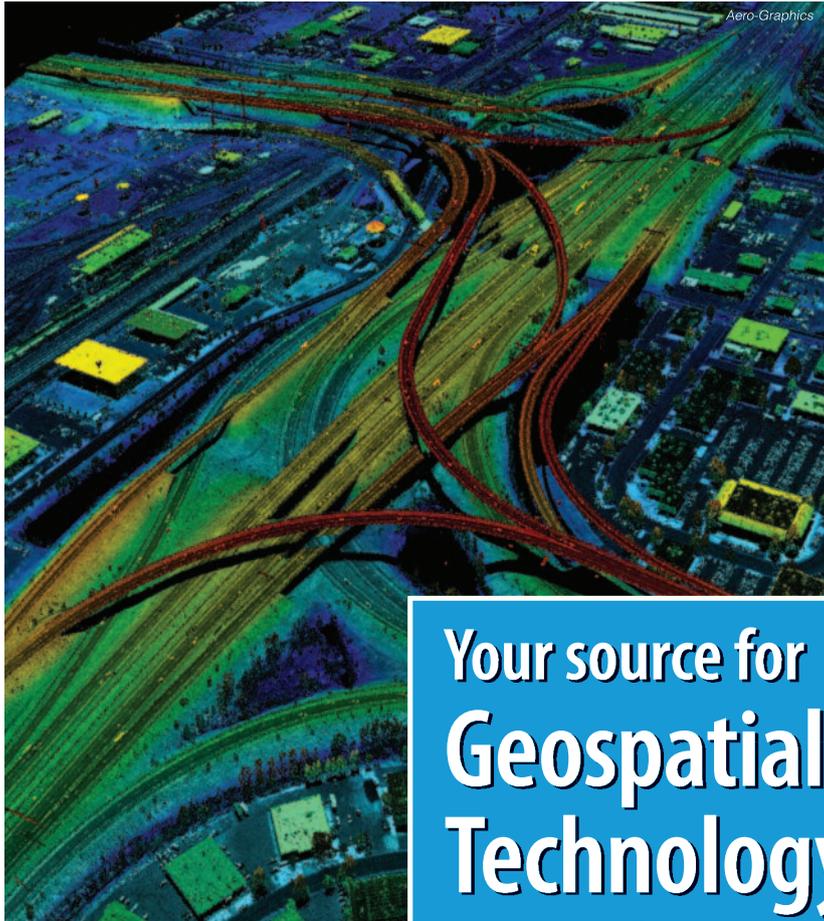
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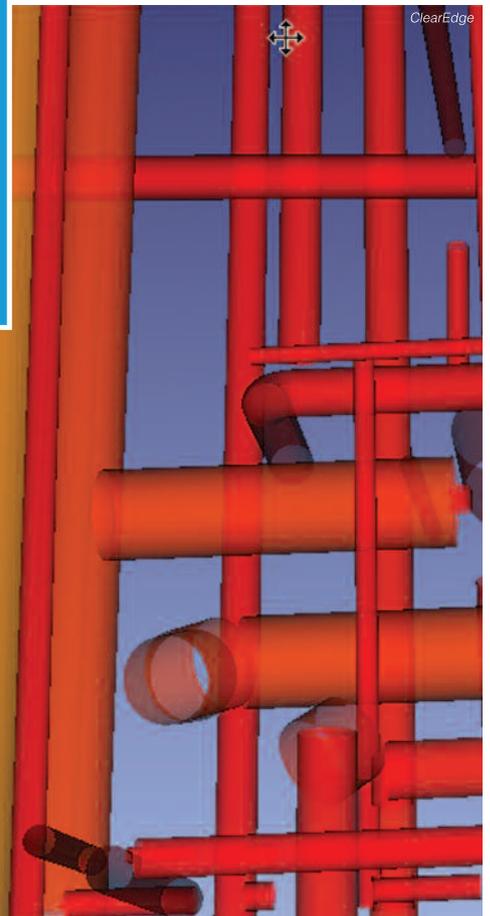
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Reduct - a new tool for locating utilities

Surveyors are familiar with electromagnetic location and ground penetrating radar for tracing underground utilities. Here, Sarah Hurley from surveyors M J Rees and Company describes another technology for tracing pipelines or ducts at any depth.

While some utilities are relatively easily traced, there are limitations to all traditional non-intrusive location methods, including electromagnetic location (EML) and ground penetrating radar (GPR), such that data has to be issued with appropriate disclaimers, advising against reliance on the 'surveyed' position of buried assets, without further (intrusive) investigations.

In 2012, to complement its EML and GPR capability, MJ Rees and Co introduced the gyro technology Reduct, to assist its work in high risk environments. The equipment is able to provide XYZ co-ordinates of the pipeline or sewer for its entire length from accurately co-ordinated start and end points regardless of the depth of asset, surrounding ground condition or pipe material. Furthermore, no access is required to the ground above the service, as is the case with a radio sonde or GPR.

How does the technology work?

Reduct is normally configured with a centralising wheel set. In this mode of operation the gyro is aligned to the pipe by the wheels which are 'spring-loaded', to place the system in a known position relative to the pipe diameter – See Figure 1. Using a range of interchangeable wheel sets, the system is adjustable to fit internal pipe diameters from 90mm – 1500mm.

As an alternative, which is typically used in large sewers where man-entry may be possible, the system's wheel sets can be configured to follow the pipe invert.

The inertial measurement system within Reduct contains a range of sensors including gyroscopes and accelerometers. Together, these form the Orientation Measurement Unit (OMU). This is fully automatic and samples at a rate of up to 100 Hz; the sensor data is then calibrated with precise start and end co-ordinates to calculate gyro alignment and changes in X, Y and Z directions. The calibrated accuracy of the OMU is 15cm in XYZ over a 500m distance between two points, assuming ideal mapping conditions.

Case Study: Reading Station

Reading is one of the busiest parts of Britain's rail network. Redevelopment work to decongest and improve passenger journeys began in 2010 and included the construction of new track and platforms, a new passenger footbridge, a viaduct to the west of Reading and widening of the rail bridges. The project is scheduled for completion in summer 2015.

In spring 2012, M J Rees & Co was appointed to locate a section of sewer running underneath the track and platforms. It was thought that the sewer followed a straight line and varied in size from 1050 mm diameter to 1100mm x 800mm (oval). There were also issues with the flow. The red line in

Right: Figure 1, Reduct with spring-loaded wheels, so that the sensors follow the centre of the pipe.



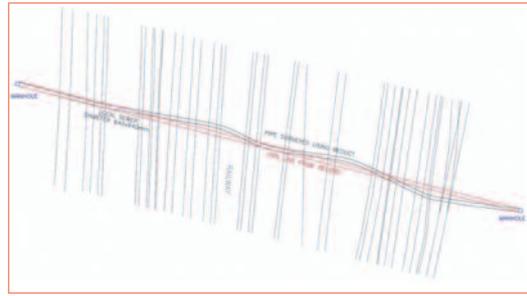
Figure 2 shows the line of the sewer from service records.

M J Rees & Co prepared the risk assessment and method statement (RAMS) and liaised with the asset owners to put in place all necessary permits to work. The sewer was cleaned, after which M J Rees' surveyors transferred coordinates from the existing Reading station redevelopment survey control network from the surface into the chambers of the manholes. The alignment survey was undertaken between the coordinated points using the Reduct DR-HDD-4.2 Survey System.

The water level in the sewer was reduced prior to cleaning and with a safe system of work established and approved, the survey was completed to specification in a couple of hours.

The sewer run was measured four times; twice in each direction. All runs were valid and showed a high degree of repeatability. XYZ results were checked and then plotted in CAD onto the existing topographical survey and checked against the piling design, as shown in black in Figure 2

Departures from the expected sewer alignment of up to 0.8m resulted in the need to adjust the piling locations. This phase of the construction then went ahead, with confidence and without infringing on the sewer easement. The survey also showed that



Left: Figure 2, Comparison of the actual route and that derived from records.

the sewer was a 640mm diameter structure, not variable as had been historically recorded.

In addition, several low points were mapped that revealed why the sewer in question did not flow properly.

Conclusions

- Even over short distances, sewers and other utility routes can have significant deviations from the straight line.
- The same technology can, and has been, used for gas pipes, water pipes, telecoms ducts and horizontal directional drilling routes.
- The process of detecting, verifying and locating buried assets is a highly skilled task, one that should be entrusted to experienced and qualified surveyors.

For more information visit: www.mjrees.co.uk

“Departures from the expected sewer alignment of up to 0.8m resulted in the need to adjust the piling locations.”



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HxGN Live 2014: workflow infuses services and solutions

HxGN Live was held in Las Vegas in June for a third consecutive year. It was where everything came together for Hexagon AB. Synergy, BIM and consumer-driven stories were just some of the themes explored by the 3500 people who attended in the vast MGM Grand hotel. And Leica Geosystems is a focal point that continues to bring everything together for its Swedish parent, observes our reporter **Adam P. Spring**.

This year's HxGN Live was another milestone event for Hexagon as a company. It was as significant as its first conference back in 2011 in Orlando, Florida. Seamless integration between Intergraph and Hexagon - rival service and solution providers until Q4 2010 - had become second nature for all Hexagon employees. Numbers for the high definition survey (HDS) sessions were also at a record high of 800 attendees. This figure was up by 100 people from the 700 users that attended in 2013. HxGN Live in Hong Kong was announced for November 18th-20th, 2015.

Point cloud a standard for BIM and CIM

The Leica Geosystems training day showed that scanning based solutions continue to evolve. For example, sessions for hybrid systems like the Nova MS50, the multi station instrument that combines total station technology with GNSS and scanning, took place for the first time. Interactions between users and seasoned HDS trainers like **Guy Cutting** also indicated the point cloud was now an industry standard. This was especially the case in emerging application markets like Building Information Modelling (BIM) and Civil Information Modelling (CIM).

Scan to BIM

Joshua Rayburn, an HDS manager for part of the NAFTA region, presented scan to BIM using a Leica P15 laser scanner. This hands-on session began with scans collected in the training room. Point cloud information was then used to demonstrate a scan to BIM workflow, where data was processed in Cyclone and Cloudworx for AutoCAD. Decision making processes were being informed by as-

built information derived from point cloud data - real world conditions for a building or structure. Navigating between what Hexagon viewed as the digital world and real world is what makes BIM a powerful project management strategy. Information use now goes beyond standalone 2D plan drawings.

Overall, the HDS training sessions highlighted that P15 and P20 scanner solutions guarantee high resolution data collection at industry leading speeds. Sessions like Rayburn's lay the foundation for numerous Cyclone related announcements made at HxGN Live 2014. Like Intergraph Imagine software (which used to fall under Security Government and Infrastructure - S,G&I), this included the use of solutions provided by Australian company Euclidean. Their technology has been integrated into several cloud based viewers and was demonstrated at the conference in order to show how to manage large datasets. HDS hardware and software solutions therefore continue to meet the demands of Hexagon's worldwide user community.

The keynotes

The opening keynote was entitled *The Disruptive Power of Transformation*. Hexagon has reshaped itself around information and communication technologies (ICT). This was achieved via its Smart Content Program (SCP) and GeoCaaS service. Outlined by president and CEO Ola Rollén, SCP was part of a business model "moving from product centric to workflow solutions." It also set the tone for a genuinely Live event based around intelligent and autonomous systems, a move away from technology isolation in favour of technology convergence and more efficient design and manufacture processes. Information capture and distribution lifecycles were also explored in the days that followed.

Right: The Pegasus Two combines several Hexagon solutions in order to create a mobile mapping add-on for vehicles.



Right: The T2 is a portable cart based laser scanning solution that continues to evolve around infrastructure based applications.



Geosystems, Geospatial and Metrology

Jurgen Dold, president of Hexagon Geosystems, discussed market growth and data integration in his Leica Geosystems keynote. Whether it was investment in the mining sector or emerging unmanned aerial vehicle (UAV) applications, Dold confidently voiced his approach to change: "We need to create places where multiple datasets are coming together from multiple data providers. So, we can then take those and create information layers - to create this information for more and more users."

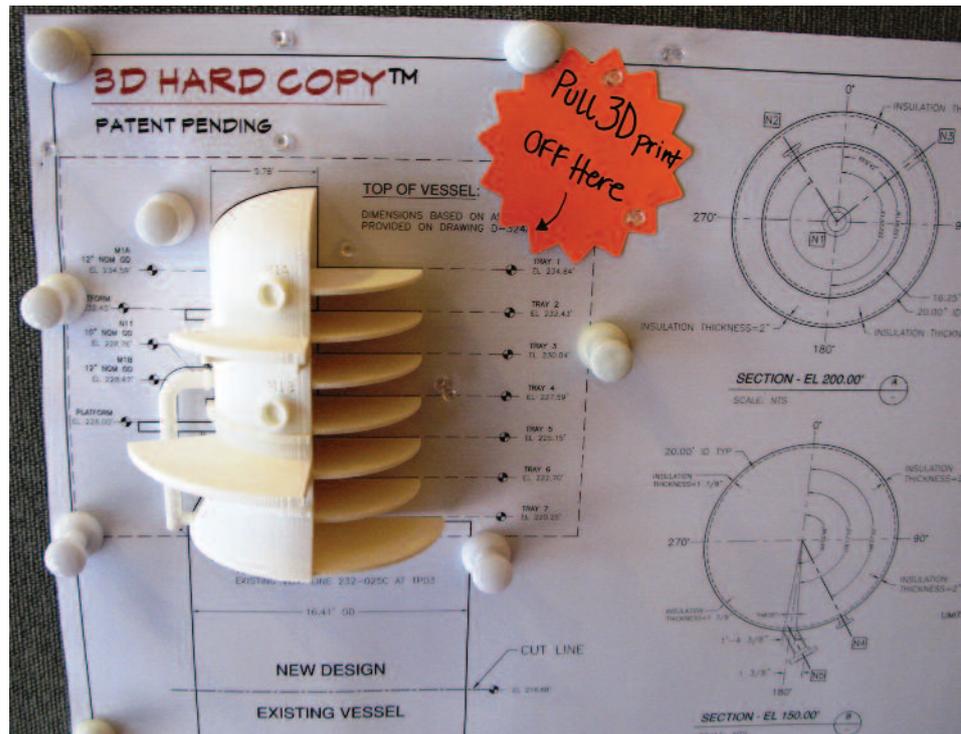
It was also the first time **Mladen Stojic** had attended HxGN Live as president of Hexagon Geospatial. Intergraph's geospatial portfolio had been rebranded at the end of 2013, and a new branch of the Hexagon family was created. In his inaugural keynote, Stojic demonstrated why he was the person to shape its future: "Our goal is to transform the industry and, ultimately, transform the geospatial economy associated with capturing content, producing content, providing content as a service and using that content in solutions."

Transforming industry was also at the heart of the Hexagon Metrology keynote. **Norbert Hanke's** team were ahead of the curve in a sector where quality control and production lifecycle are primary considerations. **Ken Woodbine**, PC-DMIS developer, used the metrology management system (MMS) - a collaboration between Hexagon Metrology and Intergraph - to discuss integrated data. He explained how MMS continues to expand the concept of product lifecycle management (PLM) in the metrology world: "It aligns with several current software megatrends like big data, cloud computing and the Internet of Things."

Nova MS50

Last year the Nova MS50 MultiStation was heralded in via a champagne reception in the Leica Geosystems keynote. One year later, numerous presentations highlighted why its Heerbrugg design team felt a great sense of pride toward their creation. In the HDS sessions, for example, **Sean Douthett** of David Evans and Associates showed how MS50 data could be integrated with ScanStation C10, P20 and HDS 6000 point cloud information. The range at which data could be collected was a notable consideration for Douthett as an MS50 user. High resolution data capture over 150 metres was a key selling point in scan-data fuelled social circles.

Hans Moller, lead surveyor at Bechtel Oil, Gas, & Chemicals, also discussed the advantages of an MS50 based workflow. Set in Australia, the story he told was driven by point cloud data for industrial sized containers from the Curtis Island natural gas processing facility. The MS50 provided high quality data as both a total station and laser scanner.



Results for site monitoring activities and various surface analysis tests were particularly impressive.

The variety of applications outlined in Douthett's and Moller's presentations teased out an important point about the Nova MS50. It had become a powerful gateway technology for users who might be unfamiliar with laser scanning. It had, no doubt, opened doors for the Leica Geosystems HDS brand since its release - such as applications where users may otherwise be resistant to change.

Market growth

User diversity and an increased number of first time attendees demonstrated that interests in geospatial information were growing. In order to capitalise on it, **Ola Rollén** likened the approach Hexagon was taking to the Apple iTunes model. His Content as a Service (CaaS) strategy took advantage of data integration, market consolidation and the long-term value of what he sees as actionable information. In other words, the non-linear workflow was here to stay.

Customer feedback on architectural, engineering and construction (AEC) work in the US revealed that the NAFTA region was in full economic recovery. The amount of work Hexagon users were getting in comparison to previous years was certainly a shopfloor indicator. Texas based companies like Lanmar Services had, as its CTO **Larry Kleinkemper** put it, "never been busier." BIM and CIM were reshaping the way spatial information was being used in the "new world". Clients were also having more of a say in decision making processes.

The power of BIM

Leica Geosystems was well placed within

Above: Low cost 3D printing can now be used as part of a BIM workflow to help inform AEC based design processes (Photograph Courtesy of **Remco Takken**)

"It had become a powerful gateway technology for users who might be unfamiliar with laser scanning."



Above: The Golden Nugget in Downtown Las Vegas is one of 20 places in the world that has a Gold to Go machine.

Hexagon to reap the benefits of BIM related applications. The HDS brand had clearly matured, and the idea of 2D plan drawings as the baseline dataset had clearly become a thing of the past. For example, scan to BIM could be used to describe how as-built conditions were documented through a point cloud. This had also translated over into the work environments of Intergraph Process, Power and Marine (P,P&M) users. Hence, the rise of the term CIM, civil information management.

Data integration was also promoted in BIM work cycles through integrated project delivery (IPD), which helps utilise the talents of all project team members to obtain the best results possible. **Cathi Hayes**, BIM manager at Leica Geosystems, reiterated this throughout her "Field Trip" sessions - even pointing out that BIM and IPD are intricately linked to one another. Market and user outcomes seemed limitless to anyone sitting in the Hayes sessions held in 2014.

Synergy

Synergy between all parts of the Hexagon family was discussed throughout HxGN Live 2014. **Jack Ickes**, President of the geospatial solutions division at Leica Geosystems, demonstrated how a ScanStation P20 scanner was combined with acquired solutions like GeoCue. This created the Pegasus Two, a powerful mapping solution new to the Leica portfolio. A cart-based system was also showcased. Called the T2 (that title is bound to send a frisson through old hands and lovers of the ubiquitous Wild T2 theodolite, which sold 90,000 over 70 years for Wild, Leica's predecessor company), it includes a Velodyne sensor. Future developments based around the growing relationship between P,P&M and Leica Geosystems were hinted at too.

Mining

Hexagon has repositioned itself within the mining industry over the last year. Design, exploration and operation are the key components of its onsite workflow. Its mining software and fleet management markets have been merged in order to make Hexagon the number one services and solutions provider in the mining sector. In other words, MineSight, Leica Mining, SAFEmine and Devex were brought together in order to "leap frog" the competition. In the Leica Geosystems keynote entitled *Dirt, Diamonds and Data*, president of Hexagon Mining, **Guilherme Bastos** outline his 360 plan for the future: " We cover mine surveying, mine planning and scheduling, real-time management for open pit and underground mines, process automation, 3D visualisation and safety."

Mining infrastructure and asset management are set to have a noticeable impact on future streams of income for Hexagon. Acquisition of the UAV company Aibotix (an ideal solution for data capture in open pit mine mapping), complimented motion extraction based solutions like SAFEmine. This all-in-one traffic safety and collision avoidance solution was already being used on the ground to make open mine environments safer.

Gold to go

The Golden Nugget casino is located in downtown Las Vegas. It is the largest casino on Fremont Street and has featured in films like *Diamonds Are Forever*. In 2011, a new chapter was added to its history when a Gold to go vending machine was installed in its Gold Tower Lobby. Prices are updated every ten minutes and 24 carat gold bars are sold in 1, 5 and 10 gram sizes. Boxes of gold coins can also be purchased.

Las Vegas is one of 20 locations where Gold to go vending machines can be found. They are also in other parts of North America, the Middle East and Europe. For example, Westfield Shopping Centre in West London had a Gold to go machine installed in 2011. The business aspiration of Germany based TG-Gold-Markt is to have 500 Gold to go machines in operation around the world.

Summary

Hexagon AB was pragmatically transparent about its immediate and long-term goals at HxGN Live 2014. The mantra of a world shaped by an evolving information flow, which had been presented to its customers, was now a fundamental part of its day-to-day business operations. Divisions like P,P&M - outlined as having sizeable growth potential in the capital markets day presentation - provided insight into what to expect at the next HxGN Live event. User stories will not only be told in Las Vegas in 2015. They will also be presented in Hong Kong.

About the author



Adam P. Spring is a consultant and visiting lecturer in Applied Technologies and Reality Capture in the Department of Archaeology, University of Plymouth. He has featured in numerous academic and research publications. In addition to reselling 3DM Analyst, he has been a consultant for Autodesk and Leica Geosystems. For more information, visit <http://remotely-interested.com/>. You can follow Adam on Twitter at [@ThatInterested](https://twitter.com/ThatInterested)

Towards a standard for Discrete Global Grid Systems

Historically, computational processing facilities were expensive, affordable data storage was limited and large volumes of geospatial data were hard to come by unless one worked for a space agency, meteorological services or a large technology firm. But today new technologies and ways of working are making this easier, argues Dr **Gobe Hobona**. And the RICS need to get involved.

The advent of cloud computing, crowd-sourcing and Big Data has meant that geospatial data users are increasingly faced with the challenge of how to organise or visualise vast amounts of data to support their daily operations. One way through which the geospatial community is addressing this challenge is through the use of Discrete Global Grid Systems (DGGS).

What is a DGGS?

A DGGS is a tessellation of regions that form a partition of the Earth's surface, where each region forms a cell that can contain smaller cells at finer resolutions. Cell regions may vary in shape and size, from irregular shapes based on attributes such as population, to regular shapes of evenly distributed vertices. Figure 1 shows an example of such a discrete global grid over the entire Globe. In a review of the literature, Sahr et al listed shapes applied in various DGGS as including triangles, squares, hexagons and diamonds. If the grids are made of regular planar polygons, the resolution can be described in terms of the aperture of the DGGS, where the aperture is the ratio of the areas of a planar polygon cell at two consecutive resolutions.

The Standardisation Effort

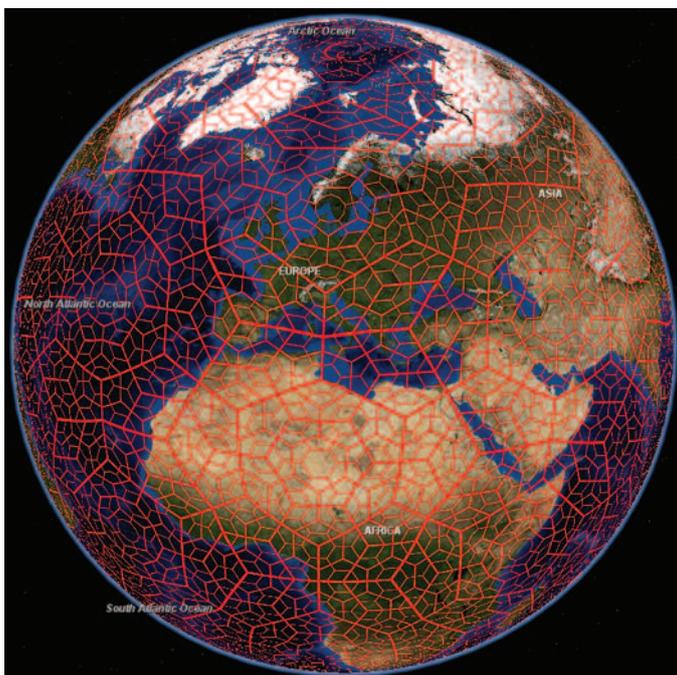
At the 2013 International Society for Photogrammetry and Remote Sensing (ISPRS) conference on Global Spatial Grids and Cloud-based Services, a variety of applications of DGGS

were presented. Researchers from Southern Oregon University presented an approach on the use of Central Place Indexing (CPI) for optimal representation of vector locations using fixed-width multi-precision quantization. A presentation from researchers at China University of Mining and Technology described an adaptive integration model based on spherical degenerate quad-tree grids for integrating vector data and digital elevation models.

A separate presentation from researchers at China University of Mining and Technology described an approach for creating global hierarchical and equal-area grids. A series of additional presentations described early research into global 3D grids. The breadth and scope of the presentations suggests that DGGS is finding applications in visualisation and data fusion. The approaches presented at the ISPRS conference, however, are only a sample of the DGGS applications that have emerged over the past decade. Recognising the increase in the number and variety of DGGS applications, the geospatial community established a new working group within the Open Geospatial Consortium (OGC) to develop a standard for DGGS.

The OGC is an international consortium of more than 470 companies, government agencies, research and academic organizations that participates in a consensus process to develop geospatial standards. By virtue of being open and publicly available, OGC standards have informed specifications of other standardisation bodies such as the International Organisation for Standardisation (ISO). At the recent International Geoscience and Remote Sensing Symposium (IGARSS), Peterson et al explained that the goal of the working group is not to identify a single discrete global grid, but to increase awareness of the advantages of DGGS in general, to define their qualities, to make them interoperable with other data sources, and to standardise their operation. The DGGS working group within the OGC is expected to consider approaches adopted by various geospatial technologies, for example, the PYXIS WorldView browser, Australian Geoscience Data Cube (AGDC), Southern Oregon University's DGGRID software and a number of global grid systems used in meteorology. Our own interest in DGGS at Envitia has emerged from recent research conducted by our consultants in the area of the visualisation of uncertainty and also in text mining.

In addition to considering approaches taken



Right: Figure 1, A multi-aperture hexagonal DGGS

by software implementations, standardisation will need to consider relationships to existing standards such as ISO 19112 and the Military Grid Reference System (MGRS). ISO 19112 defines the conceptual schema for spatial references based on geographic identifiers; the standard enables producers of data to define spatial reference systems using geographic identifiers and assists users in understanding the spatial references used in datasets. Whereas, MGRS is a georeferencing approach used by NATO to simplify the specification of positions through use of an alphanumeric identifier derived from Universal Transverse Mercator (UTM) coordinates.

Benefits

The potential benefits of DGGs standardisation to geomatics professionals will depend on the extent of the specification that is being developed in the OGC. A key benefit already becoming evident is the ability to organise various types of information unambiguously within discrete cells over the entire Earth's surface such that they can be processed in parallel. Being able to organise information in such a way, consistently between different geospatial technologies, may help to bring the related approaches in cloud computing and Big Data closer to a variety of Geomatics practices. There is

however, some work to be done to get to that point as some OGC specifications can take from a few months to a year to reach approval as standards, depending on the size of the task and the commitment of the working group members. As the DGGs standardisation effort within the OGC only began in the first quarter of this year (2014), there is a great opportunity for members of the Royal Institution of Chartered Surveyors (RICS) to participate and influence the direction the standard will take.

Acknowledgements

The author is grateful for the feedback received from OGC staff and members of the DGGs standards working group.

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About the Author

Gobe Hobona holds a PhD in Geomatics and a BSc (Hons.) in Geographic Information Science from Newcastle University. He is the Consultancy Team Leader at Envitia Ltd., a member of the OGC.

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– a free web-based application for displaying survey data

A web-based application, developed at Loughborough University is capable of transforming and displaying OS grid coordinates onto a range of freely available mapping resources, including: Google Earth/Bing/ OS maps and OpenStreetMap.

Developed to fulfil Loughborough's MEng degree in Civil Engineering under the guidance of Prof **Jim Chandler**, the web application surveyplot.co.uk is available free of charge and is ideal for displaying detailed land surveys, or any other geometric information, without the need for expensive specialist software. Although this can currently clearly be achieved using commercial GIS software, users often don't require the full functionality of a GIS for simple visualisation. In addition, the application allows sharing of the visualisation link, easily enabling others to view.

Adding data

Survey coordinates are in a simple CSV file format (Point Identifier, +3 ordinates) to be uploaded, in either the UK National Grid or WGS84/ETRS89 coordinate systems. The OSTN02 transformation is used, enabling display on maps using both systems. Google, Bing, Ordnance Survey and OpenStreet maps and imagery can all be used as a backdrop. KML files can also be downloaded for subsequent use in either Google Earth or other GIS systems. When plotting points they can be displayed either individually or optionally as a 'group'. Grouping enables lines or shaded areas to be shown, which is ideal for visualising and distinguishing buildings or roads.

The OS National Grid system (OSGB36) contains inherent accuracies arising from the

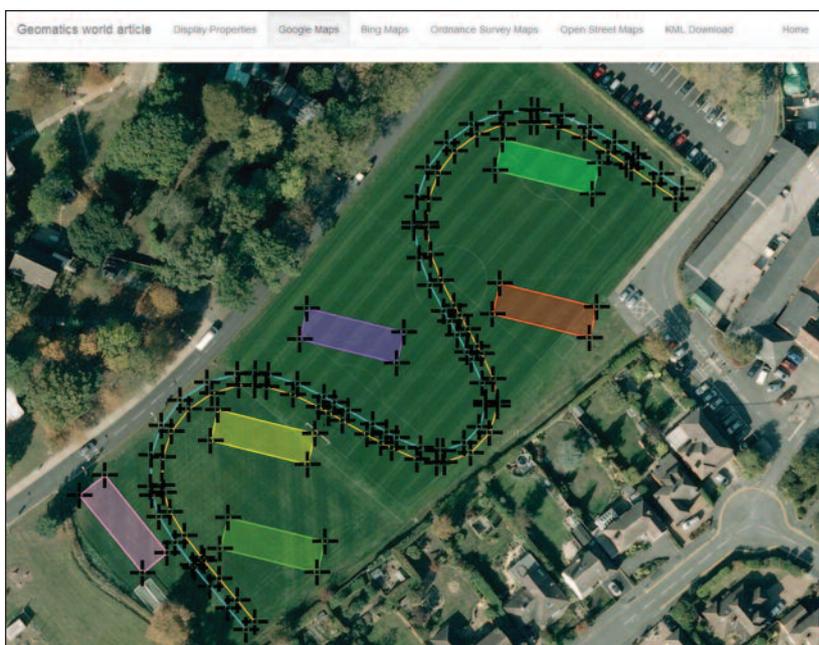
re-triangulation of the UK, which was undertaken between 1936 and 1953, before the introduction of electromagnetic distance measurement or GPS surveying equipment. These inherent errors in OSGB36 cause issues when using survey grade GPS technology and when transforming coordinates between WGS84/ETRS89 coordinate systems and OSGB36. OSTN02 was introduced to 'correct', or more strictly distort, transformed data back to the original and slightly distorted OSGB36 framework. Ordnance Survey provides a detailed description of the OSTN02 transform, which was used to write the program code for surveyplot.co.uk.

Testing

Surveyplot.co.uk's components have been tested individually to confirm accuracy. Firstly, the OSTN02 conversion implementation was checked against a range of values provided by OS, confirming it produced the same values to 3 decimal places. Secondly, 44 visible OS trig pillars were measured in both Google and Bing imagery, comparing observed against actual pillar locations. Overall, this revealed an accuracy of $\pm 2.1\text{m}$ relative to the Google imagery and $\pm 1.7\text{m}$ with the Bing imagery, at the 95% confidence interval.

Finally, both mapping services were directly compared to a full photogrammetric quality orthophoto covering Loughborough University campus and surrounding area. A GPS survey of easily identifiable ground

"... users often don't require the full functionality of a GIS for simple visualisation."



Left: A simple example survey with a road and buildings.

About the author



Matt Harrison graduated this summer with a Civil Engineering MEng degree (1st class) from Loughborough University. He currently works as a research and development engineer for SAS International, a building interior designer and manufacturer based in London.

control was used, again comparing observed against actual ground coordinates. The results demonstrated the importance of relief displacement, as the orthophoto yielded a far higher accuracy, additionally validating the accuracy of the Google/Bing imagery in the previous test.

The discrepancies between transformed positions and their apparent image locations can be attributed to two sources, of increasing significance:

- Separation between the ETRS89 and WGS84 terrestrial reference frameworks. ETRS89 is essentially WGS84 frozen to the Eurasian plate in 1989, as small movements in the tectonic plates cause the two systems to diverge at a rate of approximately 2.5 cm per annum. Ordnance Survey therefore recommend usage of ETRS89 coordinates, by linking surveys directly to either active or passive OS points.
- The remaining error can be attributed to the Google/Bing imagery not being fully corrected for relief displacement. Bing imagery was found to have a higher positional accuracy, which is thought to be due to homogenous collection methods as part of project 'global ortho'. In contrast, Google procures its imagery from a number

of suppliers with perhaps a wider quality range. Google's imagery appears to be generally of a higher resolution and contains less shadowing, grain and artefacts across the UK, giving an impression of higher quality. However, this does not appear to be fully justified in a positional sense.

In summary, surveyplot.co.uk provides a simple visualisation tool for surveyors, providing a quick way to overlay UK National Grid information on a variety of web mapping services. The site is now live and all feedback is welcome.

Note: Although detailed testing has demonstrated accuracy of the web-based application, it should be noted that accuracy can't be guaranteed.

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FIG KL is tankard full of fun!

Readers of the last issue of GW (July/August 2014) will already have studied **James Kavanagh's** world cup oriented report and **Richard Groom's** more sober technical review. Here the irrepressible **John Brock** gives his own lively account of the social side of FIG KL, but not before telling us all about his pre-event SE Asia tour.

En route to KL via Xi'an I spent two nights so I could explore the world renowned Terracotta Warriors found by three farmers in 1974. I even met one of these men at the awesome complex showing off this amazing find from the First Emperor from around 220 BC. Next, a quick visit to the remarkable 12thc. **Angkor Wat** and **Angkor Thom** in Cambodia, an extensive stone Khmer empire complex of cities through the enveloping jungle.

Arriving at the Novotel City Centre Hotel on Sunday afternoon gave me just enough time to get ready for the Welcome Reception held at the Convention Centre. Special guest greeting us to KL was the minister for trade. On Monday morning I was IHSM rep at the FIG General Assembly fulfilling this duty by giving a brief report of the activities of the history team for the last four years since the last congress at Sydney in 2010.

FIG Working Weeks in 2015 and 2016 are to be hosted by Bulgaria and New Zealand, each showing the audience why everyone should join them to share their hospitality and culture.

Set up by energetic Congress Director **Azmi** with the Forest Research Institute Malaysia (FRIM), vice president **Rudolf Staiger** led an avid group of eco-conscious surveyors to plant 100 trees in an excursion called the Carbon Offset Tour into the Malaysian jungle to illustrate the

environmental concern that FIG holds for our world. Well done troops.

Opening and Plenary

The official opening ceremony heard the Malaysian prime minister **Abdul Razak** show a noticeable affinity with his nation's surveyors as well as an acute awareness for the essential done work by his professionals. The procurement of the country's top man for this ceremony sheds much credit on the LOC upon whom praise can be showered. The PM seemed to be most grateful for the gift of a polished brass historic theodolite, taking a peep through to the joy of the audience.

At the first Plenary Session vice president **Chrissy Potsiou** chaired the FIG Task Force on Housing and Property, highlighting Land Reform in Africa and the Global Land Tool Network - an initiative of UN Habitat.

Culture and social events

On Tuesday night the FIG Foundation staged a wonderful Malaysian cultural evening where visitors were invited to shape Royal Selangor pewter dishes punching their own name into the base with the first 100 participants being made a gift for their efforts. Other arts and crafts on show for participation were Batik designs in bright colours, wooden and wicker creations along with a tasty selection of traditional dishes and desserts. After the formal speeches refreshments flowed freely to the great delight of all who came along especially the Aussies! Under the leadership of US FIG stalwart **John Hohol** the event raised essential funds to assist worthy recipients in developing countries to live their dreams of becoming surveyors. A special congress sponsorship of eight young surveyors from places such as the USA, Africa and Morocco confirmed another generous award of FIG Foundation funds to enhance world surveying.

Technical sessions on Wednesday were many and varied, allowing me to sit in on a group of Scandinavian surveyors elaborating about the cadastral systems from Sweden, Denmark, Norway and Iceland. Head surveyor from Iceland Ms. **Margret Hauksdottir** was pleased to hear that I had visited her country in 2000 having met their President **Ólafur Ragnar Grimsson** who is still in the job 14 years later. On the way out of this session I was kindly invited to join the Finns at their cocktail party in the Sky Bar at the top floor of

Below: Standing firm if not tall with the silent army of Terracotta warriors.





Above: Two Eugene's and a gal make a party!

the Impiana Hotel, at which much optimism was expressed for winning the 2017 Working Week.

Straight from there my Welsh mate **Gethin Roberts** and I were fortunate to join the Commission 7 dinner at the "Rabbit in the Hole" restaurant where **Craig Hancock** had once again arranged the best value gathering of the FIG week. Myself and compatriots **Viktor** and **Inara Sikais** were also able to see our NSW Rugby League team win back the State of Origin trophy for the first time in nine years from arch rivals Queensland.

This year I did not need to take my proton energy pill to venture forth outside the DMZ to purchase a local songkok traditional hat for the Gala Dinner because after asking the local tailor across the road from my accommodation he rather incredulously plucked one from his cupboard so that my residence for the formal evening could be complete. The stunningly gorgeous violinist main act Dr. **Joanne Yeoh** in a star-spangled dress, which other Aussies reckoned had survived a shark attack due to the large piece cut out of the left side. She was superb and the fantastic singer with accompanying band provided sensational entertainment for the large crowd who were individually provided with food and drink by their own private waitresses/waiters. The ten-course Malaysian banquet was truly delicious.

History Symposia

The IJHSM was asked to conduct one of its customary History Symposia during the formal congress week on the Friday but it only attracted about 20 attendees due to varying factors which I will not go into. Regardless of the disappointing numbers, the audience were most receptive to my paper "The Great Wall

of China: The World's Greatest Boundary Monument", which had also just been awarded FIG Article of the Month in June this year.

The second day was rather better attended with a hundred or so. I had agreed to give a presentation for **Leonie Newnham**, whose scheduled Israeli presenter did not attend due to visa problems. Among the history presenters were our chairman **Jan De Graeve** talking on Mercator and Murad III's globes, Cambodian resident **Finn Jouni Anttonen** amusing the crowd with his surveying in Donald Duck and Mickey Mouse cartoons and **Galina Kovalevskaya** from Moscow University on the History of Russian Surveying. Two of our Malaysian hosts, Azhari and Zaki gave us illustrated tales of the levelling and first order survey control on their peninsula, finishing up with Aussie **Kelly Henderson** bringing us up to date with the project to put Colonel **William Light's** Town Plan of Adelaide onto the UNESCO World Heritage List.

Winners and losers

Elections for various positions and events took priority at the GA on Saturday with the FIG presidency of **Chrissy Potsiu** ratified by the gathering of members. The first vice presidency vote was a strong victory in impressive style to Prof. **Rudolf Staiger** with the second selection going to a hard fought 4th round of ballots in favour of the UK's own **Diane Dumashie** over **Mikael Lilje** by just four votes.

Finland was victorious over Vietnam and Nepal to host the 2017 Working Week as well as a majority acceptance of Turkey to stage the XXVI Congress in Istanbul during 2018. Following the summing up of the activities of a great week came the Farewell Reception put on by the hosts of next year's Working Week in Sofia, Bulgaria which promises to be a wonderful experience for all of those attending. Leaving a little early from these excellent refreshments my taxi driver broke all speed records to travel the over 70 kilometres to get me to the airport.

Congratulations must be extended to all responsible for bringing off this brilliant event with special appreciation to the FIG ladies **Louise, Hanni** and **Claudia** whose continual diligence to needs and details made our visit so rewarding and enjoyable. Well done must be offered to FIG President **CheeHai Teo** and vice president Rudolf Staiger for their apparently effortless control of formal proceedings and protocols. Congress directors Azmi and Hassan together with their fantastic team must be enthusiastically praised for making this congress one to remember for years to come in FIG History. Extra special kudos must go to the 330 attendees from Nigeria for such loyal support to FIG.

"Finland was victorious over Vietnam and Nepal to host the 2017 Working Week as well as a majority acceptance of Turkey to stage the XXVI Congress in Istanbul. . ."

FIG 2014: Geodesy, Point Clouds, Hydrography and Monitoring

Hundreds of papers were presented at FIG Kuala Lumpur. Here our technical editor **Richard Groom** pulls them together in a review of the science and engineering orientated papers. All of the papers can be found on the FIG website via the reference at the end of this article.

The hot geodetic topics were development of geoid models, continuously operating receiver (CORS) networks and monitoring for tectonic movement.

Gravity and geoid models

Roman et al's paper (TS01A) reviewed progress with the development of a geoid model covering the USA. The overall objective is to develop a model with centimetre-level accuracy to serve as a regional datum. The target date is 2022 and work is now going on to detect biases in the land-based gravity measurements. Aerogravity data contains signals, both at long wavelengths primarily detected by satellite gravimeters. They reflect large gravity features as well as shorter wavelength data observed by surface gravimeters and detect local anomalies. The authors have used this data to detect and correct inconsistencies in the terrestrial data. The Aerogravity campaign is called GRAV-D. It covers the whole of the continental USA and extends 150 km into Canada and Mexico.

GEONET is Japan's network of continuously observing GNSS stations. Since 2011 it has comprised 1300 stations. In fact it was operating just before the devastating earthquake of 2011. Miyahara et al (TS01A) describe how, in addition to producing 'standard' geodetic products, the network has been used for crustal deformation monitoring in near real time. Initial estimates of deformation are available within a couple of minutes for large events. In conjunction with the Japanese gravity geoid model (JGEOID2008), the GNSS COGR data from 850 stations has been used to establish the Japanese hybrid geoid model (GSIGEO2011). Following the earthquake, Japan's Geospatial Information Authority (GSI) re-observed the levelling of all affected stations. GSI also computed heights for the country's legacy triangulation stations.

Abd-ElMotall (TS02A) merges local and global gravity data to produce an ultra high-degree reference geopotential model and then to compute a gravimetric model of Egypt. He then fits the model to GPS / levelled points with improved results over other techniques.

Uzodinma et al (TS03A) have tested the accuracy of the EGM2000 geoid model over a 23 ha micro-environment at Enugu in Nigeria by comparison with GPS/ levelled control points. The differences are huge, suggesting that EGM2000-based geoid heights on their own do not yield sufficient accuracy over small areas.

Triarahmadhana (TS03A) evaluates the effect of the GOCE Global Geoid Model on

the accuracy of the local geoid in Indonesia. Terrestrial gravity data, SRTM30 plus data and five GOCE GGMs were used.

Moving plates

Several papers in sessions TS07A, TS08A and TS11A discuss the analysis of tectonic plate movement using GNSS and the development of deformation models to relate the geodetic references system to tectonic movements since the epoch when they were defined.

Sanlioglu and Kara (TS09B) compare auto-regressive and auto-regressive moving average models for computing GNSS time series. Their theory comes from analysis of commercial activity, for which there are four components: trends, cyclical fluctuations, seasonal fluctuations and irregular events. It is interesting reading for those involved in monitoring and the authors apply the technique to analysis of CORS data in Turkey. Spatial filtering techniques are also the subject of Yusufian et al's paper (TS11A) for the Bengkulu earthquake in Sumatra in 2007. They calculate strain compression and extension values through the event.

Pahlevi and Pangastuti (TS07A) describe Indonesia's Geospatial Reference System 2013, which uses a deformation model to cater for coordinate changes with time. The horizontal component is realised by a network of permanently operating and periodic geodetic observation stations. The deformation vectors will be updated following sudden changes caused by earthquakes. The vertical reference system is under development. Use of the new reference system is mandatory and services can be accessed via a website. The full article is well worth reading.

Chile's new reference system is realised via a network of 66 continuously operating GNSS stations (Rivas (TS07A)). The coordinate reference system is based upon the Geocentric Reference System for the Americas (SIRGAS). In 2002, the National Geodetic Network SIRGAS CHILE 2002.0 was set up and by 2010 there were fourteen continuous and 500 passive stations with 20mm accuracy. On 27th February 2010 there was a massive earthquake which caused horizontal movement of up to five metres. Following the earthquake, many new continuous stations were established and revealed interesting information concerning the movement associated with the earthquake. When the area had stabilised it was decided to re-measure the whole network. For the future it is intended to

“Aerogravity data contains signals, both at long wavelengths primarily detected by satellite gravimeters.”

“The objective is for the datum to be fully three dimensional and to support $\pm 20\text{mm}$ positioning at the 95% confidence level.”

develop a velocity model to provide continuity.

Australia’s new datum

Donnelly et al (TS07A) describe the development of Australia’s new dynamic geodetic datum, which has been developed in order to handle regional crustal deformation including continental drift of 70 mm per year and rotation of the tectonic plate by using a deformation model. The authors justify the new datum due to the growth in the demand for high accuracy absolute positioning by users going far beyond the world of surveying and the need to correct widespread distortions in the previous datum. The datum will be aligned to APREF, the regional realisation of ITRF. The objective is for the datum to be fully three dimensional and to support $\pm 20\text{mm}$ positioning at the 95% confidence level. It is planned that the new datum will be introduced firstly as a new static datum with epoch 2020, with the fully dynamic datum in place after that date.

Sweden upgrades

Lilje (TS08A) celebrates twenty years of Sweden’s national CORS network, SWEPOS, and ten years of network RTK. Sweden uses the VRS method to deliver corrections. A notable feature of the Swedish network is that it consists of two classes of CORS. Class A stations are mounted on substantial stable concrete monuments, whilst class B stations are mounted on existing structures, such as buildings. SWEPOS is now moving into its third generation, which will see upgraded receivers and closer spacing (around 35 km) between stations. This is being made in response to users who are looking for higher vertical accuracy for setting out and machine control.

In Sweden, each municipality has historically been self-governing and developed their own height systems. Kempe et al (TS07A) describe how these datums are being related to the new national spirit-levelled RH 2000 national height system and the benefits for the municipalities that will come from unified heighting. This includes facilities to help municipalities make the transition from their old distorted height networks to RH2000, by connection to the new network, analysis of errors and inclusion of additional observations.

Sea surface heights

Pangastuti and Pahlevi (TS02A) describe a technique of determining the sea surface height around Bali from Geo/GM satellite radar altimetry data, using “waveform retracking” of corrupted waveforms in shallow water to improve the computation of gravity anomalies around the island.

GNSS – what next

Van Cranenbroeck et al (TS11E) presented a paper taking a critical look at GNSS RTK and tackling a number of questions concerning the business case for this infrastructure, considering current technology as well as possible future development of PPP (precise point positioning) and processing in the cloud. This affects users as well as infrastructure operators and therefore well worth reading.

Sato et al (TS03B) introduce the Asia Oceania Multi-GNSS Demonstration Campaign. The campaign has three functions: the establishment of a multi-GNSS monitoring network, multi-GNSS application demonstrations and annual regional workshops. They have chosen the area because multi-GNSS comprising GPS, GLONASS, COMPASS, QZSS and IRNSS will be in operation in this area before other

Reinking and Harting (TS10J) advocate the use of precise point positioning to determine sea surface heights. They argue that there are 60,000 ships sailing the oceans and that if only a small proportion of

them carried the equipment a significant amount of additional data would result, which could be used to increase the sensitivity of satellite altimetry over short wavelengths and to validate altimetry biases.



Above & Left: Cruise vessel AIDAblu used in the sea surface height study and escort craft Oceanodroma, which was used for calibration of cruise vessel’s squat (Reinking and Harting).

parts of the world.

Harima et al (TS03B) have been using the LEX augmentation signal broadcast by Japan's Quasi-Zenith Satellite System (QZSS). LEX broadcasts at 2kbps, which allows for transmission of augmentation messages aimed at centimetre-level precise point positioning. One such message is "Multi-GNSS Advanced Demonstration of Orbit and Clock Analysis" (MADOCA). They obtain centimetre-level positioning after 2 hours of convergence using static PPP and decimetre-level accuracy after 1.5 hours of kinematic PPP.

Afifi and El Rabbany combine GPS and Galileo single-frequency observables for PPP. They find that sub decimetre-level PPP is possible and that the addition of Galileo improves convergence time by 30%.

Stocker and Duetschler (TS01B) describe a means of increasing the accuracy of in-built smartphone GPS receiver by connection to an external antenna, yielding an accuracy of 5cm. They describe how the system can be used for navigation and for GIS data collection.

New receiver

Kowalewski et al (TS09B) describe a project to develop a new GNSS receiver. Their company, navXperience GmbH already produces antennas and they are now intending to produce a receiver which allows the user to access all the signals and use their own software. For those of us who dislike black boxes, this sounds like good news. Currently, the authors argue that the GNSS market is controlled by the established manufacturers with proprietary hardware and firmware, which has inflated the price of the equipment – a situation that is good for the manufacturers' shareholders but bad for everyone else.

POINT CLOUDS:

Nowadays point clouds are produced from

photogrammetry as well as from laser scanning, and use various platforms.

Power line clearances

Tham (TS04B) describes a laser scanning system for identification of non-conforming electrical conductor spans which could start bushfires in Australia. On days of extreme fire danger the risk of electricity infrastructure causing bushfires is at its highest, through conductor to conductor and conductor to vegetation sparks. Tham uses PLS-CAD power line design software to check the clearances. Initially he has collected data using a static scanner but has now turned his attention to mobile laser scanning and intends to automate the data processing and analysis. He sees MLS as preferable over helicopter mounted scanning because the latter does not pick up thin wires sufficiently clearly.

Scanning v UAV

Friedli and Theiler (TS05B) compare long range laser scanning with UAV photogrammetry for surveying of archaeological sites in Peru. The product was a 10cm grid DTMs of the sites. The results are much as expected: terrestrial scanning is better for surveying vertical and sloping surfaces and seeing through vegetation, whilst UAV photography is better for horizontal surfaces on the top of hills and bare surfaces. For the laser scanning, they use filtering techniques to reduce the size of the point clouds. One of these is an Anoctree filter which is applied after merging the point clouds and removes points from the cloud to generate a cloud of constant density. Conversely, they interpolate where necessary.

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“For those of us who dislike black boxes, this sounds like good news.”



Left: A statue at the Palace of Versailles. You can learn more about this enormous project, described by Varea, by going to the next page of this report which is online at

<http://www.pvpubs.com/DigitalEdition/GeomaticsWorld>



A warm welcome was on hand for the 50 delegates who attended the first Pacific Survey Conference on Australia's remote island territory, reports our correspondent before he was off again on his travels for more dining and some tree planting.

Below: Dame Marie Bashir Governor of New South Wales plants an English oak.



The Norfolk Island Surveyors Conference

Just lately I have been busy flying to Queensland to show my 50 Years of TV Superstar Surveyors DVD to the North Coast (NSW) Group who held their two-day seminar at the Greenmount Beach Resort Coolangatta where my parents honeymooned in 1949, closely followed by an invited talk I gave at the Penrith Library west of Sydney on surveyor **George Evans**. But right before these commitments we were on Norfolk Island again.

FIG Norfolk Island

Without doubt my favourite place on earth is Norfolk Island where the mood is always friendly with a distinct historical ambience, so what better spot to hold a Surveyors History Conference!

For five special days 50 delegates were dazzled by the content and quality of the morning talks then thrilled by a diverse selection of activities that included an historical island and cemetery tours by the best guides on NI; a VIP Reception at the oldest Government House still used for administration on Australian territory hosted by the newly appointed Administrator, The Hon. **Gary Hardgrave**; a dinner that progressed through three local homesteads; the unique play "Trial of the Fifteen" with an island banquet joined by some of the cast; an adapted "History in the Making" tour by local history guru "Onion" Evans that took in two broad arrows carved into the verandah of the Administrator's office block, which was a Gunter's chain baseline check; and a "just for us" run down of the NI Government actually in the Legislative Assembly by Speaker of the House, The Hon. **David Buffett**. The events ended with a sumptuous island fish fry put on by the local Lions Club at the old Surgeon's Quarters that houses a vast historic photo display of NI's past including a picture of the first landing of an aeroplane in 1932 (before the 1942 wartime airstrip was built!).

With 14 speakers being non-surveyors it was wonderful to hear what others actually think of us and our contribution to the development of our planet including **Kerima-Gae's** "Surveyors Through The Eyes of a Non-Surveyor", which was more like a "Brocky Roast" highlighting some of my colourful if not eccentric antics whilst on tour with her, much to the uproarious delight of the crowd. With FIG International Institution for the History of Surveying and Measurement Chairman Prof. **Jan De Graeve** joining us from Brussels and former Surveyor-General of **Victoria John Parker** made a memorable

presentation on the evolution of the borderlines of Australia's states all of which are still in dispute at this point of time!

Tree Planting & Cocktail Party

The tenure of our greatest Governor (2nd longest serving after Sir **Roden Cutler** who was one day short of 15 years at the end of his reign) is coming to an end this year. **Kerima-Gae** and I have been lucky enough to show our warmest appreciation at two separate events where Prof. Dame **Marie Bashir** and her husband Sir **Nicholas Shehadie** were special guests. Patron of both Parramatta & District Historical Society and the Institution of Surveyors NSW, Her Excellency planted an English oak sapling propagated from one of the original trees growing at Hambledon Cottage (1824) planted from seeds brought back from England by **John Macarthur's** son Edward in 1817.

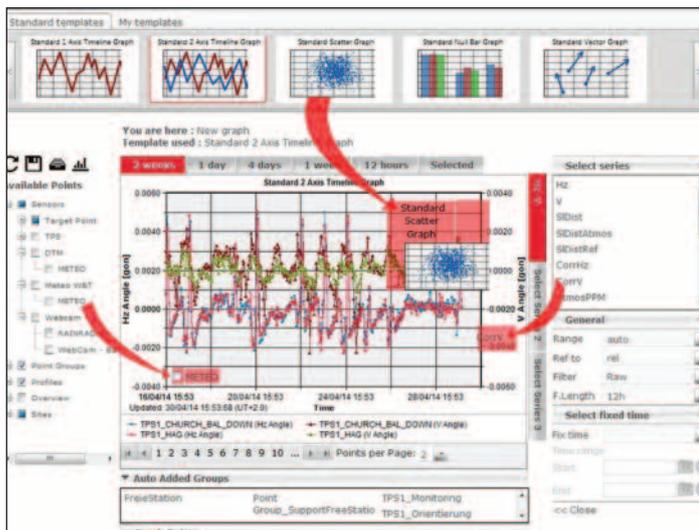
At the end of July the ISNSW Board showed its gratitude to our great patron and her equally dedicated husband at a cocktail party on floor 36 atop the Shangri-la Hotel at The Rocks. Aptly named the Altitude Restaurant the event was a wonderful reflection of just how much affection the ISNSW holds for this exceptional lady and her equally distinguished husband.

Tribute luncheon to league great

Having played in the 1971 E grade side (under 16's) for Cabramatta it was the first year that Rugby League great **Graham Murray** had played for this historic First Grade feeder club. Other top graders in the side present were Australian rep **Geoff Gerard** (the first player to reach 300 games at the highest level), **Ted Sulkowicz** and **Kevin Webb**. Our side from 43 years ago featured at the fund raising luncheon tribute to Muzza (who died one year ago) at which Graham's wife Mandy and daughter Kara spoke emotionally about their husband and father. At this event I bought a signed NSW Blues 2014 State of Origin jersey in a frame which I re-donated a week later to a Motor Neurone Disease fund-raising breakfast at Australian and Parramatta Rugby League legend **Mick Cronin's** pub at Gerringong (on the coast south of Sydney). After a silent auction the jumper fetched over \$ 1,000.00 for the charity which thrilled me.

• *John Brock is a Registered Surveyor in Australia and is a stalwart of FIG and its Permanent Institution for the Art and History of Surveying.*

GeoMoS Now!



Leica Geosystems has launched GeoMoS Now!, a web-based application that enables on-the-go visualisation and analysis of structural and ground movement monitoring data. Large amounts of geodetic and geotechnical data are now easier to handle with simplified workflows using automatic configuration and distribution tools that quickly notify users of any changes in data for faster, more informed responses. Because Leica GeoMoS Now! runs on local computers or servers on premises, the software can be fully integrated on the user's company Intranet server and data can be accessed from different locations within the company using only a web browser without any need for additional local software licences or installations on different computers.

Topcon releases MAGNET Relay for GIS

Topcon has announced the addition of MAGNET Relay for GIS to its suite of cloud-based software. As a component of MAGNET Field GIS, Relay GIS is a mobile base station RTK broadcasting service. The system is designed to allow subscribers to connect a GNSS base receiver via a cellular connection for high-accuracy RTK corrections.

Promap adds OS Terrain 5 and Terrain 50

Landmark Information Group has introduced Ordnance Survey's Terrain 5 and Terrain 50 height datasets in its Promap digital mapping and data tool. The datasets provide national coverage and enable access to detailed modelling of significant landscape and infrastructure features. Both datasets are available as a set of contours, along with spot heights and

mean high and low watermarks, as well as a gridded Digital Terrain Model (DTM) representing the bare ground surface (5m grid or 5m contour interval). The DTM product is also available as a 3D PDF that allows visualisation of the bare earth model without the need for additional processing or specialist software.

Appitrack for Nottingham tramlines

A pioneering, mechanised system for track construction, developed by Alstom Transport and Leica Geosystems, is driving the speedy, high accuracy delivery of two new tram lines for Nottingham Express Transit (NET). Construction work features Appitrack (Automatic Plate and Pin Insertion), an automated system designed to lay concrete slab track and insert base plates with speed, certainty and to millimetre accuracy. Leica Viva TS15 total stations and

Leica PaveSmart3D software position, guide and control the concrete paver and base plate insertion vehicle as they progress in convoy.

The new tram routes, operational by early 2015, will give more people in Nottingham access to clean, convenient and comfortable public transport in a city that is amongst the least car dependent centres in the UK. The expanded tram network will have the capacity to carry 23 million passengers a year travelling in and around the East Midlands capital for business, leisure and study.

Topcon releases ScanMaster v3.0

Faro's ScanMaster v3.0 brings efficient workflow for practitioners using third-party scanners. Enhanced cloud-to-cloud registration is expected to significantly reduce the need to place targets - even in the most challenging work environments. Additional features include: Faro file import options, ASTM E57 file import and export operations, point cloud library (PCD) file import and export functionality, cleanup and region selection tools, volume calculation and automatic edge set extraction.

Grasshopper

Point Grey has announced the introduction of the Grasshopper3 GigE Vision PoE camera family, an extension to the existing Grasshopper3 USB3 Vision product line. The Grasshopper3 GS3-PGE-23S6 models use colour and monochrome versions of the 1/1.2" Sony IMX174 Exmor global shutter CMOS sensor and offer image resolution of 1920x1200 pixels and frame rates of up to 46 per second.

New version of GlobeSpotter

CycloMedia Technology, has announced version 2.9 of GlobeSpotter. Following a user survey, a large number of changes were implemented to the user interface. Some key features of the update include

improvements to the main screen. Text and buttons were reduced to make the application faster and simpler to use, and an option to store settings online was added to maintain consistency in appearance for users, regardless of where they open the application.

New Topcon controller



Compatible with either the Topcon eGIS or MAGNET Field GIS software, the FC-500 is designed to create smooth and speedy dataflow between the field and office. The FC-500 has built-in wireless Bluetooth and wifi connectivity, and an optional 3.5g cellular modem, allowing interaction from users in the field, to the office, and additionally to the cloud when used with MAGNET Enterprise.

eGIS for Android

Topcon has announced the integration of the Android platform to its eGIS field software system. eGIS is designed to offer a simple and quick way to collect and maintain mapping data with GPS at various accuracies, including RTK (Real Time Kinematic). With the introduction of the eGIS for Android app, operators can use their Android-based smartphones and tablets to capture data.

Fast habitat mapping

Proteus FZC, a provider of satellite-derived mapping and classification services, has launched a fast-turnaround habitat mapping solution designed specifically for

Environmental Impact Assessments (EIAs). Through the service, Proteus delivers high-resolution classification maps of terrestrial areas onshore and of the seafloor in shallow-water marine environments.

OS Detail 3D data bundle

Landmark Information Group has incorporated Ordnance Survey's Building Height Attribute data as part of a new 3D Data Bundle, which combines OS MasterMap, OS Terrain 5 height data with the OS Building Height Attribute information. The bundle provides a full 3D representation of both the natural and built topography of a site and is ideal for developers, planners, surveyors and architects who want to review accurate site data as part of the survey and due-diligence process. The model is also suitable for 3D printing.

Persistent change monitoring

BlackBridge has announced a strategic partnership with MDA Information Systems (MDA), to introduce a new change monitoring solution. RapidEye Persistent Change Monitoring (RapidEye PCM) incorporates BlackBridge's RapidEye imagery into MDA's Persistent Change Monitoring (PCM) technology. RapidEye PCM makes for fast and simple updates to cartographic datasets. It applies MDA's patented change detection technology that uses scale- and sensor-independent algorithms to compare a stack of images over time and quickly identify areas with lasting changes. By identifying only lasting changes, such as new construction or permanent infrastructure changes, RapidEye PCM saves up to 90% of the effort and cost required than if the same area were scanned manually.

New long-range scanner



Maptek has announced the I-Site 8820 long-range laser scanner with a 20% increase in range, twice the data acquisition speed, 25% improvement in range accuracy and a new modular design. The I-Site 8820 is a modular system which can be configured to match site survey requirements. All the controls are built-in and the laser scanner is light enough to be carried single-handed. It also features an integrated high resolution panoramic digital camera for geotechnical and geological mapping and an in-built survey grade telescope for traditional back-sight workflow.



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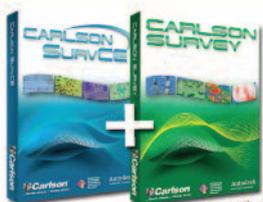
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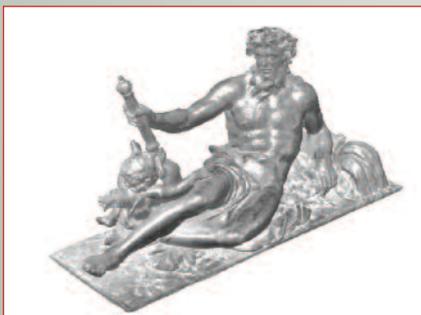


FIG 2014: Geodesy, Point Clouds,
Hydrography and Monitoring

Rokhmana (TS11B) has used UAV technology for surveying small islands off the Indonesian coast. Mapping of the islands is important because they are used as baselines from which to derive maritime boundaries. He uses a fixed-wing remote-controlled plane with point and shoot camera with GPS photo tagging powered by a Li-Ion battery for eight hours of operation. Flight planning was made using Ardupilot Controller open source software. Landings were made into a net, to avoid damage to the UAV. Saga-GIS was used to filter the DSM to produce DTMs, using slope-based criteria.



Left: Landing the UAV in a net.

Heritage

Yakar and Ulvi (TS05B) describe a survey of Kizkalesi castle in Turkey using laser scanning. It is located on an island 500m from the mainland. Control was observed by traversing around the site and coordination of paper targets fixed to the castle. The point cloud resolution was 15mm from twenty five scan positions to produce a cloud of 30 million points.

Varea (TS05B) describes a huge project to survey the Palace of Versailles. The work was carried out for Google as part of its Google Art Project. He used the Faro Focus 3d 120 for the interior and for statues and fountains in the gardens. A hundred thousand scanning stations were needed to complete the project.

Road repair

Seredovich and Altyntsev (TS05B) describe a system to identify and measure cracks and holes in road surfaces using mobile laser scanning with digital imaging. They describe two methods, firstly analysis of the laser return signal and digital imagery and the secondly of DSMs of the road surface. The authors also point out the value of comparing multi-temporal data to identify changes.

Modelling surfaces

Tang and Majid (TS05B) describe a technique for modelling surfaces using Adaptive Moving Least Squares (AMLS), which reconstructs the surfaces using a Delaunay/Voronoi based algorithm. They have tested it with the result that the smooth surface generated was within 0.17mm to 0.4mm of the scanned points. However, their examples are all small objects, such as vases.

TLS+LiDAR

Borkowski et al (TS08K) examine the accuracy of 3D building models created from a combination of terrestrial and aerial LiDAR. In particular they discuss how to register the two point clouds and examine modelling accuracy against the point clouds.

For those interested in seeing inside the

black box that tends to be digital photogrammetric processing; Strecha (TS09A) gives an insight and compares the accuracy of Pix4D with LiDAR.

Wan Mohd et al (TS10E) examine the height accuracy of digital terrain models derived from various sources. They compare IfSAR, LiDAR and ASTER digital terrain and digital surface models, digital topographic mapping – although it is not disclosed how the latter is produced.

Sadikin et al (TS10E) consider the use of UAVs for cadastral mapping of individual land parcels. In Indonesia, residential areas have to be mapped at 1:1000 scale, at which scale high resolution imagery is required over the small areas of each parcel. They look at various technologies including Balloons and Kites as well as fixed wing and rotor UAVs and come to the conclusion that quadrotors are the answer. However, they fix the position of the quadcopter using a robotic total station observing in reflectorless mode to the aircraft. The photography product is a mosaic rather than a model, in which the stability of the quadcopter minimises distortion due to tilt.

Amon et al (TS11B) have used a LiDAR scanner developed by Riegl for UAV platforms. Known as the VUX-1, it weighs less than 4 kg, has a measurement rate of 500,000 pps, accuracy of 25 mm and stores data onto an internal 240 Gb SSD card. GNSS and IMU units can be added to the scanner – with increased weight. The paper does not provide hard figures concerning the accuracy of point clouds observed in this way.

Stal et al (TS11B) have used a hectacopter to survey sixteen structures at Mayan sites to produce 3D models. Aerial and terrestrial images were combined to produce models of the structures. Ground control was observed using a total station. The paper includes explanations of structure from motion and multi-view stereo, which are useful.

Erenoglu et al (TS11B) have used aerial photography from an octacopter UAV

platform for geological mapping in Turkey using a Canon EOS-M mirror-less camera, which was calibrated using PhotoModeller. Photos were taken manually from a height of 70m and the DSM was processed in PhotoModeler Scanner software. The images were also classified using the RGB values reflected by the different rock types.

Xiaodong (TS07E) looks at use of an “L-estimator” method to compute close-range photogrammetric data containing gross errors and compares with conventional least squares, which is an “M-estimator” method.

Hamruni (TS02E) describes how vertical UltraCamD and vertical and oblique Pictometry imagery can be used to produce photo-realistic building models along with the possibility of merging the data with terrestrial imagery. The author compares the accuracy of aerial triangulation and modelling using different combinations of data, the completeness of models and quality of texturing.

HYDROGRAPHY:

Scheider et al (TS06J), examine in detail the positioning of vessels for multibeam bathymetry surveys of inland waterways in Germany. They provide a useful summary of the possibilities for GNSS positioning IMU and MEMS compass as a heading sensor. The system can also accept data from propellers and can include water level observation as a pseudo measurement, which could be a useful independent measurement of sensor position in the Z dimension.

Dapo et al (TS07J) used a sub-bottom profiler to measure the depth of sediment along 96 km of the River Bosut in Croatia. The river has historically been modified for flood prevention purposes but over time this has caused siltation and a loss of river capacity. They used a Syquest StrataBox sub-bottom profiler running on 10 kHz, which can penetrate 40m below the river bed. The instrument is able to detect layers of material with different acoustic impedance and thus differentiate between sediment layers. The data was analysed, cleaned, processed and vectorised using SonarWiz software and then imported into AutoCAD Civil 3D for modelling of the sediment layers. The method was checked using geomechanical core sampling to determine the composition of the sediments and also to check the depth.

MONITORING:

Bridges

Gikas et al (TS07E) describe a monitoring system for a single span cable-stayed bridge, which is intended to test and calibrate finite element modelling of the bridge deck, cables and pylons under static and dynamic loads. It consists of four independent systems providing complementary data. The system can also be used to assess optimum sensor placement and

De Wulf et al (TS07J) tackle the task of mapping the intertidal zone to detect archaeological features in Belgium. They provide a table comparing the various techniques and conclude that mobile terrestrial laser scanning mounted on an ARGO amphibious vehicle shows the greatest promise. Airborne laser scanning comes up with the same vertical accuracy and resolution as mobile laser scanning but the authors reject it on the grounds of expense and because it is affected by wind conditions, which are particularly difficult on the Belgian coast.



Above: ARGO vehicle with mounted with sensors (De Wulf).

integration. Techniques used include ground-based microwave interferometry (GBMI), digital image correlation (DIC), digital inclinometers and precise levelling. The paper makes a comparison between GBMI and DIC – the agreement between the two techniques is impressive.

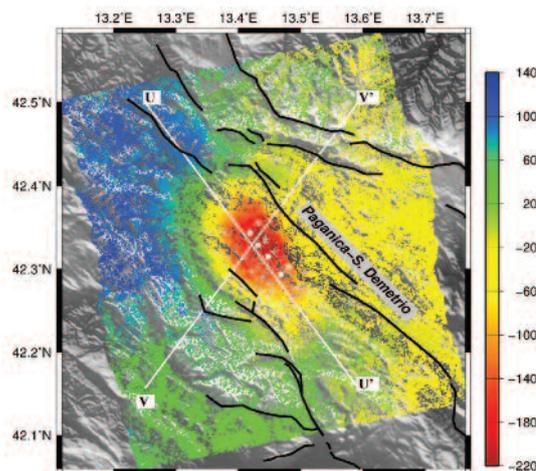
Roberts et al (TS08E) describe a GNSS-based monitoring system installed on the Severn Suspension Bridge with analysis and results from a short period of data and Babic et al (TS04B) present a case study deformation survey carried out using laser scanning of a heat exchanger in an oil refinery.

Data fusion

Data fusion is the subject of Van Cranenbroeck's paper (TS07E). He refers to the integration of geotechnical and geodetic sensors for structural deformation monitoring and provides as a case study, the monitoring of the old sports palace at the City Life project in Milan. It was monitored using a total station and geotechnical sensors. The geotechnical sensors indicated no movement but the geodetic sensor indicated uplift. Thanks to the combination of sensors he was able to conclude that the building was uplifted as a whole due to deep injections of concrete during construction.

Wireless sensor networks

Xu et al (TS08E) consider the use of wireless sensor networks for dynamic deformation monitoring using high frequency sampling. The paper looks at issues such as hardware and software selection, clock synchronisation, data compression and data loss and considers the processing of vibration monitoring data. There is no doubt that sensor networks will play an important part in the future of



Above: Pixels displacement field (line of sight) over L'Aquila earthquake zone between 6th Oct 2008 and 21st Sept 2009.

monitoring and this paper is useful for articulating the issues and solutions when dealing with high frequency data.

Slopes and faults

Lau et al (TS08C) report on research into the use of terrestrial laser scanning for slope deformation monitoring and examination of the results from using different scan resolutions, whilst Zeybek et al (TS10B) use periodic GNSS to monitor slopes

prone to landslide in Turkey and Sadarviana et al (TS11A) describe the results of five GNSS observation campaigns between 2002 and 2005 to monitor slopes in the Ciloto landslide zone of West Java. For the latter study, there were fifteen monitoring points within the slip area and two reference stations on stable ground. The types of slip can be determined from the direction of the movement vectors. In the case of Ciloto, movement has not been consistent at each campaign, indicating that rotational and translation slip faces are present.

Meier et al (TS09E) consider how to monitor a geological fault in a rock that could potentially be used for storage of radioactive waste. They use broadband seismography and hydrostatic levelling for the study to detect sub-micron displacements.

InSAR

Luo et al (TS10B) have studied the L'Aquila earthquake using InSAR by analysing scenes from ENVISAT ASAR taken between October 2008 and September 2009 and in so doing reveal ground movements before during and after the earthquake.

APPLICATIONS AND INNOVATIONS:

Airfield obstruction surveys

Schroth (TS07H) considers how to achieve aeronautical data quality (ADQ). ADQ is a new requirement of the International Civil Aviation Organisation (ICAO) and has to be implemented by 2017. Surveyors are responsible for capturing and maintaining obstacle, terrain and airport terrain data. ADQ demands structured electronic data with a defined accuracy, resolution and integrity. Documentation for personnel, equipment and software is required to support this throughout the work flow from the surveyor to airport authorities and on to national air traffic control organisations.

In Europe the exchange of all aeronautical data and information is based upon the Aeronautical Information Exchange Model (AIXM). For the AIXM, all common data has to be provided using the Unified Modelling

Language (UML) or by using a feature catalogue, the data has to include the fourth dimension to cover the evolution of features and comprehensive metadata has to be recorded. For spatial data encoding, GML has to be used. The surveys are based upon WGS84 and EGM96. All interactions with the data which affect its quality have to be recorded within the metadata. Surveying software is generally not able to deal with this although Esri's ArcGIS for Aviation and Bentley's Bentley Airport Data Model have adopted it already.

BIM from the European viewpoint

Clemen et al (TS08K) write about BIM. It's a subject much talked-about in the UK and their European viewpoint makes interesting reading. In particular, they see BIM as being able to offer 'views' of the building data, perhaps analogous to views of relational databases. Thus, for example, we have views for 2D graphical data, inventories of rooms or a virtual 3D model. This seems to differ from the concept of 'data drops'.

GPR

For underground utilities surveyors, Bell (TS11E) examines the use of arrays of GPR equipment for surveying underground. He considers what objects can be detected as well as productivity issues in the field by looking at multiple arrays and at combined GPR and laser scanning surveys as well as advances in post-processing software.

Collaborative positioning

Collaborative positioning may be a new concept to many. Kealy et al (TS01B) explain that it is a way to improve the navigation and positioning performance of a range of positioning techniques in places where GNSS will not work on its own. They introduce the concept of "the point of diminishing marginal utility for positioning". Traditionally all possible observations are used to determine position, but the authors suggest selecting the optimal set of measurements rather than trying to use all signals of opportunity.

VANET is a collaborative positioning system that involves vehicles sharing the data from their sensors with neighbouring vehicles along with observations of distance between the vehicles. The computation can also incorporate 'rules@, such as the need for the vehicle to be on a road, using digital map data.

Toth et al (TS01B) investigated the use of Microsoft Kinect sensors for indoor positioning. It uses both active and passive sensors. Its attraction is its widespread use as a games machine but it is restricted for surveying use by its short range and limited accuracy. The authors describe how, to some extent, accuracy can be improved through use of redundant observations and present the results for an experimental system.

Conference papers are published at: <http://www.fig.net/pub/fig2014/techprog.htm>

"... a way to improve the navigation and positioning performance of a range of positioning techniques in places where GNSS will not work on its own."