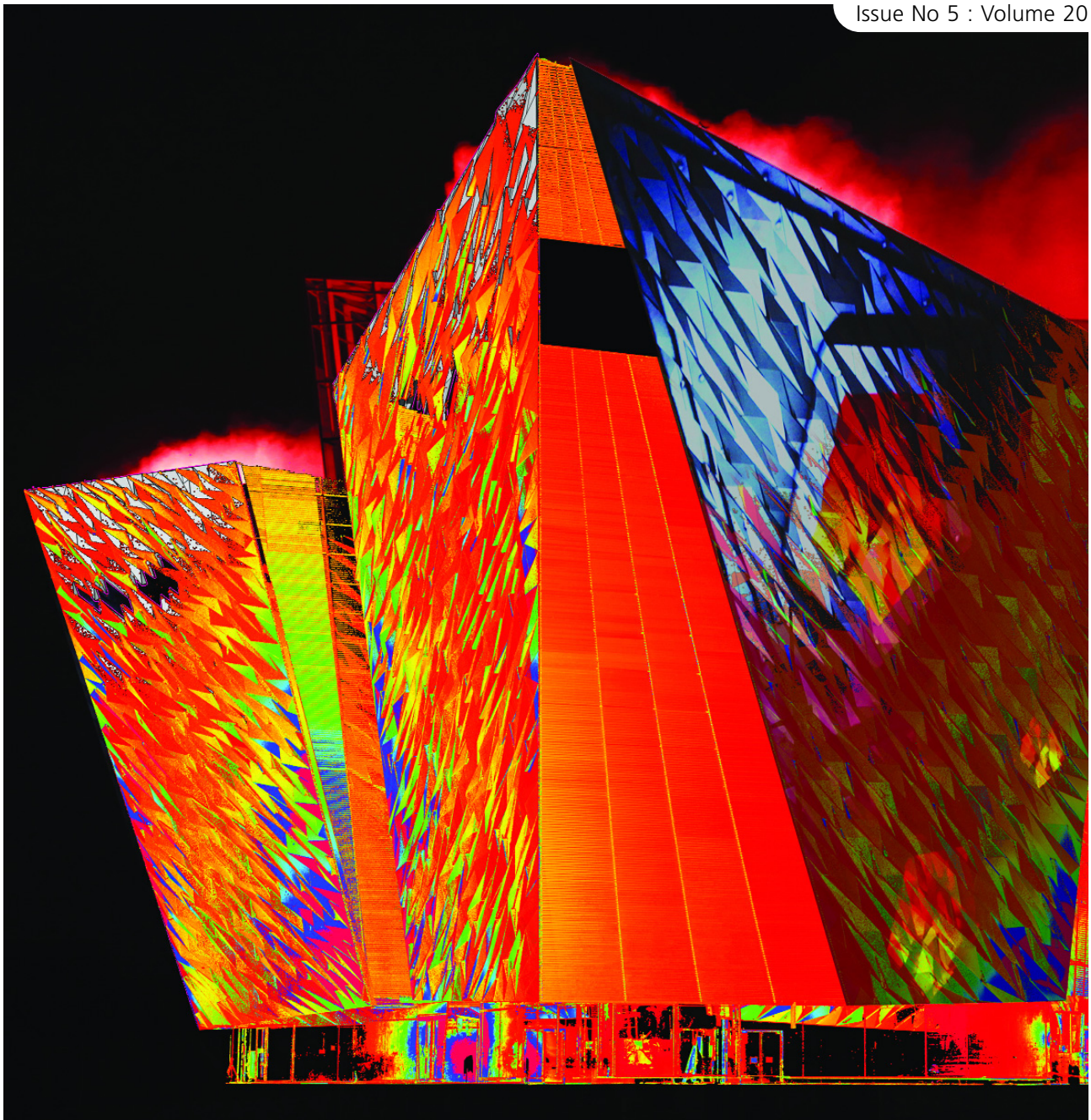
Geomatics World

JULY | AUGUST 2012

Issue No 5 : Volume 20

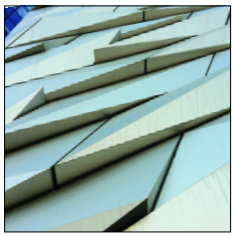


Surveying for geographical and spatial information in the 21st century

The world's most complex boundary dispute

Topcon's day in the sun with Spitfires and Hurricanes

Titanic challenge for scanners in Belfast



Hexagon's big conference goes cuddly

GNSS accuracy and interference: don't get the bird

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Read our service department article on page 19 for an insight into what a Service Technician's job entails.

Don't forget to make use of your free lens cloth for careful cleaning of your objective lens!

Leica Geosystems Lens Cloth

- when it has to be **right**

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Contents

Geomatics World is published bi-monthly by PV Publications Ltd on behalf of the Royal Institution of Chartered Surveyors Geomatics Professional Group and is distributed to group members and other subscribing professionals.

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Reprints: Reprints of all articles (including articles from earlier issues) are available. Call +44 (0)1438 352617 for details.

Advertising: Information about advertisement rates, schedules etc. are available in the media pack. Telephone, fax or write to PV Publications.

Subscriptions: Yearly subscription (six issues) is £45 (UK) £49 (worldwide). For more details, including special offers, go to: www.pvpubs.com
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© 2011 ISSN 1567-5882

Printing: The Manson Group, St Albans, UK

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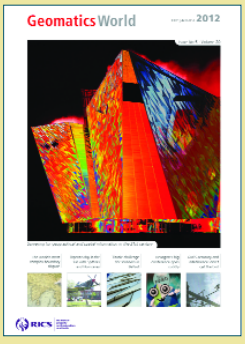
2B North Road,
Stevenage, Herts SG1 4AT
T: +44(0)1438 352617
W: www.pvpubs.com



COVER STORY
This spectacular image was captured by laser scanning the façade of Belfast's latest tourist attraction, the Titanic visitor centre. For the more turn to page 20.
Image courtesy of Coastway and seeper.

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– Hexagon buys into Blom

p.09 **Obituaries**
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A spectacular light show heralded the opening of Titanic Belfast but it was only possible due to some complex scanning and modelling.

p.22 **The world's most complicated boundary**
With nearly 200 separate enclaves, this is a truly complex international boundary. Brendan Whyte tells the enigmatic tale of Cooch Behar.

p.26 **Hexagon's own Las Vegas show**
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Would you like to receive the electronic version of GW?

Many RICS members overseas already receive an electronic version of *GW*. To receive the printed edition too overseas members must opt in. If you haven't already advised us please go to:

http://www.pvpubs.com/OverseasRICS

and register your requirements.

Meanwhile, UK and Irish readers and subscribers can also receive the electronic version, which is sent at least a week ahead of the printed copy, by emailing a request to **barbara@pvpubs.demon.co.uk**

Note: the electronic version can now be downloaded as a PDF and printed.

Next issue

The next issue of *GW* will be that for September / October 2012.

Copy dates are: Editorial: **6 August** Advertising: **17 August**

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Do members need to step up?

The powers that be keep us busy with plenty of goodies, while they decide the policy and the marketers try to steer our choices.

This is an exciting issue of *GW* and manages in too few pages to encompass hydrography, boundary surveying, GNSS, laser scanning and the latest technologies. First our thanks to Coastway for providing the spectacular cover image and the article on page 20. There is also a report on the FIG working week in Rome, which by all accounts was one of the best for many years, with FIG making a start on addressing the structural issues around its administration such as voting rights. Rome also saw the first and highly successful Young Surveyors conference, attracting over 120 delegates. More on page 12.

Filling the hydrography slot is an obituary on that great long-serving hydrographer Admiral **Steve Ritchie**; an obituary made easier as I was able to re-read and draw on much of his biography (see page 09). On boundary surveying, never was there a more complex or fascinating tale than that of Cooch Behar. Our thanks to **Brendan Whyte** for unravelling it for us from page 22.

For the techies (and aren't we all?), **Simon Canning** looks at some of the many causes of errors and interference when using GNSS. But don't get too alarmed: we also review the latest research into the quality and suitability of Britain's network RTK services, which reveals that in the hands of competent surveyors the industry has services which are fit for purpose (page 15). Staying with the technology , **Adam Spring** reports from last month's mega Hexagon user conference in Las Vegas (page 26) and **Richard Groom** has been catching up with Topcon's latest offerings (page 30).

I said 'too few pages' at the outset of this editorial because the GW editorial board would very much like to get back to the 52-page sized issues we published before the financial crisis. We have plenty of material but alas too few advertisers to support publication on this scale without an increase in support from RICS. Even your currently sized issue is difficult to sustain.

Despite the tough financial times most of us are going through, I sometimes wonder if there's not an unwritten agenda to keep us as busy as possible by offering almost unlimited choice, yet little influence over the final product or service. Intensive marketing often makes it very difficult to decide which product or service to choose, whether in our professional or private lives. Often the only way to reach a decision is to spend time trawling the Internet to see what other punters think (not always possible if it's brand squeaky new, so good luck to the early adopters).

Although we are spoilt for choice – making choice itself difficult – there is a growing democratic or participation deficit. I have mentioned this topic before. People either don't find the time or perhaps find it too difficult to engage in activities where they contribute to debate, whether being involved in running schools or professional bodies like RICS. The consequences are that, like governments, policy and decision making can fall into the hands of an autocratic elite who then try to manage any consequent unrest or rebellion. Our Geomatics Professional Group Chair **Stuart Edwards** makes this very point in his column (page 9). Too much RICS policy has been made without consultation with members. But for that to change it requires members to step up, participate and voice concerns.

Enjoy the rest of the summer. So far this has been atrocious in the UK, with predictions, as I write in weak sunshine, of yet another 'rinse cycle' from the weather washing machine.

Stephen Booth, Editor

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TEN YEARS AGO: from GW July/August 2002

The issue reported in depth on the Washington FIG Congress the previous April. The US capital was in heightened alert after the events of 9/11 the previous autumn. Professor **Peter Dale**'s judgement on the Congress was 'not a lot that was new but there was plenty of solid progress'. It was also the first Congress where PowerPoint really made a difference, contributing in many cases to the high standard of presentations.

The issue also reported on North Sydney's 3D urban model, a precursor to 3D GIS; an article by **Sarah Revell** and **William Mackaness** titled 'Porting geographic information to a Palm' was nothing to do with Dubai's 7-star hotel, but the suitability of a handheld PC for tourist information. We also reviewed one of surveying's seminal publications of the last decade or more: M*easuring America*. **Andro Linklater**'s book was a revelation in clearly anchoring measurement and land to the heart of a modern economy and how it came about.

Survey School's students awards

The Survey School's annual "graduation" ceremony of The TSA's Introduction to Surveying Course was held at Worcester in June. The Best Assignment Award, which is sponsored by CICES, went to Joshua Hackett of Tower Surveys and the 'Best Student Award' which is jointly sponsored by TSA and Leica Geosystems went to Geraint Christopher of The Environment Agency Wales. All graduates will receive a year's free subscription to Geomatics World.
Above: Back Row (l to r) Joshua Hackett, Tower Surveys (Best Assignment Award); Hamish MacDonald, Balfour Beatty Civil Engineering.
Front Row (l to r) Jonathan Scoble, Tesla-IMC International; Mark Devitt, J Brotherton & Partners; Shane Gallivan, Tower Surveys; Geraint Christopher, Environment Agency Wales (Best Student Award).

Kavanagh keynotes in Nice

Director of the RICS' Land Group **James Kavanagh** recently gave the keynote address to an audience of over 80 at the 6th Optech user conference, held in Nice France. He focused on the evolution of laser scanning from an expensive niche technology into one that can be accessed by many professions. He emphasised how RICS has continued to update members on this technology and has integrated laser scanning and other high-tech areas into its standards and guidance notes.

Kavanagh also questioned which other areas might exist for these technologies within mass appraisal systems for city planning and 3D modelling, dispute resolution, building information modelling etc. He also highlighted how other once complex geo-technologies such as GIS and GPS (GNSS) were now ubiquitous and how laser scanning is starting to explore serious business potential with non-traditional users. These developments make communication with a new type of client essential and will bring a renewed focus on what the client expects, in a language they can understand. The global real estate industries are particularly ripe for this kind of high technology and it is vital that RICS remains abreast of developments in these cutting-edge areas. The June 2012 issue of the RICS monthly magazine *Modus* focuses on communication and technology and features an article on 3d data sharing that highlights the future use of laser-scanned information, GIS and city modelling (**www.rics.org/modus**).

The conference featured two streams with highlights such as Developments in 'automatic feature extraction' – a real killer app for unlocking the vast amount of data within a laser/LiDar point cloud; the legacy aspect of future BIM modelling and the advent of integrated laser scanning/terrestrial LiDar systems; the health and safety applications of high accuracy laser scanning – a presentation featured a 'avalanche testing centre' in Stryn, Norway – and the use of scanning in conjunction with bathymetry for harbours, ports and other coastal features. Companies such as NetSurvey presented on integrated marine and land based datasets, Dr **Tim Webster** highlighted ongoing coastal erosion surveys in Nova Scotia and the survey team (Codevintec) presented on the critical survey and monitoring carried out during the *Costa Concordia* cruise ship disaster in January this year.

RICS at World Bank conference

The annual World Bank Conference on Land and Poverty brings together governments, civil society, academia, the private sector and the development community to discuss issues of concern to land practitioners and policymakers worldwide (see **http://www.landandpoverty.com/**).

Under the theme of *Land Governance in a Rapidly Changing Environment*, the 2012 conference provided a forum to discuss innovative approaches to dealing with different aspects of land governance in the context of structural change and economic transformation, climate change, increased demand for key natural resources, urban expansion and (post) conflict in a pro-poor and gender-sensitive perspective. The conference has been growing each year and this year attracted over 500 participants from 85 countries. RICS was represented by **Richard Grover** and **Robin McLaren**. Both are RICS FIG delegates.

Some sessions such as those on Land Governance Assessment Framework (LGAF) and the FIG sponsored workshop on Spatially Enabling Government and Society (SEGS) stand out. The latter session segueing with the recent release of the FIG publication *Spatially Enabled Society* (**www.fig.net**).

The conference also provided a platform for the RICS publications *Crowdsourcing and Land* and *Administration* and *Land Markets* (**www.rics.org/geomatics**).

A full report from the RICS delegate **Robin McLaren** is available to download.

Scholarships for PhD students

FIG, the international surveying body, has announced a series of Foundation Scholarships. The FIG Foundation Board is inviting applications for a 20,000 euro academic research grant and for 4,000 euro scholarships to PhD students. The closing date for applications is 30th July and for the scholarships is 1st November. For more details visit **www.fig,net/figfoundation**.

Digital mapping history

Converting Great Britain's basic-scale mapping to a digital form, 1962-95 is a history of OSGB's history from the early 1960s to the mid 1990s. Written by insider Peter Wesley, who held several posts including director of sales and marketing at Ordnance Survey. The detailed account relates how OSGB moved its basic scale mapping from tentative work on large mainframe computers to networked desktop PCs. Robin Waters reviews this personal account in the latest edition of *GIS Professional* (**www.gisprofessional.co.uk**).

All set for Intergeo 2012

The world's largest event for geodesy, geoinformation and land management is set for 9-11 October in Hanover. The signs bode well: three-quarters of the space in Halls 8 and 9 in Hanover has already been reserved. Some 15,000 trade visitors and 1,400 conference participants from around the globe are expected to attend the event, which is hosted by DVW, the German Society for Geodesy, Geoinformation and Land Management. For the first time, the CLGE (Council of European Geodetic Surveyors) is inviting its members from 35 countries, including all EU member states, to take part in a conference as part of Intergeo on 11 October. More at **http://www.intergeo.de**

Important correction

Several errors crept into **Mike Curtis'** obituary in the May/June issue of *Geomatics World*. His first wife was **Pauline** and not Jean. Also his children were **Mark** and **Helen** (and not Hannah). An amended version of the obituary is available for RICS members and subscribers in *GW* online at **www.pvpubs.com**. We very much regret any embarrassment caused to Mike's family and friends.

Business

Blom's subsidiary in France has signed a contract with IGN, the French national mapping agency, for an airborne LiDAR survey and production of flood models in the south of France. This is a huge project for IGN and will cover all areas at risk from flooding. Last year areas in France saw devastating floods that were the worst since 1827. The project will be completed within one year.

Geotechnics company, itmsoil, has undergone a management buy-out led by CEO Mark Kirkbride, who has overseen growth of the company to nearly £30m turnover since he joined in 2010. itmsoil, which employs 180 and is based in Uckfield Sussex, is a UK leader and ranks in the top four worldwide, both for the design, manufacture and supply of instruments and for installation and monitoring services to the construction and insurance industries. The firm's state-of-the-art instruments are used to monitor the stability of infrastructure, tunnels, mines, dams and roads.

Topcon Europe Positioning and FARO Europe GmbH have signed a strategic partnership agreement that will see Topcon selling the Focus3D laser scanner in most European countries, the Middle East and Africa. The agreement does not apply to the UK where Korec supply the Focus3D.

Andrew Blogg has left Korec to start his own company in the UK using unmanned aerial vehicles for digital mapping and survey. More at www.dmands.co.uk/

In a surprise move Hexagon AB is to acquire a 25 per cent stake in Blom ASA for a approximately €9m. Hexagon has over 13,000 employees in more than 40 countries with net sales of about €2.2bn. **Ola Rollén**, president and CEO of Hexagon AB said, "With this investment, Hexagon secures access to high-resolution and up-to-date geospatial information, which is becoming increasingly important to our entire customer base, especially within Intergraph, where access to such data provides the foundation for industry-specific software solutions". For Blom, such a close relationship "will. . . be a support to our competence and help us achieve our long-term strategy", said **Dirk Blaauw**, CEO Blom ASA.

Dave Shandley of Mobile GIS Services Ltd, specialists in data capture and GIS mapping software, has been appointed a UK dealer for Spectra Precision's Ashtech range of mobilemapper GPS and GNSS data collectors.

Following the launch last

Speedy's Spectra Precision range

Speedy has announced investments in a new range of Spectra Precision/Nikon total stations. Spectra Precision is a Trimble division with a products that include GPS, optical total stations, and data collectors, as well as field and office software. The range includes the FOCUS 30 robotic total station (for which Speedy has exclusive UK sales' rights) and both the Nikon Nivo 5.C and the 5.M total stations. The launch of the partnership took place at Hillhead Quarry last month, with Speedy's Steve Mokler (left above) and Trimble's Ian Pennington.

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December, Astrium's Pléiades satellite's 50-cm-resolution products are now available. Products are available at two processing levels – primary and ortho, in all spectral combinations. You can also order archive or tasked satellite imagery per sq.km over an area of interest.

Bill Blake, formerly with English Heritage, recently demonstrated the successful use of kites equipped with digital cameras in capturing aerial imagery. Most of the applications were fairly close range but included hard to reach features of tall buildings such as churches. Bill has captured some stunning images and showed them to good effect at a recent exhibition in Cambridge. Bill blogs at http://billboyheritagesurvey.wordpress.com/ and his site is a mine of interesting things if you work in the heritage sector.

BRIEFS

The 8th FIG regional conference is scheduled for 26-29 November 2012 in Montevideo, Uruguay. Organised by FIG and the Asociación de Agrimensores del Uruguay (AAU), the conference will be held at the Radisson Hotel in the centre of Montevideo. The theme is "Surveying towards Sustainable Development". Papers from professionals dealing with this subject are invited to submit abstracts by 15 August 2012. More at **http://www.fig.net/**

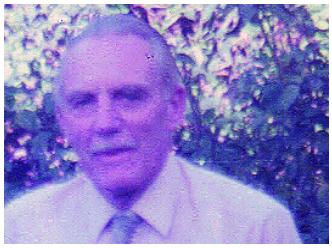
ISO, the international standards organisation and the International Hydrographic Organization (IHO) have signed a memorandum of understanding to increase their cooperation. The move aims to strengthening the existing cooperation related to hydrography and nautical charting and related data, products and services, and seeks to avoid duplication of work.

Great Britain's national mapping agency, OSGB, has won a top Sustainable Achievement Award. The base for 1000 staff, Explorer House, is one of the most sustainable buildings of its kind in the country. Immediately the building was occupied the organisation's carbon footprint fell by 60%. The building has already received a BREEAM 'excellent' rating, an accolade that applies to buildings with high green credentials.

The Technical Committee for the International LiDAR Mapping Forum, to take place in Denver, USA, February 11-13, 2013, has announced a call for papers and invites interested parties to submit their abstracts by September 28, 2012 online. The ILMF Technical Committee, led by conference chairman **Alastair MacDonald** from TMSI, will peer review each abstract and the final programme will be announced in November. For a full list of topics, please go to **www.lidarmap.org/conference**.

PEOPLE

John Maynes



It is with sadness we record the death of John Maynes, former lecturer at NELP.
Dr **Arthur Allan** adds: John (Chalky) Maynes was for many years a lecturer in Civil Engineering and Engineering Surveying at South West Essex Technical College. He is well known to a wider audience as the third author of the successful textbook, by Allan, Hollwey and Maynes, known to students as "Any old way and means".

John used his wide experience in civil engineering, gained in the Royal Engineers and municipal surveying, to hone his teaching in a focused manner. He loved the theoretical and mathematical basis of the subject, and covered blackboards with extensive mathematical derivations. For this he was given his nickname "Chalky". He was much respected by students and colleagues for his integrity, common sense, and charm. He retained an interest in surveying in his retirement as seen from his contribution to the booklet "Parallax Papers". Our condolences are extended to his widow Winifred and family.

Mavis Hollwey

Former students of land surveying will be saddened to learn of the recent death of Mavis Hollwey, writes Dr **Arthur Allan**. Mavis doubled up in two separate roles at South West Essex Technical College and its later derivations. As **John Hollwey's** wife, she provided much hospitality enjoyed by students and staff alike; whilst in her own right she was much valued as a lecturer in mathematics. Her experience as a map officer (computing) with the Directorate of Colonial Surveys, and as a surveyor's wife in Ghana, enabled her to slant her maths teaching in a relevant manner. After John's premature death in 1989, Mavis busied herself with much charitable work and family life. We extend our condolences to her three children, Michael, Helen and Charles and their families.

Chris Gray

Formerly with GBG, The Getty Trust and English Heritage, **Chris Gray** is on the move. He has rejoined the Los Angeles based Mollenhauer Group as director of business development to expand their operations, including in the UK, where deliverables of BIM have certainly established a lead in the US market place.

Worms joins Topcon

Topcon Europe Positioning has a new general manager. **Rene Worms** will be in charge of the company's positioning business in Europe, reporting to managing director **Tony Hirayama**. Worms was previously a member of the Leica Geosystems EMEA management team, and was responsible for Leica's geomatics business in North Western Europe.

Lennartsson joins Handheld

The Handheld Group has appointed **Nils Lennartsson** as service and support manager based at headquarters in Lidköping, Sweden. Lennartsson has military training and has worked in senior positions in the construction industry. Welcoming him, Jerker Hellström, CEO said, "Over time, what will differentiate one manufacturer from another is their respective ability to offer soft added values such as superior service and support. The addition of Nils adds yet another piece of that puzzle for us."

EVENTS CALENDAR

ISPRS 2012
25 August - 1 September, Melbourne Convention and Exhibition Centre, Australia. *Contact:* www.isprs2012.org

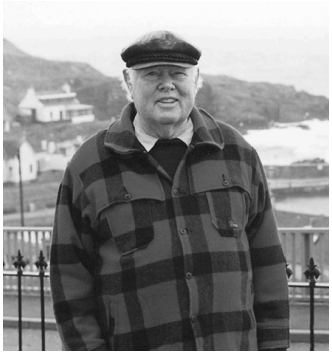
AGI GeoCommunity '12:
18-20 September, East Midlands Conference Centre, Nottingham, UK. *Contact:* www.agi.org.uk/geocommunity/

Intergeo 2012
9-11 October, Hannover, Germany. *Contact:* www.intergeo.de

Trimble Dimensions 2012
5-7 November, Mirage Hotel, Las Vegas, Nevada, USA. *Contact:* www.trimbledimensions.com

SPAR Europe 2012
12-14 November, The Hague, The Netherlands. *Contact:* www.sparpointgroup.com/Europe/

8th FIG Regional Conference
26-29 November, Montevideo, Uruguay. *Contact:* www.fig.net/uruguay/



Admiral Steve Ritchie, CB, DSC

1914-2012

Very few of us are blessed with a life spanning more than nine decades let alone three or four distinctive careers. Rear Admiral George Steven Ritchie who died in May was born during the first world war and went to the naval college at Dartmouth as an officer cadet at the age of 13.

Born of Scottish parents, Ritchie went to sea at 17 joining the Hydrographic service inspired by a chance meeting with Admiral Sir **Frederick Learmouth**, a friend of his father's. There followed early experience in the South China Sea, while the outbreak of war in 1939 found him back in home waters to provide control for mine laying. Next came an abortive trip to Suez and Singapore, which diverted first to Labrador due to U-boats and then to Rio de Janeiro for "a very important cargo" which did not materialise. Nevertheless, Ritchie somehow managed three days of bliss with his wife to be on Copacabana beach!

After marriage in Cape Town, it was off to the Middle East under Admiral "Egg" **Irvine** to survey the Bitter Lakes and for training in the Army's Special Boat Section. Using folding canvas canoes Ritchie and a colleague developed a method for beach profiling in darkness, which they used to survey a beach behind enemy lines in Libya and for which he was awarded the DSC. The system was perfected later in the war and used to good effect ahead of D-Day.

July 1943 found Ritchie involved in the Allied landings in Sicily. Joining the Americans briefly, he was involved in the commandeering of a train to reach British lines at Syracuse. On the Italian mainland he was briefly accused by the MPs of running a brothel before hitching a lift back to Britain via a US DC3 loaded with turkeys for Christmas in Algiers.

Back home he joined *HMS Scott* and took part in rehearsals for D-Day before joining the invasion, where the ship was tasked with clearing mines and establishing safe navigation channels using acetylene gas accumulator lighted navigation buoys (AGAs) and the then novel QM system that used hyperbolic position lines generated by low frequency continuous wave transmissions from two or more fixed stations. The system was to lead to the post-war Decca Navigator system and, later, Sea Search and HiFix by which most early offshore oil exploration was positioned.

When peacetime came Ritchie was involved in mine clearing and wreck charting before the chance of a lifetime. He was briefly given his first command, *HMS Scott*, before taking command of *HMS Challenger* in Bermuda for a two-and-a-half-year world cruise with a team of scientists aboard to follow in the tracks of the ship's predecessor in the 1870s which circled the world for three years on an oceano-graphic mission. Ritchie's voyage included the recording of the then deepest soundings, the Challenger Deep at 10,900 metres. He also commanded the New Zealand survey ship *HMNZS Lachlan*, *HMS Dalrymple* and *HMS Vidal.*

In 1966 he joined the select band of Hydrographers of the Royal Navy, the 19th since the post was founded by **Alexander Dalrymple** in 1795. The post is usually for five years and under Ritchie's leadership the Hydrographic Department underwent radical change that paved the way for the modern digital age of sea charting. He oversaw the move from engraved plates to digital drafting. New colour printing presses were installed at Taunton though Ritchie had to tread carefully with the unions, ever watchful for their members' pay and conditions. This was also the time of metrication and Richie bravely took on the establishment (not to mention the formidable **AP Herbert** who founded a "Friends of the Fathom" club) and drove through the change to metres for soundings shown on Admiralty Charts. Without that move today's worldwide coverage, bringing with it considerable sales, would not have been achieved.

Ritchie also oversaw enthusiastically the adoption by the Department of computer technology. The period saw the first satellite navigation systems, digital echo sounders and auto-mated data logging and chart plotting onboard vessels.

A significant footnote to his period as Hydrographer concerned the ageing *HMS Protector*, which provided a British presence in the Antarctic. Ritchie argued that a continued presence was essential and managed to get funds to purchase an ice protected merchantman, the *Anita Dan* from Denmark. Renamed *HMS Endurance*, the ship served in Antarctic waters until a careless government announced her withdrawal in 1982 and became the trigger for the Falklands War.

Following his retirement from the service in 1971 he leapt at the Navy's training scheme for preparing servicemen for civilian life. He chose bricklaying and decorating.

Next came a period in academe at Southampton University as a senior research fellow where he studied historic developments of hydrography in Europe. Although his appointment was for three years election to President of the Directing Committee of the International Hydrographic Bureau in Monaco intervened, a post he held for ten years. During his tenure he oversaw the publication of the fifth edition of the Gebco charts (1982) in time for its use by UNCLOS (United Nations Commission on the Law of the Sea) as well as the establishment of the worldwide system of radio navigational warnings that divided the world into 16 Navareas. Ritchie's time at the bureau saw the admission of Russia and China, which he had actively encouraged.

Following his retirement from the IHO he lived at his family home at Collieston, Aberdeenshire where he took a close interest in local affairs including chairing the harbour trust and founding a boules team. Here he wrote his autobiography and a new edition of the history of *The Admiralty Chart*; also as "The Old Hydrographer" he authored a regular column in *Hydro* magazine for several years, each one a pithy perceptive piece of hydrographic or naval history.

Steve Ritchie received many honours including the Founder's Medal of the Royal Geographical Society, the Gold Medal of the Royal Institution of Navigation and was the founder president of the UK Hydrographic Society. In 2004 he was thrilled to be honoured by the UK Hydrographic Office, which named a new archive repository The Ritchie Building at Taunton. It was opened by HRH the Duke of York, escorted naturally by Rear-Admiral Ritchie.

Throughout his long and illustrious career and despite his senior rank Admiral Ritchie remained a hugely personable sailor with a mischievous fun loving approach to life He was the life and soul of many Hydrographic Society functions and was an immensely popular figure among all who had the fortune to meet and talk with him. It is extremely sad that both he and Admiral **Haslam,** who succeeded him, both as Hydrographer and Director at the IHB have passed away. Both will be sorely missed.

Steve Ritchie is survived by his daughter Tertia and sons Paul and Mark.

• The Editor would like to acknowledge Richie's own biography, *No Day Too Long: An Hydrographer's Tale*, with a foreword by the late Prince Rainier of Monaco. Also acknowledged is his entry in *Wikipedia*.

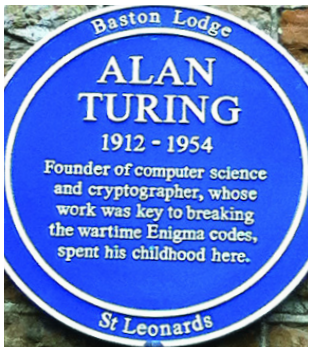
A mystery wrapped in an enigma machine

By Malcolm Draper

Exhibitions, gigs, meetings and saying goodbye to old friends, and who needs artificial intelligence when natural stupidity is much more interesting.

I apologise to fans of this column for its absence in the last issue. I understand the Editor was under pressure to find space for two important obituaries. Indeed they were important. The loss of Mikes **Curtis** and **Cooper** so close to each other really was a terrible loss. I got to know Mike Curtis with his second wife Sandra in the months before he died as he lived nearby.

Professor Mike Cooper, who I first met at the Washington FIG in 1974, I got to know very well. He was someone with an enormous range of interests – music, poetry, history, wine and of course his championing of the 17th century surveyor **Robert Hooke**. I recall him telling me about one of Hooke's field books from a survey of part of the Thames embankment after the Great Fire of London. Some sand fell out, captured in the binding all those centuries ago! I regarded Mike as a good friend. A great loss.



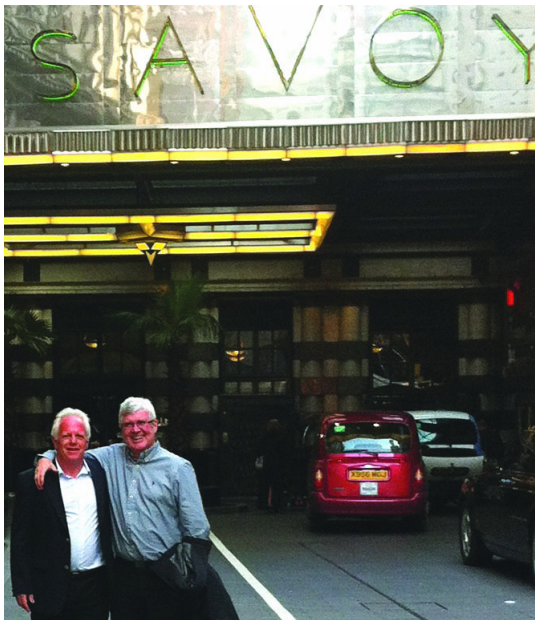
Enigma man's 100th

This year marks the hundredth anniversary of the birth of the computer genius **Alan Turing**. It was largely his work that helped Britain rapidly solve the German Enigma machine's coded messages. He was also at school in St Leonards on Sea, a town with which I have close family connections, and which marks his home with a blue plaque (left). Interestingly, it's only 50 yards or so away from author Rider Haggard's house. So I was rather looking forward to the Science Museum's exhibition to mark the man (*Code Breaker: Alan Turing's Life and Legacy*).

Frankly I was disappointed. The exhibition is very small and like too many of these things doesn't appear to follow a logical path of the person from birth to death. Casual visitors with little knowledge of Turing might come away with the idea that he was something to do with bombs and aeroplanes. Centre stage is a section of a wing from the Comet jet airliner that crashed in 1954 (Turing's work led to advances in computing that enabled the experts to unravel why the aircraft crashed). Close by is an RAF bombsight mechanical computer widely used during the war but which had nothing to do with Turing. What he did design of course was the 'bombe', a rotary electronic switch assembly which enabled the code breakers at Bletchley Park to rapidly calculate the Enigma machine's settings for that day – an essential key so the Colossus computer could crack the coded messages.

Perhaps the most interesting aspects of the exhibition were early letters from Turing and the post mortem of his death, which confirmed the cause as cyanide poisoning although I've read recently on the BBC's website that the evidence would not be good enough today to confirm a suicide. There was no mention in the post mortem of the enigmatic apple he left beside his bed and is supposed to have taken a bite out of before his death (some believe the apple was the inspiration for the Apple computer logo). To paraphrase Churchill, his death remains a mystery - literally - wrapped in an enigma.

I believe there is a much better exhibition at Bletchley Park itself so we'll try to bring you a report on that in a coming issue of Undercurrents. In the meantime I have to confess I am ambivalent about a pardon for Turing's homosexual activities. Our local paper in Hastings has been full of it with big features demanding an apology backed by the local Rainbow Alliance. It was only on my prodding that they actually ran a feature honouring the man's achievements. I also note that Turing is to be honoured with a stamp and some campaigners are demanding that he features on a new bank note. I just hope it's not a nine-bob one (younger readers please seek guidance from your elders).



Older surveyors may remember Spencer Nightingale who worked with me in the 1980s in the Middle East and Africa. Spencer is a Kiwi but did well in Australia where he worked for the Queensland Harbour Authority. I met up with him recently at the Savoy in London when he was on a bit of a world tour. After leaving London's top hotel Spencer was off to New York courtesy of the new liner Queen Elizabeth. Nice to hear of a surveyor 'who done well'.

South with Scott to Kensington

I visited a much better exhibition at the

Natural History Museum in Kensington. I went with our *Overcurrents*' columnist, **Nick Day**, who is over from California. Scott's Last Expedition tells the story of Captain Robert Falcon Scott's expedition to Antarctica in 1910-1913 aboard the *Terra Nova*. Displays are set within a life-sized layout of Scott's hut, the original of which survives in Antarctica, with artefacts used by his team with scientific specimens, appearing together for the first time. The exhibition really is superb so don't miss it if you're in London. It's on until 2 September.

Miscellany

Alan Turing was a scientist fascinated with the potential that one day we would be able to talk to machines, computers. His "Turing Test" has become famous, i.e. for a human being to be unable to detect whether he is talking to a machine or another human being. I suspect he would have liked a comment I read recently from an academic who said "My science colleagues are interested in artificial intelligence. I am much more interested in natural stupidity." There's a lot of that about.

*****

You know how irritating mobile phone users are when they fail to exercise discretion and think the world needs to know their business? In this tale an irritated commuter scores for the whole carriage. After a busy day the occupants of a carriage of a Waterloo train settle down for a nap or quiet read. A chap hauls out his mobile and starts up. "Hi darling it's Peter, I'm on the train – yes, I know it's the 6.30 not the 4.30 but I had a long meeting. No, not with that floozie from accounts, with the boss. No darling you're the only one in my life. Yes, I'm sure, cross my heart" etc, etc. This was still going on at Wimbledon, when a young woman opposite, driven beyond endurance, yelled at the top of her voice, "Hey, Peter, turn that bloody phone off and come back to bed!!" Brilliant.

*****

Our next tale concerns chickens. Scientists at NASA built a gun specifically to launch standard 4lb dead chickens (remember the good 'ol US of A still uses Imperial measures) at the windshields of airliners, military jets and the space shuttle, all travelling at maximum velocity. The idea is to simulate collisions with airborne fowl to test the strength of the windshields.

*****

British engineers heard about the gun and were eager to test it on the windshields of their new high speed trains. Arrangements were made, and a gun was sent to the engineers. When the gun was fired, the engineers stood shocked as the chicken fired out of the barrel, crashed into the shatterproof windscreen, smashed it to smithereens, blasted through the control console, snapped the driver's back-rest in two, and embedded itself in the back wall of the cabin, like a bullet.

The horrified Brits sent NASA the disastrous results of the experiment, along with the designs of the windshield and asked the US scientists for suggestions. NASA responded with a one-line note, "Defrost the chicken."

My band, the Hangovers, has continued to be busy this year. Back in May we raised £6970 for the Royal Marsden Hospital's cancer unit. An amazing sum, given that there were only 230 paying guests (okay a few more slipped in under the wire).

*****

A few more of those wonderful two-liners from the Washington Post's poetry competition that calls for the most romatic first line and the least romantic second.

I thought that I could love no other,
That is, until I met your brother.

Love maybe beautiful, love maybe bliss,
But I only slept with you because I was. . . . .

*****

What inspired this amorous rhyme?
Two parts vodka, one part lime.

Finally, a few of those "Paraprosdokians" - statements with a sting in the tail - much liked by Sir Winston Churchill:

Where there's a will, I want to be in it.

The last thing I want to do is hurt you. But it's still on my list.

They begin the evening news with 'Good evening,' then proceed to tell you why it isn't.

To steal ideas from one person is plagiarism. To steal from many is research.

Got a tale to tell?

Please send letters for publication by e-mail to the Editor: editor@pvpubs.demon.co.uk or contact Undercurrents, in strictest confidence if you wish (we promise to change names, places, etc to protect the guilty!), via e-mail: rentamalc@aol.com

FIG: Fireworks at standout Rome week

The Policy Watch column focuses on a busy week for surveying professionals in the eternal city, which saw RICS delegates leading in many areas. This is an abridged report. A full version is available at **www.rics.org/fig**

The Italian surveyors did a wonderful job at the FIG working week in Rome, reports RICS Land Group director **James Kavanagh**. All of the arrangements, of which a standout was the opulent gala dinner held at the Villa Mani which finished with a finale of fireworks overlooking St Peters, were superb and it was one of the best working weeks in many years.

Overview and general assembly

The theme was "Knowing to manage the territory, protect the environment, evaluate the cultural heritage". This was the year's biggest global event in the surveying professional calendar and was organised by the Italian professional surveying institution Consiglio Nazionale Geometri e Geometri Laureati (CNGeGL) and FIG. Over 1,200 participants from over 70 countries attended and RICS was very well represented by a delegation headed by President **See Lian Ong** and RICS FIG delegation chair, RICS member Dr **Diane Dumashie**. A week of intense activity was topped and tailed by two general assemblies which saw national member bodies vote on two new FIG Vice Presidents, commission chairs and the locations of the 2015 and 2016 working weeks and debate issues of voting rights, budgetary issues and future member bodies.

General assembly and voting

The following recommendations were adopted unanimously by the General Assembly.:

1. **the voting system be changed;**
2. **that the right to vote remains with members associations;**
3. **that a sliding scale of voting, relative to association's membership numbers, be adopted;**
4. **that Council prepare a proposal (and after consultation with the members) to be adopted for use at the General Assembly in Kuala Lumpur in 2014.**

However, RICS suggested that the finalisation of the voting rights issue is just the starting point for a root-and-branch review and upgrade of FIG governance and structure. RICS, through the President **See Lian Ong**, suggested that the FIG Council be expanded to include the largest member associations. The Kuala Lumpur Congress in 2014 is a key date for the future review of FIG.

A full download of FIG GA minutes and deliberations can be sourced @**http://www.fig.net/news/ news_2012/ga_rome_may_2012.htm**

Young surveyors to the fore

One of the highlights of this year's working week was the first FIG Young Surveyors Conference, which attracted over 120 young surveying professionals from more than 40 countries.

The strong involvement of a number of UN agencies such as the Food and Agriculture Organisation (FAO), UN Habitat, the UN agency for human settlements, and Global Land Tools Network (GLTN) brought issues of land rights, tenure and the recently released FAO Voluntary Guidelines (VG's) on responsible land governance to the fore. Delegates saw papers presented in eight different streams on subjects ranging from geodetic datum transformations to land tenure and markets via valuation of customary land and Building Information Modelling (BIM), displaying the diversity of the global surveying profession.

RICS members gave several presentations, including a keynote lecture and fully interactive session on our involvement in mainstreaming the FAO VG's on responsible land governance by RICS **James Kavanagh** and **John Tracey-White**, and a plenary session by RICS President **See Lian Ong** on BIM. Commission deliberations were held against the backdrop of three plenary sessions including:

- *Knowledge to manage*
- *Knowledge to protect and*
- *Knowledge to evaluate.*

Two key plenary presentations stood out. Karl-Friedrich Thorne presented 'Meeting the environment issues; challenge for surveyors and surveying associations'. Underpinned was the message that there is increasing political awareness of the need for accurate and current 3D digital and geo spatial information. Within the land management context this plays an important role in all three socio-political issues and global drivers. It also discussed the fundamental role of a connected Geo community, shaping networks between all stakeholders.

RICS President See Lian Ong presented 'Preserving the Built Environment' with strategic highlights of where BIM has come from and where it is going.

FIG represents over 250 000 Land and Surveying professionals worldwide and the next FIG working week will be held in May 2013 in Abuja, Nigeri with Sofia, Bulgaria in 2015 and Christchurch, New Zealand in 2016. To find out more about FIG, and download a full programme from this year's event, visit **www.fig.net/**

Below: *FIG Rome featured the first Young Surveyors Conference with over 120 attending.*

Individual Commissions

The work of FIG is done by its ten individual commissions for different aspects of surveying. Delegate presentations and other FIG Rome 2012 resources will be added to **www.rics.org/fig** in due course, in addition readers can find individual commission reports at **http://www.fig.net/comm/comindex.htm**.

Currently, RICS members serve on seven of the ten FIG Commissions as listed below:

Commission 1: Professional Standards and Practice
Commission 2: Professional Education
Dr Tim Goodhead
Commission 3: Spatial Information Management – *Robin McLaren*
Commission 4: Hydrography
Gordon Johnston
Commission 5: Positioning and Measurement
Commission 6: Engineering Surveys
Prof Gethin Roberts (ICES)
Commission 7: Cadastre and Land Management – *Dr Richard Grover*
Commission 8: Spatial Planning and Development – *Dr Diane Dumashie*
Commission 9: Valuation and the Management of Real Estate – *Dr Frances Plimmer*
Commission 10: Construction Economics and Management

Key online resources

The key online resources and papers generated by the Rome FIG working week are listed below. *GW* recommends the following papers for further study, which are available on the FIG website. We will also review them with a view to future publication in *GW*.

Towards 2020 - Critical Developments in Land Surveying in 60 Years (Comm. 1)
Brian Coutts (New Zealand) and Malcolm McCoy (Australia):

FIG Africa Task Force - Roundtable Discussion Commission: FIG ATF
Dr Diane Dumashie, Chair, FIG Africa Task Force, UK

FIG's Role in Promoting and Supporting Responsible Governance of Tenure of Land, Fisheries and Forests
CheeHai Teo, FIG President, (Malaysia)

Coordinate Systems for Surveying and Mapping in Hong Kong
Simon Chi Wo Kwok (Hong Kong SAR, China)

When Is a Land Market Not a Land Market?
Frances Plimmer and William McCluskey (UK)

Draft Strategy for Mainstreaming of Leading Academic Institutions in the Implementation of the Voluntary Guidelines
John Tracey-White and James Kavanagh, RICS (UK)

Crowdsourcing Support of Land Administration
Robin McLaren (UK):

How the National Mapping Organization of Japan Responded to the Great East Japan Earthquake?
Toru Nagayama, Kazuo Inaba, Tamotsu Hayashi and Hiroyuki Nakai (Japan):

Cadastre 2.0 – A Technology Vision for the Cadastre of the Future
Brent Jones (USA) and Nick Land (UK):

Closing the Gap - New Technologies and Airborne LiDAR Bathymetry Survey Techniques in European Environmental Monitoring Projects
Hugh Parker, Mark Sinclair, Nigel Townsend (Australia) and Paul Seaton (United Arab Emirates)

Meeting the Environmental Issues – A Challenge for Surveyors and Surveying Associations
Karl-Friedrich Thöne, President, DVW (Germany)

Challenges in the Land Sector: GLTN's Response and Strategies
Clarissa Augustinus, UN-Habitat

An Evaluation of the Performance of Network RTK GNSS Services in Ireland
Audrey Martin and Eugene McGovern (Ireland)

Evaluation of Tides in the Caribbean
Cassandra Nanlal, Dexter Davis (Trinidad And Tobago) and Michael Sutherland (Canada)

An International University Education; The University of Nottingham Ningbo China
Gethin Roberts (China, PR)

Scenarios for the Spatially Enabled Society
Peter Laarakker (Netherlands)

Valuation Methodology of Unregistered Properties
Muhammad Swazuri (Kenya):

After 10 Years of Criticism: What Is Left from the Ideas of De Soto?
Paul van der Molen (Netherlands)

Quality Assurance Systems – The Difficulties in Providing a Global Unified System for Surveyors
Tim Goodhead (UK)

Preserving the Built Environment: Importance of Building Information Modelling
See Lian Ong, RICS President, 2011-2012 (UK)

Surveyors' Participation in Active Politics in Africa: Bridging the Disconnect
Chukwubueze Onwuzuligbo, Joseph Ejikeme and Victor Nnam (Nigeria)

BIM from a Contractors Perspective
Jason Smith, President, ICES (United Kingdom)

Precise Point Positioning: Is the Era of Differential GNSS Positioning Drawing to an End?
Chris Rizos, Volker Janssen, Craig Roberts and Thomas Grinter (Australia)

Influences on the Strength of Property Rights
Richard Grover and Christine Grover (United Kingdom):

> *"The work of FIG is done by its ten individual commissions for different aspects of surveying."*

Chairmen's Day airs views

Stuart Edwards, chair of Geomatics Global Professional Group Board, reports on a recent meeting of chairs with other professional groups and forums, which gave sound advice for RICS Governing Council on early policy consultation ahead of implementation.

As billed in my last column, the RICS Professional Groups and Forums chairmen's meeting was held on the 16th May. As promised, I took the opportunity to press home two points on behalf of the Geomatics PG Board (PGB):

(i) That RICS Governing Council should be very careful in adopting an exclusively 'top down' approach in relation to new policy development and implementation. Increasingly, as RICS looks to expand into the global marketplace (which is sensible and supported by our PG Board – we are already truly global), it has adopted a growing tendency to develop policy without proper consultation and then to simply present this to PGBs – i.e. its member community – just prior to adoption when it tries to solicit member buy-in. I reminded the meeting of the recent APC revision 'debacle'. Pleasingly, many other PGB chairs supported my comments and the meeting's chair accepted that such an approach was indeed 'sub-optimal'. The meeting resolved to increase engagement in future policy development and to consult with PGBs at the earliest opportunity.

(ii) That the RICS proposal for the establishment of Global Centres of Excellence in a number of countries as 'one-stop-shops' for RICS expertise and advice was, like the APC revamp, flawed in a number of ways. Our own PGB agrees with the overall vision presented but again further engagement is required from RICS. The meeting agreed to rework the current draft paper and bring a revised proposal forward in the next few months.

As an interesting footnote it was very pleasing to observe that 10% of those in attendance at the meeting were from our very own PGB, a feat unmatched by any other PGB represented. Further proof if it were needed that Geomatics really does punch above its weight.

June PG Virtual Board

The 24th June saw the launch of our yearly PG Virtual Board. I have reported previously in these pages of the uniqueness of the Geomatics PG in running one of its meetings this way and it generated much e-traffic as we re-examined our current APC pathway in preparation for future engagement in the APC review process. In particular the Board examined the number, spread and level of competencies and considered the current and future appropriateness. Whilst there is too much detail to report here the overwhelming picture emerging was that a diverse and increasingly diversifying professional group, which on occasion struggled to describe this adequately in a list of finite competencies.

For example, some PG Board members noted the requirement of the APC to accommodate diverse skill-sets encompassing legal or cadastral, engineering surveying and setting out, geodesy and expert witness. The temptation here of course is to develop still more narrowly constrained competencies but the smart way must surely be to develop fewer but smarter competencies. Needless to say there is much work to be done. The PGB would welcome your thoughts.

Evening Lecture Series 2012-13

The 2011-12 period saw attendance at the RICS Geomatics evening lecture sessions reach capacity levels for the majority of lectures and a global increase in demand for lecture recordings. We recorded two of the lectures on video but alas this didn't really fulfil our communication needs. A YouTube type recording breaks lectures into ten-minute 'bites', which detracts from the viewer experience. Also, global bandwidth issues mean video streaming for many members is almost impossible. With this in mind we have sourced a new software platform for use in the 2012-13 series. Used extensively in the higher education arena, this software platform provides podcast facilities for voice and presentation slides.

The final lecture in the 2011/12 lecture programme saw Dr Nigel Penna of Newcastle University present the findings of the RICS co-sponsored Network RTK (II) research. Dr Penna also presented the best practice guidance that has been drawn from the work. Turn to page 15 for more on this topic. Meanwhile the full report and best practice guidance can be downloaded at no charge from The Survey Association (TSA) website; http://www.tsa-uk.org.uk/ . The lecture series now rests over the summer but will return in the autumn with an exciting menu of topics.

On that note of anticipation I will sign off but as ever I welcome your comments and thoughts and any aspect of this or other GW columns and indeed any other topic you may wish to raise so please email on the following address: **geochair.rics@gmail.com**

Stuart Edwards
welcomes your comments and thoughts so please email on the following address
geochair.rics@gmail.com

NetRTK2: GNSS guidelines updated

by Stephen Booth and Richard Groom

The last of the 2011/12 season's Geomatics lectures took place on Thursday 17 May at RICS headquarters. It was an opportunity to hear the results of the latest research on the accuracy and limitations of Network RTK GNSS.

Conducted by Dr Nigel Penna and his team from the University of Newcastle on behalf of The Survey Association, RICS, Ordnance Survey and commercial stakeholders, the latest research into the reliability and accuracy of network RTK GNSS updates similar work in 2008. The result is a new guidance note on GNSS Network Surveying in Great Britain which can be downloaded from the TSA's website (www.tsa-uk.org.uk) along with a paper detailing the results for the three network providers under a variety of survey conditions.

It is now well over six years since Leica Geosystems launched Britain's first commercial network RTK service, SmartNET, to be followed by similar services, albeit using different techniques, by Trimble and Topcon.

The latest report – "NetRTK2" – follows the Ordnance Survey's upgrade of their national network of CORS (continuously operating reference stations) to full GNSS. The research was based on establishing a network of 22 points near to Newcastle (Chester-le-Street) and was designed to test the three network services under conditions ranging from easy (open sky), moderate, difficult and severe (urban canyon). Also considered were base station to rover height differences, ocean tide loading and the limitations of surveying at the margins of the OS network upon which the service providers rely.

The tests included using fixed and roving antennas with standalone GPS and with GPS+GLONASS. All equipment used was proprietary receivers, detail poles, data collectors and antennas.

The overall conclusion is that typically, commercial network RTK services provide instantaneous measurements of around 10-20mm in plan and 20-40mm in height depending on conditions and whether GPS alone or GLONASS is added.

Richard Groom, our technical editor, adds:
When Network RTK was first launched in the UK in 2006, it was treated with great caution by surveyors and clients alike. They had been burnt by their experiences of static and rapid static GPS. Yes, we obtained answers from the equipment but how could we tell if they were correct? How many surveyors (and their clients) came a cropper through having used the wrong antenna in their computations, or thought they could get away with observing in a suburban tree-lined street?

NetRTK-1 brought guidance from an authoritative source that not only helped the surveyor, but also the client. We had a much clearer idea of what could be achieved and how to achieve it. We could require surveys to be carried out according to the TSA guidelines and have confidence in the results. The guidelines were downloaded 2000 times, from people in twenty countries and from all application areas.

But the study only touched on combined GPS+GLONASS receivers. Indeed the tentative dual-constellation test results suggested that if you used dual-constellation receivers, you would get worse results!

The NetRTK-2 study brings the guidelines up to date and has covered network RTK in much greater depth. It covers use of Network RTK for control and for detailing. It includes all three services and use of one manufacturer's hardware with a different network RTK service. It compares GPS-only results with GPS+GLONASS results. It looks in greater detail at the effect of operating in a range of conditions from easy (open sky view, no multipath) to severe (poor sky view and high risk of multipath). It checks if the coordinate quality indicators on the receivers are reliable and the effect of working with PDOP limits of 3 and 5. The study also simulated what happens when using network RTK near the edge of the network and in the case of local base station failure.

For the answers, read the report and the guidelines. But when researching which system to use don't forget to consider other factors, such as mobile communications and how quickly the receiver reinitialises having lost lock.

Conclusion

It would be rather easy to dismiss this research as 'angels dancing on pinheads' as the accuracy and precision of GPS is well known amongst surveyors. However what this research does is provide serious confidence to surveyors (and therefore their clients) that network RTK based on GNSS provides reliable measurements. It may allow the individual network providers to argue to potential customers that their service and equipment works better than the competition under particular situations but more importantly surveyors in Britain have a proven tool in their armoury.

References

The latest guidance notes and the full research report are available from the TSA's website http://www.tsa-uk.org.uk/ and are available in low and high res versions.

• *For more on the limitations and interferences that GNSS can suffer turn to page 16 and Simon Canning's article,* ***GNSS interference – how safe is GNSS?***

GNSS interference – how safe is GNSS?

By Simon C Canning

We have become used to the ubiquity of GPS and GNSS. But surveyors and engineers will be aware that signals are not always consistent and sometimes are inadequate for precise positioning. The author looks at the many sources that can degrade or interfere with signals, from sea gulls (above) to electronic jammers.

GNSS signal interference can be placed into four categories, all of which can cause intermittent or complete loss of GNSS signals. These are physical interference, propagation interference, partially in-band spill-over, in-band interference and out-band interference.

Hiding the antenna - physical interference

The most common cause of physical interference is masking, where the GNSS signal is prevented from reaching the antenna by natural or man-made features. It is very common even for experienced GNSS users to question the intermittent or complete loss of GNSS signal when they do not have a good clear sky view. This is imperative and is fundamental to GNSS. Natural features that cause masking include hills, mountains, canyons, valleys and trees but masking is more commonly caused by man-made features such as buildings in urban canyons, buildings in general, wind turbines, communication masts and water towers.

In order to mitigate signal fading and poor reception, L-Band signals use circular polarization. The GNSS L-Band signal uses right-hand circular polarization (RHCP), therefore GNSS antennas are designed to receive RHCP signals. However, signals arriving at the receiver will often have left-hand circular polarization (LHCP), which the antenna should be designed to suppress. The suppression of LHCP signals is important because they are often a symptom of multi-path.

Multi-path is caused when the received signal reflects off of a surface prior to being received at the antenna. The effect of this signal reflection is to cause constructive and destructive interference. As well as phase-shifting causing intermittent or complete loss of the GNSS signal, an increase in pseudo range is also experienced, both of which ultimately result in poor positioning at best, and no positioning at worst.

The final frontier - propagation interference

The radiation pattern, or gain pattern, is the measure of antenna gain change with respect to azimuth and elevation. Ideally, the gain pattern would be uniform across the antenna; however, GNSS antennas commonly have high gain about the antenna zenith, decreasing towards the edge of the antenna. This is because signals from satellites at low elevations are subject to more interference than those at high elevations.

GNSS signals propagating through space, inclusive of the Earth's atmosphere are subject to interference, especially at low elevations and around the geomagnetic equator.

It is well known that the major causes of interference to signals as they travel through space are firstly the ionosphere, a region of ionised gas around ~ 50km to ~ 3000km above the surface of the Earth, and secondly the troposphere, ranging from the Earth's surface to ~ 50km.

The last few years have seen an expected increase in ionospheric activity as we reach the apex of solar cycle No 24. The solar cycle is a sinusoidal increase and decrease in sunspot activity with a period of around 11 years. This activity has a direct effect on the ionosphere and thence the GNSS signals that propagate through it. Interference of this nature is predominantly experienced over huge areas by GNSS users around the geomagnetic equator.

Scintillation is another symptom of ionospheric activity and appears in smaller localised regions of the sky affecting signals from individual satellites. This type of interference results in rapid fluctuations in the phase and amplitude of the signal, as the signal passes through small disturbances in the ionosphere. Amplitude fluctuations lead to a drop in signal level, resulting in an increase in measurement noise within the antenna code and carrier tracking loops; whilst the fluctuations in phase increase stress on the antenna carrier tracking loops. Both of these phenomena cause errors in the pseudo range and can also result in complete loss of signal.

Whilst the interference caused by the ionosphere can be measured and thence mitigated, it is a much larger beast to deal with than the troposphere as it is the cause of intermittent and complete loss of GNSS signal. Whilst disturbance in the troposphere does not cause loss of signal, is does cause GNSS signals to be delayed, resulting in a bias to the pseudo range.

Overcrowding the airwaves - partially in-band spill-over and in-band interference

The result of overcrowded airwaves is intentional and unintentional in-band and partially in-band spill-over interference. Partially in-band spill-over occurs when other signals next to GNSS signals cause intermittent or complete loss of the GNSS signal. For example, some of the GLONASS L2 band

overlaps amateur radio bands in some countries, resulting in a more localised loss of signal. More notably, overcrowding means that some navigation aids, which transmit high powered pulses used by aircraft, share the same frequency band and interfere with new GNSS signals such as GPS L5 and Galileo.

An often overlooked source of unintentional in-band interference is caused by the GNSS antenna itself, despite the antenna being passive. All GNSS receiving equipment has a local oscillator that produces a very low level signal. Interference occurs when this local signal is re-radiated by either a faulty antenna, or more often a breakdown in the coaxial cable shielding. The coaxial cable then acts as an antenna for the local oscillator, which can then be picked up by other receivers in close proximity. This can have a huge impact and cause receivers within 100 metres to lose their signal.

In-band interference resulting in swamping can also be intentional and can cover a much larger area than the 100m radius mentioned above. The text below is the first line of an advance notice to GPS users [NATS Ltd, United Kingdom Aeronautical Circular, P008/2012, 2012]:

> "In accordance with UK procedures for the control of non-operational jamming, this circular gives notification of radio jamming activity, forming part of the Ministry of Defence (MOD) JOINT WARRIOR exercise (JW121), to intentionally provide interference to Global Positioning System (GPS) signals"

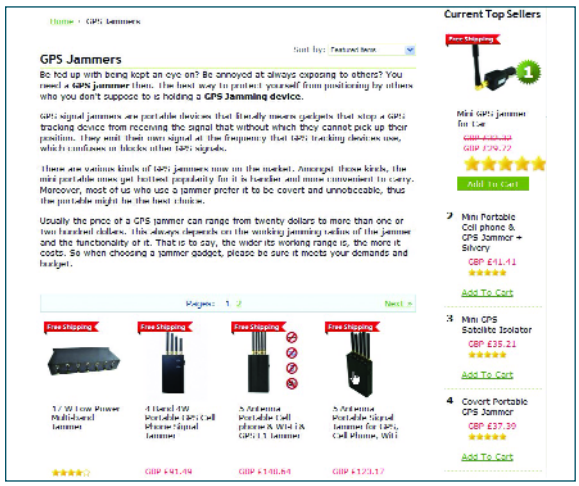
Intentional in-band interference used to be the domain of governments. However, inexpensive GPS jamming devices can now be bought for a few hundred dollars. These devices are used by thieves involved in high end vehicle theft to counter GPS tracking devices. The range of these devices is dependent upon their power and can extend from a few metres to a few kilometres.

As mentioned earlier, partial in-band interference can lead to a localised loss of signal, where for example some of the GLONASS L2 band overlaps amateur radio bands. Whilst this may not be as glamorous as a large military exercise, it is still a problem. Given that the loss of L2 means loss of RTK GNSS, loss of any TEC calculations to mitigate ionospheric delay, loss of PPP GNSS, static and fast static positioning solutions.

These examples demonstrate how interference resulting in intermittent and total loss of GNSS signal can be caused by partially in-band spill-over and in-band signals.

Inherently weak signals – out-band interference

GNSS signals are intentionally very weak. They are around 100 times weaker than the background noise, "Think of GNSS signals as if you were watching a 100W light bulb flying at a height of 20 000 km." [*Jan Van Hees et al, Septentrio*, SSNWP062012_01_GNSS_Interference, 2012]. GNSS signals are wide open to all manner of unintentional and intentional interference from out-band signals. Essentially, the weaker GNSS signal is more likely to be swamped by a stronger signal.



Right: *a website offering GPS jamming devices like the one below.*

Out-band radio frequency interference is a common source of GNSS signal interference. These sources are numerous and often lead to loss of GNSS signal. Microwave data links, telemetry, RADAR, communications and TV transmitters are all examples of transmitters that can cause out-band interference.

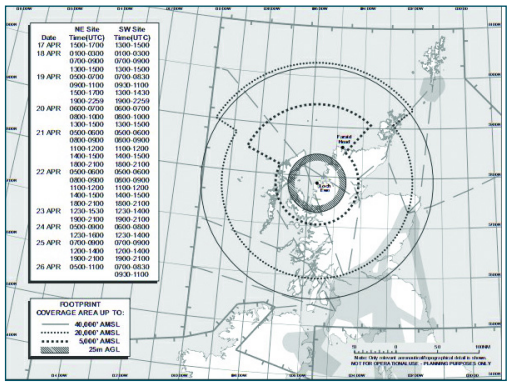
Out-band interference is very common on board offshore survey and construction vessels which have a plethora of high powered transmission devices. These may interfere with a number of devices on board such as navigation receivers, GMDSS, communications domes, doppler speed loggers, automatic identification systems, GNSS heading sensors, ECDIS plotters (with integrated GNSS), DGNSS and PPP augmentation services and survey and seismic receivers for tail buoy tracking.

A well known and controversial example of out-band interference was the proposed LightSquared project, whose terrestrial communications stations were set to transmit just below the GPS L1 frequency, sparking fears that the GPS L1 signal would be lost. No L1 GPS, would have meant no GPS. Fortunately LightSquared's plans have been shelved, but the episode was a wake-up call to the GNSS industry.

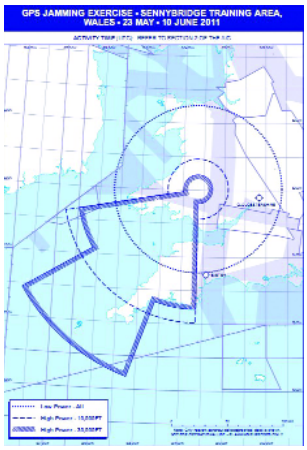
> *". . . inexpensive GPS jamming devices can now be bought for a few hundred dollars."*

Preventing and mitigating interference

Prevention is better than cure, they say, and GNSS manufacturers, academia and users of GNSS have been working and continue to work hard to try and prevent or mitigate interference in all its forms.



Below: *Chart indicating the area in which intentional in-band GPS Jamming interference was expected [NATS Ltd]*



Clear sky views

Physical interference is perhaps the easiest form of interference to prevent. Location is key. The antenna should always have a clear sky view and be above any natural or man-made features that cause masking. The antenna should also be away from any flat surfaces that might cause multipath. Not all sites are perfect, so be aware and consider masking.

Multipath can be reduced by choosing a good location and using hardware such as choke ring antennas that limit its effect. This is not so practical for all occasions but there is antenna hardware available which uses techniques that reduce and even eliminate (or so it's claimed) the effects of multipath. These techniques include reverse polarity shut-down that blocks LHCP signals. Antennas also have low gain towards the edge of the antenna, because signals from satellites at low elevations are more susceptible to multipath.

Space is space

Space is space and there is not much we can do to prevent it from interfering with GNSS signals. Therefore we have to measure, calculate, model and even work around the effects of this interference.

The first line of defence in propagation interference mitigation is the Klobucher model, broadcast in the navigation message. This doesn't suit users who require greater precision and accuracy from their positioning. The Klobucher model has a limited number of parameters and serves as a general device to mitigate ionospheric interference. The next line of defence for L1 users is differential GNSS augmentation delivered by satellite or locally transmitted by the user, in a similar way to RTK GPS. To reduce the effects of this interference further, dual-frequency receivers can be used, in conjunction with a global network, to generate accurate ionospheric models for PPP augmentation. These techniques enable users to mitigate ionospheric interference sufficiently so that they are able to remain dynamic. For higher levels of accuracy, whilst remaining dynamic, baselines have to be shorter and RTK GNSS solutions must be used. For even higher accuracies static GNSS observations must be made over long periods, adopting post-processing techniques in order to mitigate ionospheric interference.

Scintillation can strike in any part of the sky and if we are required to carry out dynamic positioning this can be a problem. It can be mitigated by using dual-constellation GPS+GLONASS receivers, which will increase the number of satellites in view and reduce the effect of scintillation that blocks satellites in discreet areas of the sky. The CIGALA project in Brazil, funded as part of GALILEO, is ongoing and producing promising results, whilst RAIM solutions are being developed in order to remove scintillating satellites from computations, so that precision is maintained. INS systems can also be integrated where dynamic positioning is required as these can bridge short breaks when GNSS cannot be observed due to signal loss.

The troposphere is a little "easier" (just ask Hopfield et al) to deal with. The signal delay caused by interference here can be mitigated using Local Area GNSS, Wide Area GNSS, PPP, network tropospheric modelling and modelling techniques applied when static or fast static post processing is carried out.

On the other band

In-band, partially in-band and out-band interference, whether intentional or unintentional is a different beast. Out-band saturation is difficult to prevent. Although modern antennas and receivers are generally more resilient to out-band interference, if working in an environment where interference is a problem it is worth trying different receivers to find the one that offers the strongest resistance to the interference. Other than this, the only practical way to mitigate this type of interference is to investigate what the source is. You can then move away if possible, adjust the power of the source down (it is not unheard-of to find that interfering sources are transmitting at well over the legal power output) or alter its direction.

The most up-to-date antenna hardware uses several types of technology, including filters, to mitigate or suppress these types of interference, categorised as bursts, pulses and continuous waves. For bursts or pulses, pulse blanking can be used as a mitigation technique. The pulse blanking unit inside the receiver is triggered when a burst or pulse of interference signal arrives at the receiver input; the unit then stops the signal from being received by the receiver tracking and measurement engine.

Jamming devices produce interference as a continuous wave. When interference comes in continuous waves antennas are available that alter the gain pattern, in order to generate null areas in the direction of the interference, allowing GNSS signals to be received by the rest of the antenna. This is similar to the concept used in noise-cancelling headphones. Another technique used where interference is a continuous wave is adaptive notch filtering; this technique is used to mitigate continuous wave and narrow band interference. The adaptive notch filter scans all the signals that enter the receiver; if interference is detected the signal is digitally processed to suppress the interference.

It is important to remember and gain confidence from the fact that GNSS signals are widely used, successfully, everyday, all over the world on land, at sea and in the air. Whilst we can take comfort from this, it is also important to remember that interference comes in many different forms. It should be part of the project planning process, and included in risk assessments.

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About the author

Simon Canning received his MSc from the Institute of Engineering Surveying and Space Geodesy at Nottingham University and is a member of the RICS. He has 20 years experience in all fields of geomatics. He has held senior positions at Atkins, Gardline Geosurveys, BLOM Aerofilms and Halcrow Group Ltd before joining Veripos Ltd as their senior technical support specialist

Instrument servicing: details, tests, fault finding and. . . soft skills

Today's high-end surveying instruments have raised the stakes for service and repair workshops. How do you know if your technician is delivering on quality standards and what does best practice look like? *GW* hears from Leica UK's service supervisor, Tim Knight.

If a gale is blowing and an unattended total station heads for the horizontal, the chances are a service technician will soon know all about it. As surveying technology has moved from mechanical to electronic so the infrastructure for service and repair has to be equal to the task in order to comply with national quality management requirements.

Tim Knight has been service supervisor at Leica Geosystems for the last 16 years. He is responsible for ensuring that Leica Geosytems' service operation in the UK and Europe meets the factory's rigorous quality standards. Modelled on the factory facility in Heerbrugg, Switzerland, service procedures at the UK service centre in Milton Keynes comply with a strict corporate audit schedule and national quality management system certification.

The centre receives around 1200 instruments a year. In addition to those booked in for an annual standard service routine, a proportion will be assessed for damage or malfunction following an encounter with the elements, vandals and even a rogue sheep!

An annual service and certification for a total station typically involves more than 60 tests for functionality and laser safety. An instrument must pass all 60 tests in order to meet the manufacturer's specifications. Baseline measurements are verified daily, when testing high-end total stations, and other test equipment used is verified and calibrated according to the factory's guidelines. Every detail is recorded on a database, providing an audit trail and traceability should an instrument be returned within the three-month service warranty period. Frequent checks are made to ensure that protocols for technical records and administration are correct.

A team of eight in-house service technicians carry out 95% of their activity at electrostatic discharge (ESD) protected workstations. Regular training sessions at Heerbrugg give them the expertise required to return high-end TPS and GPS instruments to production line condition and specification. Computer diagnostics are used to interrogate every part of an instrument for accurate performance and individual testing and adjustment to the manufacturer's specifications.

Away from the bench, final baseline checks are carried out from a specially installed concrete pillar, using prisms to simulate use in the field. All test equipment is regularly verified and audited by a Swiss quality system using a newly acquired baseline measurement device capable of giving measurements with an accuracy uncertainty of ± 0.2mm.

The service centre operates on a three-day turnaround for most repairs and parts ordered from Switzerland are received in a couple of days. Co–operation between the international Leica Geosystems service network can also be called on to locate spare parts if the factory is out of stock.

Continuous research and development means that typically, Leica Geosystems' survey systems follow a five-year cycle. After a particular line is superseded, Leica then commit to continue to service and provide spares for the phased-out equipment for a further five years, and beyond, whenever possible.

"We train our service technicians to be empathetic with customers" says Knight. "If we know an instrument is going into a service phase-out we can alert the customer and advise on an upgrade, but there are always people that like to stick with what they have got, because regular servicing has delivered the reliability they expect. We can deal with that."

The role of the service engineer has changed significantly since Knight joined the company, more than two decades ago. "We have moved away from fault finding on single components to modular repairs. As technicians need to be PC literate, they come from various technical backgrounds." Soft skills are increasingly important in the service environment, along with the technical expertise. "The best service engineers have to be good ambassadors and know how to approach customers. For example, we can often spot when a customer has an issue that could be easily resolved with some additional knowledge and can swiftly alert our technical support teams."

• *For more information about the service department contact Tim Knight, email* ***tim.knight@leica-geosystems.com****.*

• Don't forget to use your new lens cloth, which can be found on the inside front cover of GW, to keep your instrument clean and scratch-free.

More than 60 tests are carried out on instruments sent in for servicing at Leica UK's Milton Keynes facility.

Laser scanning enables Titanic Light Show

A high precision 3D model of Belfast's new Titanic visitor centre was behind the opening ceremony of motion graphics and pyrotechnics. **Mark Hudson** explains the challenges his company had to overcome to laser scan a complex irregular building façade.

Titanic has been making the headlines in recent months as Belfast marks the one hundredth anniversary since the ship's maiden voyage and subsequent loss. To mark the centenary Titanic Belfast is a 14,000 square metre start-of-the-art visitor centre telling the story of the giant ill-fated ocean liner from its conception through to the ship's tragic maiden voyage.

In April 2012 Belfast City Council and the Northern Ireland Tourist Board organised a festival to commemorate the Titanic story and to mark the centre's opening with a spectacular 3D motion graphics and pyrotechnics light show projected onto the building's façade. But for the show to succeed a high precision 3D model of the building was necessary to accurately coordinate the visual effects.

The show was designed by UK interactive arts and technology collective, seeper, who retained Coastway, a chartered geospatial engineering company based in Co Kildare, Ireland to produce the 3D model of the city's newest tourist attraction: Titanic Belfast.

Project brief

For the light show seeper required Coastway to provide them with a highly accurate 3D model of the visitor centre to enable them to plan, design and execute a fully immersive light show using 3D projection mapping onto the building façade.

The challenge

Whilst Coastway had significant experience in producing 3D models of façades using laser scanning technology, the unique architectural design of the Titanic Belfast building presented a number of challenges during the laser scanning and modelling process due to its asymmetrical structure and use of specialised façade materials. The building façade is comprised of over 3,000 irregular anodised aluminium satin finished panels manufactured in Belfast by EDM Spanwall.

Below: *the building façade comprises over 3000 irregular shaped panels, as revealed by the inset image.*

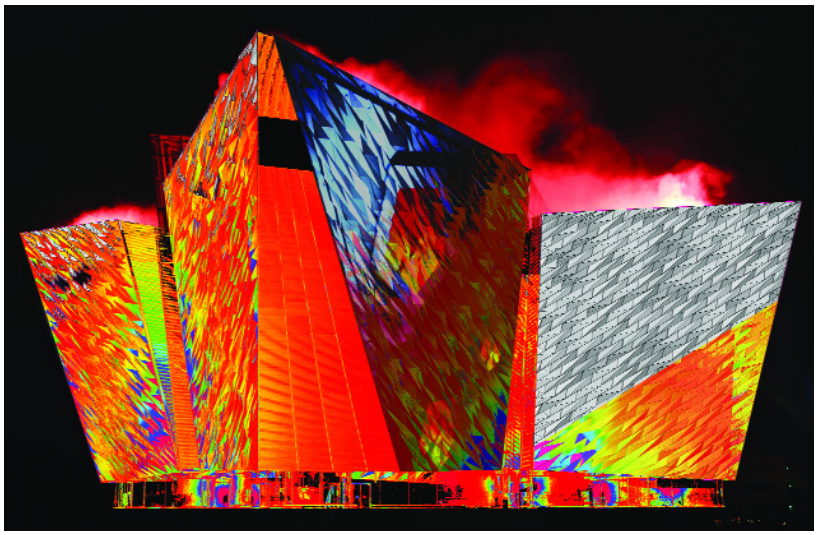
Coastway's solution

Following a detailed study of the building, Coastway proposed a solution using a Leica HDS 6200 laser scanner to produce the 3D model for transferring into seeper's required Cinema 4D format. The survey was performed using a 2-metre tripod, elevated platforms and by scanning from the roof of the protruding hull structures. The survey was completed in three days on site with a further three days to register the laser scan data gathered and geo reference the

resultant point cloud to Irish National Grid Co-ordinates.

Coastway were required to achieve accuracies of ±10mm with the final model. The HDS6200 quoted accuracy of 2mm on a modelled surface when combined with survey control accuracy of ±2mm enabled us to achieve and exceed the desired accuracy. To further ensure the accuracy of the 3D model, Coastway collaborated with EDM Spanwall to verify each of the irregular panels against the fabrication dimensions.

Creation of the full 3D model of the building façade took three weeks to produce. Each of the 3000+ irregular panels had to be individually modelled in the Leica Cloudworx plug-in for AutoCAD and the Point Tools plug-in for Rhino.



Above: *the opening ceremony was a perfect fit for seeper's spectacular graphics and pyrotechnics.*

Problems encountered

The complex façade and highly reflective surface of the aluminum panels created problems for ensuring a complete return of laser scan survey data. Return signals to the scanner were just about at their limit with the range of 79 metres being reached from the instrument set up to the very top of the building. Access to the top of the building was limited but Coastway had to ensure that they could capture any remaining areas, which could not be surveyed from the ground. Nevertheless, these challenges were overcome and the façade model was completed on time and saved as a Cinema 4D format for seeper to use for the production of their light and pyrotechnics shows.

For future similar projects Coastway would consider using the longer range Leica C10 laser scanner, where the extended range would enable a larger proportion of laser scan data to be captured from the ground set-ups

What our client had to say

"This was an extremely challenging project due to the irregular shape of the building structure and the reflective materials used on its façade. The output from Coastway's work was of paramount importance, giving us the ability to accurately align our creative content to the architectural canvas. The team at Coastway did a fantastic job, and we look forward to using them again for future projects." Evan Grant, Founder of seeper

The Titanic Belfast Light Show was held on 5 April and watched by an estimated crowd of 30,000 people. The show consisted of projection mapping onto different sides of the building simultaneously combining pyrotechnics, fireworks and soundtrack to tell the story of Titanic.

About Coastway

Coastway is a chartered geospatial engineering company providing cost-effective survey solutions to the construction industry and expert advice to the legal profession in Ireland, the UK and internationally. They specialise in capturing, processing and managing geospatial data with expertise in geospatial engineering, laser scanning, laser scan to BIM, rail track surveys, environmental monitoring, structural monitoring, expert witness and legal mapping. Their clients include building and civil engineering contractors, architectural practices, legal professionals, public sector and semi-state organisations. Coastway was founded in 1999 by Mark Hudson and Enda Nolan. For more visit **www.coastway.net**

About the author

Mark Hudson is a leading global geospatial engineer, with over three decades of experience in some of the world's major civil engineering, construction and tunnelling projects. He is regularly called upon to act as an expert witness for construction litigation cases.
Mark is a director of Coastway Ltd, managing director of Subsurface Laser Scanning Ltd and director of Irish Legal Mapping Ltd.

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Cooch Behar – the world's most complicated boundary

by Brendan Whyte

Boundary disputes between countries are usually about ethnic and cultural groups or topography. Few come down to individual field ownership or are so complex as to involve nearly 200 enclaves including the world's only counter-counter-enclave! **Brendan Whyte** ably unravels this amazing conundrum.

Cooch Behar! A name to conjure with… used as a byword for exoticism and the far reach of the British Empire by Bertolt Brecht in his Threepenny Opera ("From the Cape to Cooch Behar") and sung by Julie Andrews in the title song of the film Star! ("Known from Maine to Cooch Behar"). But how many of those who have heard and hummed along to these music-hall songs could place Cooch Behar on a map? And how many who found it on a map would have noticed and marvelled at its incredible topology? For the erstwhile princely state of Cooch Behar (area 3387 km² in northern Bengal), had almost 150 "chhit-mahals", or enclaves, within the surrounding districts of Jalpaiguri and Rangpur in the Bengal presidency of British India (and two or three more in Goalpara district in Assam) and those British districts had a little over 100 chhit-mahals within Cooch Behar.

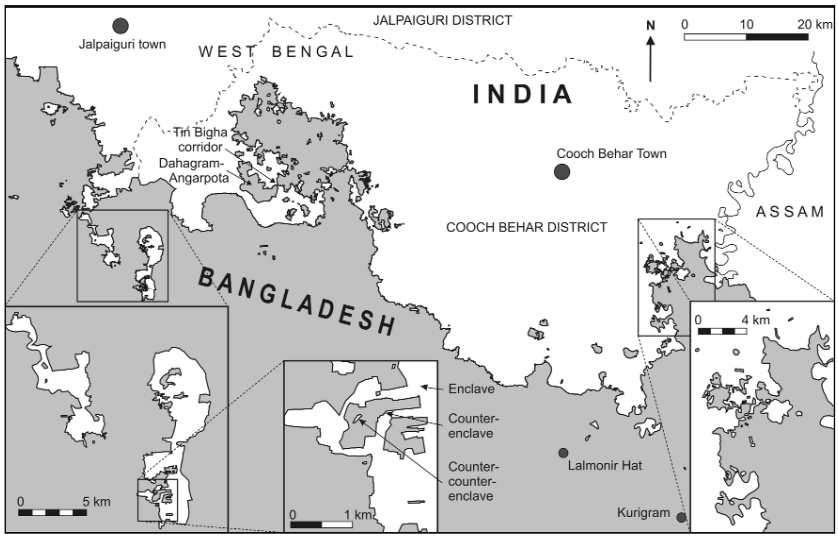
Today, Cooch Behar is a backwater district of West Bengal, and its royal line is extinct. But the enclaves of and in Cooch Behar remain: those of Cooch Behar now being inside Bangladesh, and those of former British India in Cooch Behar now being Bangladeshi enclaves inside Republican India. Bangladesh possesses 71 enclaves, with a total area of over 47 km², in India. Within these are three Indian counter-enclaves (enclaves inside enclaves) totalling 17 ha. Meanwhile India has 102 enclaves in Bangladesh, totalling over 69 km². Within these are 21 Bangladeshi counter enclaves totalling over 206 hectares. And within one of these is the world's only counter-counter-enclave, an Indian jute field of 0.69 hectares, inside a Bangladeshi counter-enclave, inside an Indian enclave, inside Bangladesh!

Enclave origins

These enclaves – some, at 0.1 ha, as small as a single rice or jute field, and some up to 25 km² – originated quite some time before the British East Indian Company (EIC) gained control of Bengal (and subsequently India) in the mid 1700s. Indeed, the enclaves, despite current native rumours that they were the creation of a literal 'divide and rule' policy by the British, were in fact the result of a 1713 treaty between the Maharajah of Cooch Behar and the Mughal Empire, which had been expanding eastwards into Assam from the mid-1600s. By this treaty, Cooch Behar was forced to cede several districts to the Mughals.

India at the time was a very feudal continent, and, like pre-Westphalian Europe, its political entities were not contiguous blocks of territory sharing the same culture and history, but rather scattered patchworks of landholdings personally belonging to a ruler or his vassals. Thus the districts that Cooch Behar ceded to the Mughals included pockets of land within the rump Cooch Behar state, and likewise, Cooch Behar retained isolated pockets of land within the districts it ceded to the Mughals on its west and south.

The EIC gained control of Bengal in 1765.



Right: *Brendan Whyte reveals the mysteries of Cooch Behar.*
Far right: *Map showing the Cooch Behar enclaves.*

Boundaries in this period were of importance mainly for tax-farming purposes, so the Company was quick to have its boundary with Cooch Behar 'determined' in 1769. Cooch Behar soon acknowledged its vassal status to the EIC (becoming the first of India's 'princely states'), in order to gain Company aid in a territorial dispute with Bhutan. The Company, however, ended up siding more with Bhutan, through which it wanted to engage in trade with Tibet. The Bhutanese boundary was moved southwards across the Bengal plains from the Himalayan foothills in 1817, but certain land parcels were retained by Cooch Behar, creating more enclaves to the north of the state. An Ensign Brodie 'fixed' (surveyed and demarcated?) the new boundary in 1832.

After the Indian Mutiny of 1856, the British Government took direct control of India from the private East India Company. One of its first acts was to fight a small and brief war with Bhutan (which had just emerged with a new ruler after a civil war), and to annex Bhutanese lands on the Bengal plains in 1865 (leaving the Cooch Behar enclaves within these lands intact). Coupled with the erstwhile Company's annexation of Assam in 1826, Cooch Behar was now totally surrounded by British territory, and the former Cooch Behari-Mughal enclaves were now Cooch Behari-British Indian enclaves.

Until the British withdrawal from the subcontinent in 1947, the enclaves did not cause any real friction. The British did not actively 'divide' in order to rule, but rather retained local rulers in the more than 600 princely states that existed around and within the provinces of directly-ruled British India, of which Cooch Behar was the oldest. British India basically imposed its rule upon the local polities as they existed when annexed. The government would depose nabobs who were deemed unsuitable, and occasionally annexed whole states, but no wholesale redrawing or 'rationalisation' of boundaries took place.

Under the British, then, the patchwork quilt of princely states was, from a boundary point-of-view, frozen in time. On occasion, the complex boundaries of the hundreds of subcontinental polities would cause irritations. The Cooch Behar enclaves were no exception: in the early 1900s, enterprising locals had set up outlets for alcohol, opium and others narcotics in the enclaves, to capitalize on differences in excise regulations between the two governments. British district officials proposed exchanging the enclaves to remove the irritant. But more senior officials rejected this on the grounds that the Maharajah of Cooch Behar opposed any exchange, as did the local people themselves. So rather than a political exchange of territory, a customs exchange was instituted instead, so that the enclaves of British India in Cooch Behar fell under Cooch Behari excise laws, and those of Cooch Behar in British Bengal fell under Bengali law. While simplifying the policing of regulations in each state, the British were fair-minded enough to agree to compensate Cooch Behar each year for the effective net loss of revenue this arrangement caused the latter, due to Cooch Behar's enclaves in India being larger both in area and population.

Cooch Behar boundary pillar for Putimari enclave north boundary, viewed west (enclave in top right) viewed from Bangladesh.

Survey history

Administration, and land rent in particular, was the primary purpose of EIC, and later British, surveying and mapping in India. Under the Mughals there was little local mapping, and rents were imposed by a hierarchy of zamindars (tax-farmers) at various administrative levels relying almost purely on guesswork as to the extent and capability of each landholder's land, but also influenced by the actual revenue needs of the state, and the profits each tax-farmer thought he could extract from those below him. The British inherited this system (and indeed, the EIC's initial capacity in Bengal was that of dewan, or finance minister, to the increasingly sidelined nabob).

James Rennel is justly famous for his remarkable medium-scale topographic mapping of Bengal in the 1770s, which assisted the EIC in assessing its newly acquired lands. Mapping and revenue settlements were carried out on an increasingly scientific, and decreasingly corrupt, basis under the EIC, and its successor, the British Indian government. In Cooch Behar – and other princely states – a British Resident acted as both ambassador and overseer to the ruler, ensuring stability and reasonable (and pro-British) rule. But it was only in the mid-1800s that the British really began to reform the administration of the Cooch Behar state.

J J Pemberton mapped the state topographically for the first time at one inch to the mile (1:63,360) in 1858-60. **J H O'Donel** then compiled a detailed revenue survey between 1864 and 1870. The state was divided into six parganas, these were subdivided into taluks (mapped at 8 inches to the mile or 1:7920), and the taluks into jotes (mapped at 16 inches to the mile or 1:3960). Technically, a jotedar was the cultivator of a jote, and so the actual farmer of the land, but up to six levels of sub-infeudation existed below this, so that a jotedar had effectively become a petty landlord.

"It was only when the subcontinent returned to native rule in 1947 that they became problematic..."

Above: *Cooch Behar boundary pillar at Dahagram Angarpota with locator stone, taken from Indian road.*

These undertenures were not mapped, but simply noted as comprising so many fields per jote. Each holding was numbered and tabulated with its relative position, length of sides, area and soil class. From this survey and tabulation, a revenue settlement was calculated, specifying the rents due to the government.

Cooch Behar's first scientific revenue settlement, under Settlement Officer **W O A Beckett**, was finished in 1877 and was initially of 7-8 years' duration. It was then extended for five years to 1888-9 while a second settlement was begun in 1886-87. There was no resurvey, but changes in possessions and land classes were noted. The second settlement lasted until 1927, and a third until the mid-1950s. Similar revenue settlement work was conducted in the Bengali districts of Jalpaiguri and Rangpur bordering Cooch Behar from the 1850s. In the 1950s, land reforms in both India and (East) Pakistan brought all cultivators into direct relation with the state, technically eliminating the intermediary tax-farming zamindar classes.

During the 1920s and 1930s, a standardized one-inch map series of British India was compiled, which, together with derivative ½-inch and ¼-inch series, remain the best mapping publically available due to Indian and Bangladeshi restrictions on distribution of official 1:250,000, 1:50,000 and 1:25,000 post-independence series, particularly in border areas.

> *"The enclaves thus became a no-man's land of unadministered territory..."*

The boundaries of Cooch Behar and its surrounding British districts were adjusted by various boundary commissions in the early 1900s as a result of problems identified during the revenue surveys and settlements. The Cooch Behar-Jalpaiguri boundary was adjusted in 1919-20, Cooch Behar-Assam in 1912-14 and 1922-23, and Cooch-Behar-Rangpur in 1931-38. The Cooch Behar enclaves involving Jalpaiguri and Rangpur were formally demarcated with concrete pillars – apparently for the first time – in 1937-40.

British India became independent in 1947, and was partitioned into India and Pakistan by Sir **Cyril Radcliffe**. The princely states, including Cooch Behar, were expected to join one or other of the new countries (Hyderabad tried to become independent itself, but was overrun by Indian troops). Radcliffe's partition of Hindu and Muslim Bengal left Cooch Behar straddling the boundary of India and East Pakistan. In 1949, as a Hindu state with a Hindu ruler, it decided to join India, and the next year became an ordinary district of West Bengal. The enclaves of Cooch Behar in other districts of West Bengal, and those of West Bengali districts in Cooch Behar, were merged into their respective surrounding districts in three stages in 1952, 1955 and 1960. Cooch Behar's enclaves in Assam, and those of Assam in Cooch Behar, remain to this day – somewhat surprisingly given New Delhi's proclivity to 'rationalize' many other state boundaries.

The enclaves of Cooch Behar in East Pakistan, and vice versa, also remain. An agreement in 1958 between prime ministers **Jawarhalal Nehru** and **Malik Firoz Khan Noon** to exchange all the enclaves foundered when a succession of court cases dragged the issue through the Byzantine Indian judicial system. The matter remained unresolved when Bangladesh broke away from Pakistan in 1971.

In 1974, the 1958 agreement was renewed and modified by prime ministers Indira Gandhi and Mujibur Rahman. As part of the new agreement, in exchange for Bangladesh dropping a former Pakistani claim to part of Jalpaiguri, Bangladesh was able to retain its largest enclave in India. This enclave comprises two villages, Dahagram and Angarpota, and, being only 178 metres from the Bangladeshi mainland at its closest point, India leased to Bangladesh, in perpetuity, an 85-metre wide corridor of land at this point, to allow free passage for Bangladeshis. But court actions in both countries prevented the lease until 1992, when that part of the agreement was finally implemented. Initially the east-west Tin Bigha corridor (named for its surface area of three bighas), and manned by Indian border guards, was open to Bangladeshis on alternate daylight hours, but today is open 24 hours, except when Indians wish to cross north-south, when Bangladeshis must wait for the Indians to pass.

Since partition

The rest of the enclaves have sat in limbo since 1947. The politics and emotions of partition forced an almost total border closure between India and Pakistan, and then India and Bangladesh. Enclave residents were initially able to cross from enclave to their home country's mainland, and officials were able to travel from the mainland to the enclaves to administer them. But slowly all government authorities were banned from transiting the intervening country's territory: soldiers, police, electoral and census officials, school teachers, doctors. . . On each side, the surrounding state classified the enclaves within it as foreign territory, so did not provide any services to them (electricity, water, development projects, education, health…) and did not allow the residents of the enclaves to access schools, hospitals or markets in its own territory. As no enclave had an official border crossing, any enclave resident leaving his enclave was considered to have illegally entered the surrounding country, and faced harassment or arrest. The enclaves thus became a no-man's land of unadministered territory; and a haven for criminals, smuggling and drugs.

Residents of enclaves therefore became

effectively stateless: unable to vote or travel. The inability of the owning country to police its own enclaves also enabled the population of the surrounding state to force the original enclave residents out, and take over the enclave lands. Both India and Bangladesh today claim that the people now living in their own enclaves in the other country are no longer their citizens, but invaders who have 'captured' the enclave. This provides a further excuse not to let those people cross into the enclave's motherland, or to provide services to it.

Today, up to 100,000 people live in the enclaves on each side of the (fenced) main boundary. Negotiations to exchange the enclaves have foundered over the years on the issues of whether to exchange the enclave populations or leave them in situ, of compensation for differences in enclave area and population between the two countries, and of resolution of several instances of adverse possession along the main boundary in the vicinity of the enclaves. Nevertheless, in late 2011 the prospect of enclave exchange appeared close, with officials on both sides claiming negotiations are almost concluded, but no details or timetable has yet been made public.

The Cooch Behar enclaves are now three centuries old. They existed without problem for half a century under the Mughals, and another two centuries under the British. It was only when the subcontinent returned to native rule in 1947 that they became problematic, and they have remained disputed and ungoverned for the 65 years since. But the dispute over them is not a result of their existence as feudal leftovers in a modern world: about 50 enclaves still exist at international level in Europe, where they are stable, prosperous tourist attractions, and thus immensely valuable to the owning and surrounding state for bringing revenue and jobs to otherwise marginal frontier areas.

The Cooch Behar enclaves, if given the chance, could also bring economic benefits to their surrounding region, a remote and undeveloped part of both countries. This economic potential, as well as their purely heritage value as the world's most complicated boundary, would be lost if they were exchanged. Given current relations, exchange may well be the most likely way to offer immediate relief to the marginalised enclave residents; but it will also be a sad reflection on the inability of the two subcontinental cousins to live together despite their shared heritage. After the polemics directed against Sir Cyril Radcliffe's partition line of 1947, it is ironic that the Radcliffe line is now accepted on both sides, but that the one remaining boundary dispute is over a pre-British, native, boundary upon which the now-independent states prefer to cast a Solomonic judgement rather than try to share.

"...and did not allow the residents of the enclaves to access schools, hospitals or markets in its own territory."

About the author
Brendan Whyte PhD is Assistant Map Curator at the National Library of Australia. He has published books (with detailed maps) on the historical geography of both the Cooch Behar enclaves, and the 30 enclaves and counter-enclaves of the Belgo-Dutch village of Baarle-Nassau/Baarle-Hertog. They can be downloaded at **http://repository.unimelb.edu.au/10187/985 and http://repository.unimelb.edu.au/10187/9940**

Hexagon 2012: 'taking care of business'

Synergy, integration and multidimensional context-aware thinking was at the heart of what Hexagon has achieved since its acquisition of Intergraph two years ago. But there was much more to see at the 2012 User Conference, reports **Adam P. Spring**, including the launch of the cuddly Hex-e above.

Hexagon's acquisition of Intergraph in October 2010 marked the beginnings of the integrated technologies on display in Florida (see *Geomatics World*, Sept/Oct 2011). Now, flash forward almost two years to the MGM Grand Las Vegas – the home of Hexagon 2012. A conference where cross-divisional communication was matched by displays of data fusion and synthesis. Even 'The King' would have been stunned by the way Hexagon was 'taking care of business' - Elvis' motto in his later years.

Hexagon 2012 was a gathering of 'Thinker's Gone Wild' - it even said so on the T-shirts! In addition to networking opportunities for the 3000 plus attendees, there were 29,000 hours of presentations, 60 exhibitors, 50 training sessions and a Legends of Vegas stage show. Seen by some as a gamble, the Intergraph merger was not only paying off, but reaping rewards. It was one marriage witnessed in Las Vegas that should stand the test of time.

Emerging outcomes

Fundamental to the successful union was the cross pollination of workflows from all four company divisions: Hexagon Geosystems; Hexagon Metrology; Intergraph Process, Power and Marine; and Intergraph Security, Government and Infrastructure. This included IPP&M's SmartPlant 3D which has fully embraced Leica Truview and ScanStation C10 workflows. Full immersion of the HDS product line in the power plant industry is finally achieving the dynamic management solutions envisioned by **Ben Kacyra** in the late 1990s. For **Ola Rollen**, president and CEO of Hexagon AB, it was a sign of sustaining innovation and 'evolution, not revolution'.

Strategic foresight

The ten-year evolution of Hexagon as a company was outlined in an update of its financial targets. Though the company has not fully escaped the effects of a slowing Chinese market or the Eurozone crisis, it was clearly on course to achieving its targets of 8 per cent organic market growth in the long term and €3.5 billion in revenue by 2015. There was even a duality to the Eurozone crisis in that negative figures confined to the southern region were offsetting positive returns in the north. Though remedied by recovering North American markets and automotive industries, Rollen confirmed they would provide firm solutions in times of uncertainty: 'In a recession scenario we'd be prepared to do more bold mergers and acquisitions'.

Rollen was clearly in his element analysing, predicting and encouraging market growth. In fact, his presentation was more than just a tale of emerging markets, synergy, solutions and divisional balancing acts. It was an insight into the acquisition of Intergraph, as well as an intuitive business strategy flexible to change: 'What we did with Intergraph was we analysed them over a couple of years and then we had the dip in '09. And, already in the first quarter of 2010, we were ready to act'. His analytical skills were inspirational; they were as finely calibrated as the instruments Hexagon produce.

Opening keynote

The opening keynote started by identifying visual information as a primary form of communication. Rollen elaborated on this, framing it in the context of fast moving information flows synonymous with modern life. Included was the prominent issue of communication between workflows and achieving data optimisation – especially when information is not just visual but incorporates precise measurement accuracy. Multi-dimensional, dynamic, and context-aware thinking was encouraged. Thinking that valued current trends in mobile technology use and looked forward to a growing demand for real-time data workflows. Fortunately for Rollen there would be no talk of gambling from this part of his Las Vegas adventure. Instead, he had his very own Jordanaires, Elvis' backup quartet: **Juergen Dold**, **Norbert Hanke**, **Gerhard Sallinger** and **John Graham** – 'taking care of business'.

Hexagon Geosystems, which includes Leica Geosystems and other brands like Z/I Imaging, is the leading light in synergy across the divisions. Out of the presentations given by each divisional leader, Dold heralded future technological possibilities. Not content with making the digital world real, Hexagon's recent acquisition of myVR was taking his multidimensional workflows to the next level: 'They have created a software for every one of you who has this challenge of having data from different sources and wants to merge them for a 3D view and then stream it over the Internet'.

Blom and myVR

In May Hexagon announced the acquisition of myVR; shortly followed by a 25 per cent stake in another Norwegian company, Blom, on June 1st. With integration of the myVR mobile viewer into cross-divisional workflows, and an invested interest in the geospatial service provider, a progressive and integrated technology strategy continued to be implemented building up to Hexagon 2012. One year on from Hexagon's first

"... Geosystems is the leading light in synergy across the divisions."

user conference, the new additions were indicative of the way trends in mobile technology are shaping geospatial markets as well as presenting what Rollen termed 'actionable information' in practice. Presentations by SG&I president John Graham, his CTO **Mark Doherty**, integration of Geomedia into the Leica CS25 and an iPhone app for photo dehazing, all reaffirmed this. Mobile media communication even played a major role in attendee interactions before, during and after Hexagon 2012.

Thinking Forward

Rollen describes Hexagon's strategies within the context of an ecosystem; a geospatial ecosystem where the individual is key and 'the power really comes from the solution, not the technology itself'. The intuitive social media strategy presented in Las Vegas, which included video documentation, YouTube dissemination and constant news updates, was an extension of this idea. In fact, it fed into Hexagon's strategies for coping with a rapidly evolving digital landscape.

Hexagon is using the 'digital world' to better inform real-world decision making processes. One way attendees were encouraged to think forward and make 'real-world' decisions was to look to the accumulated knowledge of the company and its user community for help. Name badges were transformed into effective social networking and peer-to-peer learning tools where 'Fresh Thinkers' and 'Alumni' could engage with one another. The badges were even compatible with smartphone or tablet devices, which could run the Hexagon 2012 app to navigate the event.

Hexagon 2012 app

The Hexagon 2012 app took full advantage of technology. Feeding into the idea of an Internet of Things – originally taken from **Bruno Latour**'s *A Parliament of Things (1993)* – the app enabled users to build their own conference before touching down in Las Vegas. Much like media coverage for the conference it promoted the use of mobile devices in a way that freed up, augmented and encouraged collaboration between users and information flows. The same could be said for Hex-e.

The Rise of Hex-e

Drawing on experience from Walt Disney World Resort and Hexagon's 2011 event in Florida, a mascot – Hex-e – was unveiled. Available for autograph signings, photo opps and media bytes, the seven-sided sidekick contributed to social networking strategies in its own way - quickly becoming a conversation starter. With fridge magnets advertising Hexagon 2013, cuddly toys, posters and customised footprint floor banners, Hex-e looks set to be a franchise within his own right. Could a festive workout video be Hexagon's next big release?

Above: Networking was encouraged by the 'Think' themes.

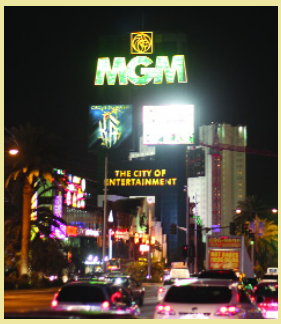
Think again, think exploration and think progress

Networking spaces were structured around the 'Think' themes of Again, Exploration and Progress. Of the three, Exploration was a noticeable constant throughout and was represented by the sixty exhibitors in the technical park. Situated in an area that conveyed synergy, Hewlett Packard, much like the other gold sponsor Microsoft, brought mainstream appeal to the conference. The inclusion of non-profit organisations like the US Institute of Building Documentation and open source archive Point Cloud Library (PCL) amongst such giants reflected a shift in corporate thinking – one toward more transparent research and development strategies. For instance, the director of Leica Geosystems' scanning software team, **Chris Thewalt**, gave his approval to PCL with four words: 'That is pretty cool'.

The advantage

Even in a digital world, it is hard to ignore the experience gained from the workflows of the past. This underlying statement was integral to the Leica Geosystems keynote given by **Juergen Dold** and **Ken Mooyman**. In a technological climate where companies like Google champion the notion of ubiquitous information use, Dold emphasised that there is no substitute for the wisdom gained from experience and workflows informed by trial and error over time. Z/I Imaging and Leica Geosystems (formerly Wild Heerbrugg) were his examples; companies with strong 80-year

> *"Hexagon is using the 'digital world' to inform real-world decision making processes."*



MGM Grand, Las Vegas

Staged at the MGM Grand, Las Vegas, the conference fitted David J. Schwartz's mantra "Think big goals and win big success". At 80 metres high and with thirty floors containing 6,852 rooms, the emerald green giant was the largest hotel in the world when it opened in 1993. Though currently weighing in at number three it still boasts a 171,500 square foot gaming floor, 2500 slot machines (stakes range from 1 cent to $1000 – maximum pay-out over $100,000,000) and 139 poker and table games. Until 1999 it even had a lion habitat amongst the now defunct Wizard of Oz themed decor. One wrong turn en route to the two nightclubs or eight swimming pools in those days surely resulted in shrieks of: 'There's no place like home'.

Above: With a hint of that old 'Rat Pack' feel, Greg Walsh (left) and Geoff Jacobs swap views.

histories in their respective fields of airborne sensors and photogrammetry. 'In the past we have competed for the same money, for the same budget, with the customers but not necessarily for the same applications. We can now offer the right solution for what you need and not sell you what we have'. The bonus of having this acquired synergy within the company benefits users across software and hardware lines. Such products were now infused with what Mooyman termed the 'Hexagon Geosystems advantage'.

Leica Geosystems' latest solutions

The updated Leica Geosystems range mixed ubiquity of use with guaranteed, reliable solutions. Taking inspiration from exhibitor Pictometry, airborne capture now included oblique photography within photogrammetric workflows. This was complemented by the software solution XPro, which processes data at the 'speed of flight'. Adding to the Internet of Things were handheld solutions like the Leica Zeno 5 GPS receiver and Leica X310 Disto. An extension of the workflows centred on iCON – an asset management software package – and the new Leica Flexline Plus total station are bringing surveying to a fresh generation of users.

> *"Gary Howell. . . redefined the way ScanStation C10 workflows were being used in the field of forensics both at the scene of a crime and in the laboratory."*

HDS user community

Leica Geosystems' HDS user conference first met as a large event in 2005. At the centre of developing this user community and the HDS brand was **Geoff Jacobs**, senior VP of strategic marketing. Employed by Cyra Technologies in 1998 (acquired in 2001) the rise of mid-range laser scanning is as much a product of Geoff's network building skills as **Ben Kacyra**'s business savvy. Initially congregating near HDS headquarters in California from 2005-2010, the user community has done much to encourage Hexagon's user conference. Backed by a last minute increase in registration figures, attendees were literally standing in the back of sessions to watch presentations from this part of the Geosystems' session. High Definition Surveying remained the epitome of cool at Hexagon 2012.

Canon 60D camera workflow

The leading development for the HDS brand was the Canon 60D external camera workflow. Designed by the company's chief scientist **Greg Walsh**, classes on how to use it formed part of the 20 training sessions. The workflow was also outlined in the presentation Imaging Advances for HDS Scanners & Design Trade-offs When Integrating Imaging into Laser Scanners. The integrated Canon 60D camera workflow incorporates a sprinkling of photogrammetry to achieve faster, more photo-realistic texture mapping of point clouds.

Future direction of CyArk

At the start of 2012 **Tom Greaves** became executive director of CyArk. A departure from his previous role as the founder of the SPAR Point Group, Tom took the position after a call with HDS brand creator and CyArk founder, **Ben Kacyra**. As Kacyra's response to the destruction of the Bamiyan Buddhas in Afghanistan, his California not-for-profit corporation has been digitally preserving endangered heritage sites since 2003. In the keynote given at the Geosystems luncheon on Wednesday, Greaves outlined his vision for the future of CyArk. This included continued support from Leica Geosystems and an evolving relationship with Google and Autodesk. In fact, the latter is helping CyArk develop a photogrammetric workflow centred on its free solution 123D Catch.

Integrated presentations

The HDS sessions were a mix of increased integration with other technologies, the evolution of established themes and a noted curiosity from users in other sessions. Of the six themes specific to laser scanning – BIM, Forensics, Heritage and Plant & Marine stood out from strong competition in the Civil and General sessions. **Caitlin Stevens** presentation of the digital campus created for the University of Arkansas, for instance, was redefining planning and development strategies - taking advantage of all skill-sets on site in order to achieve the required millimetre accurate results. Whereas, **Gary Howell**, director of the Johnson County Sheriff's Office Criminalistics Laboratory, redefined the way Leica ScanStation C10 workflows were being used in the field of forensics both at the scene of a crime and in the laboratory. For Howell, end user deliverables included evidence suitable to stand trial in a court of law. Long time HDS specialist, **Tony Grissim**, did a seminal job in coordinating this portion of Hexagon 2012.

Conclusion

Hexagon 2012 emphasised the company's position within markets and cultures governed by rapidly changing information flows. Internally, point cloud meshing solutions like 3DReshaper continue to influence other products like Cyclone II TOPO and is one of the examples benefiting from Hexagon's appetite for acquisitions that can be leveraged across the organisation. The context in which patents were discussed emphasised the excitement and new buzz coming from the many heads of the hydra Hexagon has created. There was even a self-referential break-out session for industry journalists who wanted to morph into industry commentators. Scheduled to return to Las Vegas' MGM Grand, June 3rd - 6th, 2013 and 2014, there should be more bright lights ahead.

About the author
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Fair-weather cumulus or cumulo-nimbus? Don't let it rain on your parade

Cloud services are growing and it's not because of the wet summer. Our legal correspondent unravels the acronyms and the issues surrounding contracts and licences when IT resources leave your server or desktop.

By Carl Calvert

This evening I am off to see Beating the Retreat by the Coldstream Guards and also the Pipers and Dancers of the Scots Guards Association. The clouds are building up and there is a risk of a washout. Cloud computing is like that too if the contract is misunderstood, according to the Centre for Commercial Law Studies (CCLS) at Queen Mary University of London (QMUL) **http://www.cloudlegal.ccls.qmul.ac.uk/**.

So, what is cloud computing in the first place? 'Some analysts and vendors define cloud computing narrowly as an updated version of utility computing: basically virtual servers available over the Internet. Others go very broad, arguing anything you consume outside the firewall is "in the cloud," including conventional outsourcing'; so says **Eric Knorr** of *InfoWorld*. In other words it is 'out there'.

As with every new or developing concept there are acronyms: in cloud computing all three aspects end as 'aaS' referring to 'as a Service'. What is then needed is the noun to say what is provided as a service. These are:

(a) Infrastructure (IaaS);
(b) Platform (PaaS); and
(c) Software (SaaS).

The next question to ask is why? Many organisations have fixed IT resources and often need to allocate more resources dynamically without the capital expenditure and with transparency to their clients. IaaS provides users with servers to rent; PaaS additionally provides the system software whilst SaaS includes application software and sometimes databases. Thus the costs of expanding a company's IT resources can be considered relative to different levels of service of the cloud providers: then comes the legal bit – the contract.

Research by QMUL [**http://papers.ssrn.com /sol3/papers.cfm? abstract_id =2055199**] examined how and why cloud providers have begun to negotiate standard contract terms to better meet cloud users' needs, minimize operating risks and address legal compliance obligations. The study predicted a multiplicity of contracting models for cloud computing and the report also raised concerns that end-users often fail to do an adequate risk assessment, if at all, and invariably agree to standard terms, overlooking unfair ones. In some instances this is due to an inability to negotiate because of 'click thru' licences.

The research showed that the top six types of cloud contract terms most negotiated were:
(a) provider liability – almost anything may be excluded; including lost or damaged data,
(b) service level agreements – which often do not reflect either the users' business or their clients' requirements,
(c) data protection and security – if it involves personal data then it must comply with EU Directives, in fact the location of the storage of the data is often unknown and users may inadvertently breach data protection laws. It is up to the user to ensure that data storage complies with relevant laws. One global user said that if it could not ensure its data were confined to the EU, it would nevertheless avoid the US because of the US Patriot Act and litigation issues.
(i) *termination rights and lock-ins/exits* – almost self-evident that the user should negotiate a way to terminate the contract with an ability to move the data to another provider,
(ii) *unilateral amendments to service features* – it seems common amongst cloud computing providers to reserve the right to change any aspect of the service unilaterally. This may mean that the user has no or limited negotiating rights at all in alterations to service provision, and
(iii) *intellectual property rights* – not all licences allow the application to be ported into the cloud, and standard terms may not address users' applications developed or deployed in the cloud.

'These are the key contractual issues of concern to users in the cloud market at this relatively immature stage of cloud adoption,' said Professor **Christopher Millard**, lead academic on the Cloud Legal Project (CLP) and as reported by **Patrick Burke** of Ulitzer.

Conor Ward (Partner at Hogan Lovells International LLP), chair of the Cloud Industry Legal Forum (CILF), took a view that legal concerns can generally be addressed by technical and legal means with the supplier having restricted flexibility due to the technical infrastructure. That is one view. The pragmatist within me believes that the legal concerns often arise because of real technical restrictions (discovered later) rather than implied ones.

Of course the cloud has many benefits to those of our community who have lost an iPAD and needed to recover the data: a cheap affordable way of backing up.

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Topcon on the move: a sunny day in Hendon

A visit to the UK's RAF Museum at Hendon was the penultimate stop on the British leg of Topcon's recent road trip around Europe, reports **Richard Groom**. Planning, measuring, controlling, collaboration, imaging and scanning were all on the agenda.

The RAF Museum is a fine setting and for once we were blessed with some of that glorious sunshine that makes field surveying a pleasure. Whilst there were equipment demonstrations outside, most of the business of the day was conducted at the far end of a voluminous hangar holding aeronautical displays from the first half of the 20th century.

Topcon is a Japanese company with global tentacles. The US is where much of the GNSS development takes place and Asia the home of the company's optics expertise. Europe is a big market for Topcon and in Britain the focus is on working with customers to get the most out of the technology.

The state of the market

Following an introduction from **Steve Cooper**, general manager of Topcon UK, **James Abraham** of Glenigan spoke about the state of the construction industry in the Britain. Glenigan identify and record all planning applications and track projects from start to finish, including details of who is doing what. They produce a free monthly report which is well worth keeping an eye on: www.glenigan.com/topcon. Current government economic aims are well known: reduce the deficit, rebalance the economy and foster growth. Glenigan's graphs make interesting reading, but the central message is that the declining number of new builds is being replaced by a corresponding increase in refurbishment work. Development is also London-centric, and bolstered by an influx of money from other European economies.

Topcon GB has four operating areas: machine control, construction, surveying / geomatics and mobile solutions. Delegates were taken on a trip into each area, where lurked some unexpected gems.

Machine control

Topcon has gone to town on machine control and a trailer in the car park contained an exhibition of the systems, which they have devised for controlling all the heavy equipment on a construction site. The surveying can come from 3D GNSS, 3D total station or 2D laser. Topcon has carried out tests and in one instance conducted bores in a road surface after construction, that revealed paving thicknesses correct to within 2mm, well within construction tolerances.

Stuck inside on a sunny day with the lure of Spitfires and Hurricanes and survey kit outside itching to be used.

The business case for machine control is compelling. Less materials are consumed, rework of design during the construction phase can be implemented more efficiently, and higher accuracy means less spent on materials. **Daniel Smith** is Topcon's machine control guru. He says that the UK is way behind Europe, where the technology is specified in tenders. Topcon also has a remote asset management software package called Tierra, which analyses the productivity of each item of plant in near real time using the machine control and other sensors. The software also includes an alarmed geo-fence to make sure the plant is working where it should be.

Machine control has not yet filtered down to the small building site where Topcon has setting-out lasers, some of which come with interesting gadgets. Beam scanning is a technique whereby you can hold a special reflector to the rotating beam and generate a 'solid' marker line against a surface. Topcon's latest total stations all come with TS Shield. This technology incorporates mobile telecomms that allow the instrument to be shut down via the Internet. Useful in the fight against thieves as well as preventing hirers from overrunning their term. The same technology can report errors back to the company so firmware updates can be sent. The latest instruments can be fitted with long-range Bluetooth, so data collection can take place at the pole. This causes one to consider whether it could be more efficient to have a person on the instrument than to operate as a sole surveyor with a robotic total station. Particularly impressive is the distance measurement time of 0.9 second.

New survey software

MAGNET is Topcon's new processing software and was presented by **Peter Roberts**. It comes in field, office and enterprise components and, unlike its competitors, presents a challenge to the ubiquitous use of AutoCAD in the survey world. The first thought is that this is a huge gamble, but seeing it in practice one wonders whether, on the contrary, it could in fact be a great success. The advantage of taking this course is that there will be no need for compromise when interfacing with new Topcon equipment. It is field-to-finish software which can incorporate photographs and notes. MAGNET Enterprise allows users to store their surveys on the cloud for collaborative working. The software is not yet available, but is due for launch soon.

Planning and scheduling

Another of the hidden gems of the day was undoubtedly DynaRoad, which has nothing to do with clearing drains! This is BIM software

for construction with an emphasis on planning and scheduling. It is a most impressive product. Changes ripple through from end to end and 'impossible' changes are flagged as such. The results are presented as charts and plans that make for excellent visual checking. But. . . the ultimate goal of BIM is to model the life of a structure from design through build, operations and decommissioning. Furthermore, at the Infrastructure Show last year, the point was made again and again that construction and design have to work together to get the most out of BIM. Collaboration is the key, yet DynaRoad software is not linked to CAD. This point is recognised but the current advantage of the DynaRoad approach is that construction planning can be implemented quickly because it is NOT linked to CAD. It seems inevitable, however, that design and construction will be connected and so it also seems inevitable that this software, covering a neglected part of the process, will be snapped up by one of the big boys.

Imaging

Topcon's imaging total station is now in its fourth generation and does all that is required of an all-rounder. Its best bits include: 300m range, coaxial camera, 360 degree passive prisms, highly responsive tracking and a 20pps scanner that can scan at any resolution.

Mobile scanning

Cat Surveys Geomatics Ltd is Topcon's mobile laser scanning partner. They recently purchased an IP-S2 system and brought it along to the event. They have been doing some serious testing of their system over the summer with various configurations of survey control to enhance sensor positioning from the GNSS / IMU.

RTK + laser

Moving on to GNSS: Topcon brought out the GR5 six months ago. In addition to working with GPS, GLONASS, COMPASS, Galileo and IRNS (Indian Regional Navigation System), it can process augmentation signals from EGNOS and others. Network RTK is not, on its own, suitable for levelling on sites due to its low relative accuracy. Topcon address this problem by augmenting GNSS with a laser levelling instrument to determine height. They also sell an 'RTK Bridge', a small receiver and radio transmitter that can be set up in a car located where there is mobile phone coverage and can then broadcast RTK corrections into a survey area where there is no mobile phone signal.

Topcon's latest total stations, the OS series, could put the surveyor back on the pole. Meanwhile the IP-S2 scanner (below) has undergone serious testing.

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Surprise sheep shed silent film show

By John Brock

Determining the path of ICBMs and viewing a 1920s film of a land surveyor who beats the bad guy and gets the girl are all part of our antipodean correspondent's recent adventures.

Returning from the FIG Working Week in Rome in May I knew that I was getting on after the celebration of my grandson Dylan's third birthday at the end of that month! Not only that, this just happens to be the tenth year of my regular contributions to our great surveying mag *Geomatics World*, truly an icon of international standard. My most sincere thanks are extended to our fantastic editor Steve and all of those who continue to encourage me to provide some easy Aussie reading from downunder also covering worldwide events and topics with a surveying nuance.

Lecture on the "Rocket Man" surveyor

Australia's Government has been widely criticised for letting the UK military explode atomic bombs on our territory in the early 1950s with radiation contamination still being detected over 50 years later. However, there was a great man who single-handedly determined the trajectory path for ICBMs (Intercontinental Ballistic Missiles for younger readers) across the western lands of our country from the town he named Woomera (Aboriginal for spear thrower), together with 1000's of kilometres of roads leading in and out of this town.

He was **Len Beadell**, who I met at a lecture for a 4-Wheel Drive Club at Brisbane in 1992. At the Parramatta Historical Society April meeting **Vic Grant**, who was a personal friend of Len, gave a great presentation of the enormous work Len did for the establishment of the Woomera Rocket Range. Len was a very funny man who delighted in his recollections of how he would frequently take the mickey out of illustrious UK scientists like Lord Penny. Truly an Australian colonial scallywag for we of Irish ancestry to be most proud.

Macarthur's mansions tour

John Macarthur is a legendary character in the early years of the development of Australia, not only because of his tremendous success with the establishment of the wool industry in the colony but more so for his belligerent personality. His ongoing feuds with various governors were punctuated with two pistol duels and ultimately the coup that deposed Governor William Bligh in what we affectionately term 'The Rum Rebellion' (Aussies like to mark most significant events with an alcoholic beverage).

A silent cinema surveying spectacular

Two Topp Tours of the Bathurst region provided top enjoyment, with Fitzgerald's Valley one week followed by the regional country area, Freemantle (20 minutes from Bathurst, three hours west of Sydney). I regard myself as fairly knowledgeable about Hollywood movies with surveying content but I was thoroughly stunned when we were shown a very old film on our second tour.

Viewing one of the two movies filmed by director **Franklyn Barrett** in this sheep-shearing district of Freemantle in 1920 I thought that I was in heaven when the silent film *A Girl of the Bush* (released 1921) threw out actor **Jack Martin** as Tom Wilson the land surveyor male hero of this historic classic. Not only are there scenes of Tom shaving outside his tented accommodation next to his prized theodolite, he beats up the bad guy three times, survives hanging for being falsely accused of killing the same baddie then wins the female lead actress, **Vera James**, who played the part of estate owner Lorna Denver. It is not the earliest example of surveyors on film but it is definitely an amazing circumstance that I actually viewed this film within the historic shearing shed (c. 1890s) in which scenes from the movie had been filmed.

Sir Pawel Strzelecki and Mount Kosciusko

Les Strzelecki is an old school friend of mine, descended from the brother of the first man recorded to ascend Australia's highest peak giving it the name of Mount Kosciuszko in memory of the heroic Polish freedom fighter **Tadeusz Kosciuszko**, who helped George Washington beat up the English army in the US War of Independence. Pawel Strzelecki was the brother of Peter, the great great grandfather of Les and his brother John. Knighted by Queen Victoria in about 1854 for his selfless work saving hundreds of Irishmen during the potato famine, Sir Pawel made explorations along the east of New South Wales down to Van Dieman's Land (now Tasmania) between 1839 and 1843. His book of these extensive investigations, *Physical Description of New South Wales and Van Dieman's Land (1845)* with a large hand painted map, is now held in the British Geological Survey at Keyworth in the UK.

• *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.*

• Watch out in the next issue of GW for John Brock's report of the History Workshop held at the FIG Rome Working Week

Having a ball in the Baltics

by Nick Day

Escaping the English rainy season our correspondent heads for Baltic states and finds a world of advanced technology that even little old ladies can master.

Leaving California on May Day (perhaps not the best day to fly!), I arrived in London in time to catch the last of the RICS Geomatics' lecture series on latest research in GNSS. But noting the grim weather, I soon headed out for a month on the road visiting five new countries-Russia, Finland, Estonia, Latvia and Lithuania (sounds a bit like some chemical element from the Periodic Table, doesn't it?). And, what an eye-opener it was, making me wonder whose propaganda to believe-the West's or the East's? Neither, of course. One needs to see for oneself. If you had told me even 20 years ago that I would be walking around inside Moscow's Kremlin in 2012, seeing the old TASS news agency and KGB buildings, I might have questioned your sanity. Other Brits and fellow travellers I chatted with were blown away by what they saw. Very clean (you could eat your piroshky off the marble floor of a Moscow metro station), everything was relaxed, lively, many pavement cafés, and no one ever stopped me taking photos anywhere.

Europe's oldest capital

The fascinating thing about the pace of advance in technology is that it allows originally backwards countries (perhaps "held back" would be a better description) to leapfrog first world ones, mired in the past with outmoded ideas and infrastructure. Cable TV, perhaps fine for a big metropolis, falls down seriously over satellite TV. Not just the medieval cities of Tallinn, Riga and Vilnius - the three Baltic capitals - but even in rural areas, many people have satellite TV with a wide variety of channels. So, they tend to be better informed on world events than the majority of Americans living outside major cities, and most likely even inside, with only Fox News and other restricted cable networks to rely on. Many folks don't realize that even if you have the highest speed broadband connection with fibre-optics, the last mile to your house may be old copper wire.

Tallinn dates back to the 12th century and is Northern Europe's oldest capital. The first traces of human settlement date back 5000 years. The walls and various square towers of this "walled city" still mostly exist. But, within those medieval walls I soon discovered that Estonia invented Skype, a technology I use a lot while travelling. Wi-Fi is everywhere in Estonia, and free! You can even see signs out in the forests saying "Internet spot @ 250m". I journeyed the 309 km from Tallinn to Riga by luxury bus, which for a ridiculously cheap price, provided free newspapers, coffee, tea, wi-fi connection, electrical outlets for each seat, comfortable reclining seats and footrests, and a spotlessly clean toilet. Saturation of mobile phones is 120 per 100 people. Latvia and Lithuania are not far behind. I was amused to see a little old lady at the bus terminal in Tallinn pay for her newspaper and a few goodies with her mobile phone. People already pay for parking using SMS on their mobiles.

Not back in the USSR

The Baltic countries do not consider themselves ever part of the USSR. They assert that their incorporation into the Soviet Union in 1940 was illegal. Be that as it may, they still suffered under the Bolsheviks, then the Nazis and Stalin. They did not achieve true independence until 1991 after the collapse of the USSR. Each capital city has its own "Occupation" or "War" museum. Riga has both, and I spent several fascinating, if not chilling hours immersing myself in the Baltic peoples' struggles. The assemblage and staging of memorabilia was brilliant; I don't think I've seen better elsewhere. It is history from an entirely different perspective, not one generally known or taught in Western Europe or the USA. The old photos on display are incredible. Two particularly stuck in my mind: one, a group of young boys, innocent looks on their faces, kneeling with their rifles and fixed bayonets, ready to defend their land. From statistics, we know probably none survived. Another photo showed four soldiers, all in gasmasks, with one holding the reins of a horse which was also wearing one.

Below: The Moscow Metro. Public luxury and private squalor was the watchword back in the USSR.

Left: the Geometres office in Riga. But why the frog? Surely not a backhanded compliment to French geometres?

World's first automatic 360° camera

Claiming a world first, NCTech has launched a fully automatic 360° panoramic camera. The **iSTAR** captures instant 50 Mpx high-resolution full spherical images. The image resolution far exceeds existing cameras and when superimposed onto a point cloud allows the viewer to clearly visualise the scene. Designed to be integrated seamlessly into lidar scanning process, the camera can process its images internally. Operated by a touch screen, iSTAR can be controlled remotely via a tablet providing a real-time view and can also be linked live to a TV monitor or over the Internet.

Small, light and robust making it easy to transport and quick to deploy the iSTAR is available in two models. The basic model is Fusion whilst the Pulsar offers extended capabilities including speed and time saving features to speed up productivity and provide even higher quality HDR (high dynamic range) images. It also offers a superior user interface with live full immersive view and introduce network connectivity and fast capture for video surveillance. Fusion can be easily upgraded remotely to Pulsar.

Raft of launches from Leica

The Hexagon user conference (see page 26) was the venue for the launch of many new Leica Geosystems products including a new generation of its mid-range series of total stations. The new flagship is the **FlexLine TS09** Plus offering superior convenience and performance through a colour touch screen. The new iCON range (see *Engineering Surveying Showcase 2012 issue No 1*) added a 3.5" color display rugged PDA, the iCON CC50.

The Leica **Zeno GIS** family added the Zeno 5, an entry-level, rugged PDA for users with full phone capabilities; wi-fi and Bluetooth; a 3.7" full VGA transflective display; Windows Embedded Handheld 6.5.3 Operating System; Rechargeable and hot-swappable all-day battery (10 hours +); a full range of interactive sensors including camera, digital compass, gyroscope, light sensor, proximity sensor and accelerometer.

Also announced were dual-head and penta-head configurations for the Leica **RCD30** series of medium format cameras. The RCD30 combines unique design features such as bi-directional motion compensation and beamsplitter technology. It is also the only medium-format camera to generate highly accurate, co-registered multispectral imagery from one camera head for photogrammetric and remote sensing mapping applications.

Other new products include an external camera mount for the Leica ScanStation C10 and C5, automatically integrating camera images into the scanner's onboard controller and data storage system. And the company has introduced a dedicated GNSS monitoring sensor, the GM10.

Optech's camera

Optech has launched the CS-10000 aerial camera with "True" forward motion compensation, a field-replaceable shutter, interchangeable lenses and 80Mpx format. The unit can be seamlessly integrated with Optech's existing lidar sensors.

• We apologise to readers for the brevity of this column but we have so much material and so little space. More next time.

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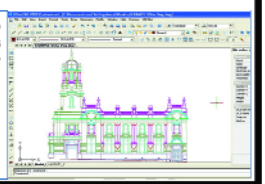

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