

Cadastral Boundaries from Point Clouds?

Towards Semi-automated Cadastral Boundary Extraction from ALS Data

MULTISPECTRAL AND THERMAL SENSORS ON UAVS

FAIR TREATMENT OF PROPERTY RIGHTS

ORDNANCE SURVEY IRELAND SHOWS NEW PERSPECTIVES

GALAXY G6

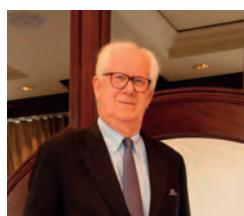
- Linux Operating System
- WIFI hotspot & connection
- Radio router
- Rinex storage support
- Complete NTRIP Caster
- 8GB SD storage

POLAR

X5/X6

- 8GB SD storage
(Android y/Windows Mobile optional)
- Laser centering
- 4.3 inch 480×800 screen
- NFC and fingerprint identification optional
- 4 hours quick charge

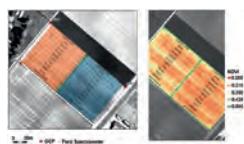


**INTERVIEW PAGE 12****Harmonising UAS Regulations and Standards**

GIM interviews Peter van Blyenburgh, president of UVS International

**FEATURE PAGE 16****Cadastral Boundaries from Point Clouds?**

Towards Semi-automated Cadastral Boundary Extraction from ALS Data

**FEATURE PAGE 19****Multispectral and Thermal Sensors on UAVs**

Capabilities for Precision Farming and Heat Mapping

**FEATURE PAGE 22****Fair Treatment of Property Rights**

Stop Land Theft: Abolish Article 34(6)



This month's issue of *GIM International* contains – amongst many other state-of-the-art geospatial features – an article on semi-automated extraction of cadastral boundaries from airborne laser scanning (ALS) data. The cover shows an overview of automated extraction results overlaid on imagery from a sample region. For the full story see page 16.

ADVERTISERS INDEX

Beijing UniStrong, www.unistrong.com	29	Ruide, www.ruideinstrument.com	7
ComNav Technology, www.comnavtech.com	26	Sanding, www.sandinginstrument.com	25
FOIF, www.foif.com	42	Siteco Informatica, www.sitecoinf.it	11
Hi-Target Surveying, en.hi-target.com.cn	14	South Surveying, www.southsurveying.com	2
Kolida, www.kolidainstrument.com	35	TI Asahi, www.pentaxsurveying.com	32
Leica Geosystems, www.leica-geosystems.com	4	TI Linertec, www.tilinertec.com	40
MicroSurvey, www.microsurvey.com	24	Trimble Geospatial, www.trimble.com	43
RIEGL, www.riegl.com	9		

REPORT**PAGE 27****Ordnance Survey Ireland Shows New Perspectives**

Part 1: Cartographic Orchestration

FEATURE**PAGE 30****UASs for Cadastral Applications**

Testing a Fit-for-purpose Land Administration Approach in Indonesia

REPORT**PAGE 33****Frankfurt: Lack of Open Data Frustrates Researchers****COMPANY'S VIEW****PAGE 36****The Quest for Large Urban 3D Scenes without Visual Artefacts**

Spotscale

News & Opinion**page**

Editorial	5
Insider's View	6
News	7
5 Questions	10

Organisations

FIG	38
GSDI	38
IAG	39
ICA	40
ISPRS	41

Other

Advertisers index	3
Agenda	42



Leica Geosystems HDS software makes up the complete solution for Digital Reality Management

Leverage the ability to integrate data from a variety of sensors and sources - hand-held, terrestrial, mobile and aerial. Use the most complete set of enhanced productivity tools for time and cost-effective end-to-end processing of point clouds. For desktop, mobile or in the cloud, Leica Geosystems HDS software efficiently generates the most accurate deliverables for any project. Create your own Digital Reality for success in any market.



Leica Geosystems AG

leica-geosystems.com



© 2016 Hexagon AB and/or its subsidiaries and affiliates.
Leica Geosystems is part of Hexagon. All rights reserved.

- when it has to be **right**



PUBLISHING DIRECTOR Durk Haarsma
FINANCIAL DIRECTOR Meine van der Bijl
SENIOR EDITOR Dr Ir. Mathias Lemmens
CONTRIBUTING EDITORS Dr Ir. Christian Lemmen, Dr Rohan Bennett, Martin Kodde MSc, Huibert-Jan Lekkerkerk, Frédérique Coumans, Ir. Sabine de Milliano
EDITORIAL MANAGER Wim van Wegen
COPY-EDITOR Lynn Radford, Englishproof.nl
KEY ACCOUNT MANAGER Sybout Wijma
ACCOUNT MANAGER Rutger Post
MARKETING ASSISTANT Trea Fledderus
CIRCULATION MANAGER Adrian Holland
DESIGN ZeeDesign, Witmarsum, www.zeedesign.nl

REGIONAL CORRESPONDENTS

Ulrich Boes (Bulgaria), Prof. Dr Alper Çabuk (Turkey), Papa Oumar Dieye (Niger), Dr Olajide Kufoniyi (Nigeria), Dr Dmitry Kurtener (Russia), Dr Jonathan Li (Canada), Dr Carlos Lopez (Uruguay), Dr B. Babu Madhavan (Japan), Dr Wilber Ottichilo (Kenya), Dr Carl Reed (USA), Dr Aniruddha Roy (India), Prof. Dr Heinrich Rüther (South Africa), Dr Tania Maria Sausen (Brazil)

GIM INTERNATIONAL

GIM International, the global magazine for geomatics, is published each month by Geomares Publishing. The magazine and related e-newsletter provide topical overviews and accurately presents the latest news in geomatics, all around the world. *GIM International* is orientated towards a professional and managerial readership, those leading decision making, and has a worldwide circulation.

PAID SUBSCRIPTIONS

GIM International is available monthly on a subscription basis. The annual subscription rate for *GIM International* is 120 with. Subscription can commence at any time, by arrangement via our website or by contacting Abonnementenland, a Dutch subscription administration company. Subscriptions are automatically renewed upon expiry, unless Abonnementenland receives written notification of cancellation at least 60 days before expiry date. Prices and conditions may be subject to change. For multi-year subscription rates or information on current paid subscriptions, contact Abonnementenland, Postbus 20, 1910 AA Uitgeest, Netherlands +31 (0)251-257926 (09.00-17.00 hrs, UTC +1) paidsubscription@geomares.nl.

ADVERTISEMENTS

Information about advertising and deadlines are available in the Media Planner. For more information please contact our key account manager: sybout.wijma@geomares.nl.

EDITORIAL CONTRIBUTIONS

All material submitted to Geomares Publishing and relating to *GIM International* will be treated as unconditionally assigned for publication under copyright subject to the editor's unrestricted right to edit and offer editorial comment. Geomares Publishing assumes no responsibility for unsolicited material or for the accuracy of information thus received. Geomares Publishing assumes, in addition, no obligation to return material if not explicitly requested. Contributions must be sent for the attention of the editorial manager: wim.van.wegen@geomares.nl.



Geomares Publishing
P.O. Box 112, 8530 AC Lemmer,
The Netherlands
T: +31 (0) 514-56 18 54
F: +31 (0) 514-56 38 98
gim-international@geomares.nl
www.gim-international.com



No material may be reproduced in whole or in part without written permission of Geomares Publishing.
Copyright © 2016, Geomares Publishing,
The Netherlands
All rights reserved. ISSN 1566-9076

Turmoil

The year 2016 has been one of the most challenging and unstable years of recent decades – what with the Brexit vote, the unexpected election of businessman Donald Trump as the next president of the United States, the impeachment of President Rousseff in Brazil, unrest in numerous countries and outright war in other parts of the world, plus an ongoing global stream of migrants seeking a better place to live. When it comes to the question of why there is so much turbulence among citizens all over the world, part of the answer could lie in governments' land policies. Land policies, together with property rights, all too often benefit the people who hold power at the expense of those who do not. Paul van der Molen, our long-standing contributor and emeritus professor of cadastre and land administration at the University of Twente (ITC) in Enschede, The Netherlands, addresses this issue in his article titled 'Fair Treatment of Property Rights' on page 22. Van der Molen points to the massive problem of land grabbing by large-scale foreign investors in Africa, resulting in many poor, vulnerable people and small farmers being evicted from land they have been living on for generations – some publications speak of 80 million hectares of fertile agricultural land being affected. Since access for individuals is

currently restricted, Van der Molen advocates the possibility for individuals to lodge their case on human rights grounds to the African Court of Justice and Human Rights. It would certainly stop a number of people looking for a better future elsewhere. The article by our contributing editor Frédérique Coumans titled 'Frankfurt: Lack of Open Data Frustrates Researchers' on page 33 describes problems at the other end of the spectrum. In her article, Coumans outlines a project by the Department of Geoinformation and Public Works at Frankfurt University of Applied Sciences. With the number of refugees in Germany already standing at over a million, the department is looking for suitable housing for thousands of them in the city of Frankfurt. In the project, the researchers built a GIS application using the large-scale map of Frankfurt and the cadastre real estate map with building polygons. The search focused on large, uncultivated land parcels and vacant buildings where several hundreds of refugees could be housed. The researchers were hindered not only by the lack of good data, but also by the informal guidelines for spatial planning coming together in three acronyms that say it all: NIMBY ('Not in my backyard'), LULU ('Locally unwanted land use') and BANANA ('Build absolutely nothing anywhere near anybody'). The causes of the first two problems seem unlikely to go away anytime soon, but it is apparent that good and fair land policy plays a big role in solving and preventing turmoil in the world. Unfortunately, everyone has their own ideas of what is 'fair' and 'good' depending on their own specific situation. Let's hope for more insight and balance in the year to come!



▲ Durk Haarsma, publishing director

EAB

The Editorial Advisory Board (EAB) of *GIM International* consists of professionals who, each in their discipline and with an independent view, assist the editorial board by making recommendations on potential authors and specific topics. The EAB is served on a non-committal basis for two years.

PROF ORHAN ALTAN

Istanbul Technical University, Turkey

PROF DEREN LI

Wuhan University, China

MR SANTIAGO BORRERO

Coordinator, GEOSUR Programme

PROF STIG ENEMARK

Honorary President, FIG, Denmark

DR ANDREW U FRANK

Head, Institute for Geoinformation, Vienna University of Technology, Austria

DR AYMAN HABIB, PENG

Professor and Head, Department of Geomatics Engineering, University of Calgary, Canada

DR GÁBOR REMETÉY-FÜLÖPP

Past Secretary General, Hungarian Association for Geo-information (HUNAGI), Hungary

PROF PAUL VAN DER MOLEN

Twente University, The Netherlands

PROF DR IR MARTIEN MOLENAAR

Twente University, The Netherlands

MR JOSEPH BETIT

Senior Land Surveyor, Dewberry, USA

PROF SHUNJI MURAI

Institute Industrial Science, University of Tokyo, Japan

PROF DAVID RHIND

ret. Vice-Chancellor, The City University, UK

PROF DR HEINZ RÜTHER

Chairman Financial Commission ISPRS, University of Cape Town, Department of Geomatics, South Africa

MR FRANÇOIS SALGÉ

Secretary-general, CNIG (National Council for Geographic Information), France

MR Kees de Zeeuw

Director, Kadaster International, The Netherlands

PROF JOHN C TRINDER

First Vice-President ISPRS, School of Surveying and SIS, The University of New South Wales, Australia

MR ROBIN MCLAREN

Director, Know Edge Ltd, United Kingdom

Fit for What?

Today, we have the benefit of extensive guidance on how to achieve good land governance. The Land Governance Assessment Framework, the Voluntary Guidelines on Tenure, the Land Administration Domain Model, the fit-for-purpose approach – all of these offer us the wisdom of considered thinking and many lessons learned. When I started my professional career, the only serious document available was the World Bank Land Reform Policy of 1975. With all the recent guidance, one would expect the world to be making good progress in providing security of land tenure to the millions of people who still lack it. But a prerequisite for applying the fit-for-purpose approach is of course that the 'purpose' is clear. Some countries are very successful. Rwanda managed to develop a land policy in 2004, an organic land law in 2005, pilots from 2005-2009 and an implementation from 2009-2014 in order to issue more than 10 million title certificates covering most of the country. Rwanda formulated a clear 'purpose', and made its institutions and technology 'fit for purpose' before the term even existed. Meanwhile, most of Vietnam's agricultural land is today covered by land use certificates: about 100 million certificates are recorded. Is this one of the reasons that Vietnam has developed from a poor rice

importer into one of the world's top rice exporters? Vietnam also knew what it wanted. I'm not suggesting that these countries are now problem-free when it comes to land, but at least they're walking 'on the sunny side of the street'. I regard Kenya as another good example. After a long process of consultation, in 2009 the National Land Policy was endorsed and translated into the Constitution (2010) and into a set of new laws (2012), providing tenure security to private lands, public lands and customary lands: a well-balanced piece of work. A central role in land governance is reserved for the Land Commission, which should work independently of the government. Unfortunately a High Court order was needed to force the president of the republic to publish the names of the members, meaning that the Commission was not actually sworn into office until 2013. Now great problems exist between the Commission and the Ministry of Lands, resulting in arguments over a Land Law Amendment Bill that proposes to drastically change the constitutional mandate of the Commission. Despite these political problems, the legal framework is generally considered by pundits as wise and fair; it should have been easy to formulate a 'purpose'. In Namibia, after 15 years of delay, the new Flexible Tenure Act was finally endorsed in 2012 – a fine law providing innovative forms of tenure, which might be an example for many other countries. Unfortunately regulations are still to be gazetted. Hopefully this will happen soon, so that a 'purpose' can be formulated in Namibia too. I hope that this brief overview of a handful of countries creates awareness that – now the institutional and technological guidance is in place – politicians bear a great responsibility for offering their countries a sound 'purpose'. If so, the available documents will easily make clear what will be fit for that!

Paul van der Molen is an emeritus professor of the University of Twente and a former director of Kadaster International.



▲ Paul van der Molen.

Pix4D Launches Crane Camera Solution for Construction Industry

Today, as more and more industries adopt unmanned aerial vehicle (UAV) mapping and modelling for its quick and accurate results, certain industry applications benefit from alternative forms of data capture,

especially where UAV flights are either not possible or are inconvenient. The construction industry is one of them, as it needs the ability to automatically collect site data, analyse it collectively and monitor site development over time. Documenting and measuring sites on a regular basis is necessary, although time consuming and/or costly. That is why Pix4D has developed, in collaboration with Liebherr, a new way to collect site data which leverages equipment already on site. By mounting a camera system on a tower crane and combining it with Pix4Dbim software, Pix4D provides an automated and non-intrusive way to monitor construction sites daily, from an aerial perspective.

► <http://bit.ly/2f3yUUc>



Pix4Dbim timeline 3D model.

Siemens and Bentley Systems Join Forces

Siemens and Bentley Systems have formalised a strategic alliance agreement to drive new business value by accelerating digitalisation in order to advance infrastructure project delivery and asset



Greg Bentley.

performance in complementary business areas. Siemens and Bentley Systems will initially invest at least EUR50 million in developing joint solutions to enlarge their respective offerings for infrastructure and industry to the benefit of the end customers. This work will leverage new cloud services for a connected data environment to converge respective digital engineering models from both companies. In addition, Siemens has acquired approximately EUR70 million of secondary shares of Bentley's common stock under a company programme that will continue until such time as Bentley Systems' stock is publicly traded.

► <http://bit.ly/2gj0IXR>

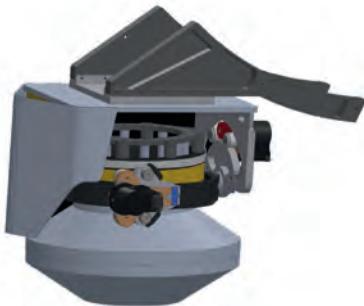
RUIDE | IMAGINSTATION **RIS**

“A buddy I rely on.”

RUIDE_ [Q](#) [f](#)

Lead'Air Launches New Multi-use Oblique Camera System

Lead'Air has developed a new, compact five-camera multi-image digital acquisition system (MIDAS), the Helidas, capable of mounting on the nose of a Bell 206B or AS350 Eurocopter with the use of the FAA-approved Meeker mounts. With just a few bolts, the unit can also be disconnected from the



Helidas with Meeker Bell 206 helicopter mount.

helicopter mount and connected to the simplified table design for fixed-wing aircraft. The simple design characteristics make the changeover fast and efficient. The need for flexibility in the design of the MIDAS has become more apparent as the world of 3D oblique imagery becomes more prevalent in the GIS, design and engineering fields.

► <http://bit.ly/2g1x7la>

Joint Venture for Cloud Services for 'Constructioneering'

Topcon Positioning Group and Bentley Systems have announced their joint intentions to connect cloud services for 'constructioneering'. During keynote speeches at Bentley's Year



Topcon's CEO Ray O'Connor.

in Infrastructure conference in London in November 2016, the companies' CEOs presented new construction workflows designed to increase efficiency and productivity with enhanced integration between their respective cloud services. Each company will bring to market cloud-based solution offerings, which include services of both and provide construction workflows not previously possible. Initially, Bentley Systems will offer its ProjectWise CONNECT Edition users seamless connectivity with MAGNET Enterprise, and Topcon will incorporate ContextCapture image processing for its mass data collection via unmanned aerial systems (UASs).

► <http://bit.ly/2flqTFA>

Hélicéo Introduces Itself to Worldwide Geomatics Audience

At Intergeo there were various new companies showcasing their latest geospatial technology. One of the new kids on the block was Hélicéo, a French start-up that designs, develops and implements innovative UAVs for use in geomatics applications. The company, which is based in Nantes, France, raised funds of EUR1.5 million earlier this year. This financing will encourage Hélicéo's development by boosting the company's design office as well as its international expansion. The Hélicéo engineering company, founded in 2015, demonstrated the versatility of its know-how at Intergeo in Hamburg, with vertical take-off plane UAVs, two multi-rotor UAVs (Fox 4 and Fox 6), the Drone Box concept, the very innovative FoxyWalk (a tool for the acquisition of geo-localised data for terrestrial photogrammetry by foot), HASK software for processing GPS data, and a big data solution. From design through to distribution, Hélicéo offers professional imaging systems – mainly for use in the topography sector. Its UAVs are the crucial link in a complete value chain that includes the equipment, software, maintenance, training, image processing and final analysis, as well as making these available via a web platform.

► <http://bit.ly/2eJmDcf>



Hélicéo FoxyWalk.

FARO Launches Laser Scanner for BIM Projects

FARO, specialised in 3D measurement and imaging solutions, has announced the release of the all-new FARO Focus^s laser scanner. This is the newest member of FARO's popular Focus laser scanner product line and is available in both 150m and 350m ranges. It is particularly designed for construction BIM-CIM and public safety forensics applications. This new line of laser scanners brings together several customer-centric features such as an increased measurement range, Ingress Protection (IP) rating of 54 for use in high particulate and wet weather conditions, an accessory bay for custom add-on devices and a built-in field compensation routine for ensuring system accuracy at all times.

► <http://bit.ly/2eJsSN2>



Focus^s laser scanner.

Esri Donates Cloud-based GIS Solutions to Ethiopian Universities

Esri has announced an agreement between Esri Eastern Africa Limited and the Federal Democratic Republic of Ethiopia to install free Esri geospatial software at more than 30 Ethiopian public universities. Under the terms of the agreement, the universities will enjoy high-speed fibre-optic internet access to Esri's platform ArcGIS, including mobile and web applications, online training courses, global datasets and teaching resources. The implementation will be overseen by the Ethiopian Education and Research Network (EthERNET) with the assistance of Addis Ababa University and Esri partner PanAfrica Geoinformation Services. EthERNET will serve as a central hub for providing support and training to all universities. In future phases, all major Ethiopian public universities will be connected to EthERNET. This advanced university GIS hub will allow Ethiopia to leapfrog other African nations in terms of access to the latest GIS technology, said Jack Dangermond, Esri founder and president. Moving from purely desktop GIS functionality to distributed web-GIS will help Ethiopia facilitate faster collaboration among researchers and learners across the country. This is a great step that the Ethiopian government has made, said Judah arap Bett, managing director of Esri Eastern Africa. The initiative will create a geoenabled community in the near future. Esri echo their support and partnership with EthERNET and the universities in Ethiopia to make this vision come alive.

► <http://bit.ly/2fk2SUU>



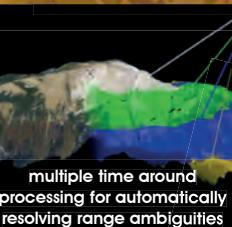
Esri ArcGIS.

NEW

RIEGL VQ-1560i

Dual Channel Airborne Mapping System

Waveform Processing LiDAR Solution
for Demanding Airborne Surveying Missions



World Premiere at
INTERGEO 2016



Turnkey Airborne System for Demanding Large Scale and High Altitude Environmental Mapping

Ultra high performance, fully integrated and calibrated airborne laser scanning system offering online waveform processing, full waveform recording, and excellent multiple-target detection capability | up to 2 MHz pulse repetition rate | up to 1,330,000 meas./sec on the ground | offers data acquisition at a wide range of point densities | operating altitude up to 15,500 ft AGL | forward & backward looking capability | automatic Multiple-Time-Around (MTA) processing for up to 20 pulses simultaneously in the air | IMU/GNSS unit and cameras fully integrated | mounting flange for interfacing with typical hatches and stabilized platforms | enables straightforward flight planning for increased flight safety



Stay connected with RIEGL



www.riegl.com



RIEGL

5 Questions to...



Willemijn Simon van Leeuwen is one of the founders and a director of GeoFort, a former Dutch defence fortress which has been transformed into an educational geo experience centre, where children of all ages learn the ins and outs of geoinformation technology and its applications. Through the success of GeoFort, Willemijn has proven she is an expert in turning seemingly dull topics into fun experiences. In this interview, we ask her about her vision on geoeducation.

GeoFort recently won the prestigious Children in Museums Award 2016. What makes GeoFort so special from an educational point of view?

All the geospatial educational programmes we develop have to fulfil three objectives: 'Sense of Fun', 'Sense of Urgency' and 'Sense of Experience'. We adhere to this very strictly. If the fun part is really good the children will explore very enthusiastically, which turns learning into an automatic process. A sense of urgency is very important because children are much more motivated if they see the relevance of what they are doing. At GeoFort they see a simulation of a flood and they have to make a good evacuation plan using digital maps. It's serious business! And last but not least, learning is much easier when you experience it yourself. When school parties visit GeoFort, the pupils are divided into small groups and they experience a

Willemijn Simon van Leeuwen

different geo-related topic together with a GeoFort teacher every 45 minutes.

You regularly refer to the concept of 'learning by doing'. How do you teach geomatics-related topics to young children?

There is not a lot to read at GeoFort; you have to do things yourself. We ask 14-year-olds to measure the width of the moat. They get a sextant to work with and apart from that they have to use their brains to calculate the distance using the sine rule. If they have problems with maths, we tell them they can also swim to the other side to measure the width that way... Once a kid came up to me and said "Now I know what the point of maths is; it's all about keeping your feet dry!". Of course we also let children work with GPS. First they're asked to draw a picture on a 2D map of the fortress. We then ask them to draw that same picture by walking through the reality of the hilly fortress while being tracked and traced. It's not as easy as they think! Afterwards they look at each other's drawings in Google Maps and select the winning team.

Many geomatics and other geo-related degree programmes struggle to attract a fair number of students, yet some other technical fields of study appear to be more popular. What do you think could be the cause?

Many people have simply never heard of geo studies and don't have the faintest idea about all the interesting geo-related jobs there are in the world. So there is a clear mission for GeoFort: to let a broad audience experience how interesting and relevant the geo world is in an appealing way. GeoFort not only gets this message across to children, but also to their teachers, parents, uncles, aunts and so on. They can all influence the children's study choices. To make that decision easier, we've launched a website: www.gogeo.nl. After you've answered 20 questions about your hobbies and your character we advise you which area of study will suit you best. Of course, it's always a geo-related field, but it

can vary from GIS, geodesign, logistics, water management and 3D architecture to space engineering. That range of variety surprises people.

At what age should children start learning about geo, and how can schools, universities and other educational institutions learn from your experiences at GeoFort?

Research done by the University of Twente shows that you have to start at primary-school level if you want to get children interested in technical topics. The problem in the Netherlands is that a lot of primary-school teachers are non-technical women who tend to be a bit scared of technology. Therefore, GeoFort makes it very easy to do experiments in the classroom too: making your own compass or crushing a chocolate bar in order to understand the concept of continental drift. For those teachers who are most afraid, a visit to GeoFort is of course the best remedy. After their visit they all love geoscience! GeoFort has educational offerings for children aged 8 to 88; it's all about life-long learning.

The geomatics industry continues to grow, and more and more geoprofessionals are expected to be needed in the future. How can the industry help educational institutions to attract more students?

Geo-related companies and institutions can help to make youngsters enthusiastic by participating in career events in schools and getting involved in academic projects. Some secondary schools in the Netherlands are so-called 'technasiums', in which children work on projects together with technical companies. This is a perfect way for pupils to really start enjoying the fascinating and innovative world of geo-ICT. In addition, at GeoFort we will keep developing our educational offering to further boost the popularity of geo amongst the younger generation!

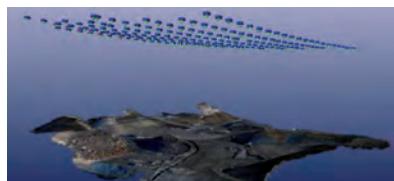
More information
www.geofort.nl

Integrated and Bundled Survey Solution for UAVs

Eos Systems, the developer of PhotoModeler, and Klau Geomatics, the developer of the KG PPK system, are launching an integrated and bundled system for high-accuracy survey for unmanned aerial vehicles (UAVs) while using minimal or no ground control points. The Klau

Geomatics PPK system provides precise camera positions for aerial photography. Coupled with PhotoModeler's photogrammetry software, this is a solution with a great level of accuracy and reliability for survey-grade mapping applications. The Klau Geomatics PPK is a lightweight plug-and-play box that can be installed on any UAV by end users or as an OEM product for manufacturers. Integrating PPK into a photogrammetry program provides a strong platform for obtaining very accurate drone-based surveys with minimal or no ground control input, greatly reducing the time and cost involved in accessing a site to place GCPs. This integrated product simplifies the workflow from the field data (UAV photos, drone PPK data and base station data) to a survey-grade 3D surface model or ortho-mosaic. The powerful algorithms in PhotoModeler complement and cross-check the PPK data for a high-quality result.

► <http://bit.ly/2g1vUKA>



PhotoModeler.

Renewed Agreement to Provide Secretariat Services for UN-GGIM: Europe

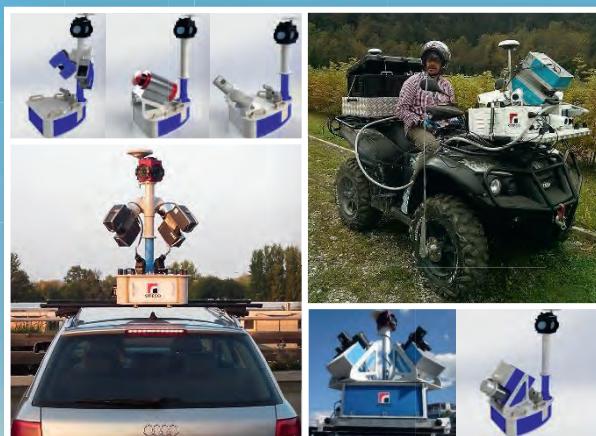
EuroGeographics has renewed its Service Level Agreement with The Netherlands' Cadastre, Land Registry and Mapping Agency (Kadaster) to provide secretariat services for UN-GGIM: Europe. The membership association for the European National Mapping, Cadastre and Land Registry Authorities, which has UN-GGIM: Europe observer status, has supported the Executive Committee in delivering its objectives since 2015, with Carol Agius fulfilling the role of administrator. In addition to ensuring that relevant organisations in the European UN Member States and European institutions are well informed about its activities, EuroGeographics also organises the annual plenary as well as Executive Committee and Working Group meetings.

► <http://bit.ly/2NFp1g>



ROADSCANNER

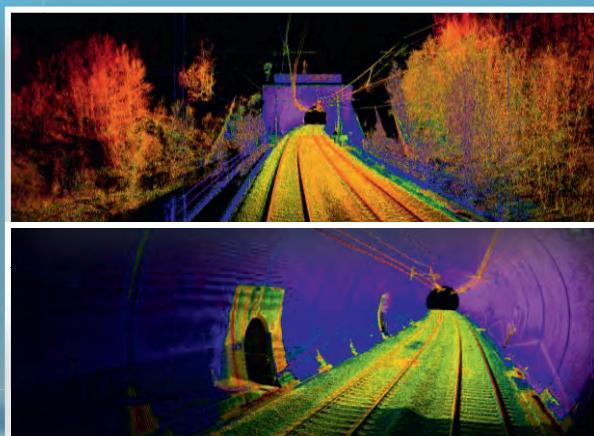
NEW! MORE COMPACT & COST EFFECTIVE



Simple, powerful and scalable entry level, to allow surveying companies to evaluate and execute mobile mapping projects and increase their normal productivity 10 to 20 times

ROADSIT SURVEY

ASSET MANAGEMENT
FEATURE EXTRACTION SW SUITE



Calibration, acquisition, post-processing, GCP, feature extraction, hi-grade mapping, GIS asset, PM and data exchange in all standard formats. Autocad, Microstation and ArcGIS Plug-ins



On the road
TO INNOVATION

GIM INTERVIEWS PETER VAN BLYENBURGH, PRESIDENT OF UVS INTERNATIONAL

Harmonising UAS Regulations and Standards

Many people dream of making a living out of remotely piloted aircraft systems (RPASs), but so far a lack of clear rules and regulations has stood in the way of that dream. However, there is a glimmer of hope on the horizon – especially in Europe – and best practices will spread across the world like an ink blot, according to Peter van Blyenburgh, president of UVS International. His independence from individual companies or governments makes him notoriously frank and he is an outspoken ambassador for the sector on all five continents.



▲ Peter van Blyenburgh: "Privacy is not a real problem in the professional market. The rules will be the same as for mobile mapping." (Image courtesy: Jeroen van Berkel)

Your main concern over the past decade has been the international co-creation of rules and regulations. Are you satisfied?

Never! But we are going in the right direction, especially in Europe. In December 2015, the European Commission submitted its 'Aviation Package' proposal to the European Parliament and the European Council for their approval. This covers, among other things, the integration of remotely piloted aircraft systems (RPASs) in the general European aircraft regulations and the modification of the basic regulation of the European Aviation Safety Agency (EASA). If the proposal is accepted, EASA will become responsible for the certification of all aircraft, including those weighing less than 150kg. That is the first step towards European harmonisation of the rules and regulations as well as the industrial standards pertaining to RPAS in the 28 EU member states, plus Switzerland and Norway. That's something they can still merely dream of on other continents. Governments and companies can only legally use drones if the local civil aviation authorities grant the required flight permits based on exceptions. The process in Europe will make it possible for the

This article is part of an interview by Frédérique Coumans, contributing editor, that originally appeared in the April 2016 edition of *GIM International*. Because of the persistent interest in this interview in digital format, we have decided to re-run it this month. Some information provided in this interview may have since changed.

RPAS sector to look to the future with confidence leading to investment and hence growth. I believe that the effects of what is happening in Europe will be felt worldwide. Outside the European Union, individual regulatory authorities with limited resources will find it attractive to adopt these regulations because they represent a negotiated pact with broad acceptance. This would generally be more efficient and less costly than devising their own laws and training programmes.

But a European Regulation takes time; it's up to each member state to make its own laws on how to implement the Regulation and to decide what stance to take until it comes into force. It will take until late 2017 before proper, balanced business plans can be made. In the meantime, UVS International has started a multinational fast-track initiative to produce recommendations on safety rules for test & evaluation sites and also for public demonstrations and drone races. Neither of these topics are dealt with by EASA. The initial core team that will undertake this work consists of the RPAS communities in France, The Netherlands and Belgium, and they will shortly be joined by the communities from several other EU member states.

Which market size and growth figures are reliable?

There are no reliable figures so far; accurate statistics will not become available until the second half of this year. For now, there are only reports published by American companies which are aimed not at unreservedly presenting the facts but rather at dreaming up the largest possible market growth to motivate lobby groups, senators and the industry. The EU has recently commissioned the Boston Consulting Group to conduct a long-term market research study. The initial study gives a high-level projection of how the market and its segments look right now and how they will evolve over the next 25 years. The study concerns not only the commercial RPAS/drone market, but also public users such as the police, customs and suchlike and the recreational market, which will be the largest

segment. Subsequent studies will refine that knowledge.

Can the professional market grow if the general public doesn't accept the large-scale use of drones?

No it can't. But privacy, to name the most important issue, is not a real problem in the professional market. The rules will be the same as for mobile mapping: people and number plates will be pixelated. National laws could make the rules even stricter. Drones can be equipped with electronic identity (registration) chips containing the drone's serial number and the owner's name. When a drone passes over you, you can use an app on your smartphone to view that information. This could make policing easier and facilitate filing a complaint. Our organisation is also contributing to the creation of a special

past 18 years, this has been Europe's principal event on RPAS-related regulatory matters, pilot training, operator and pilot responsibility and liability, insurance, data protection and privacy, and suchlike.

Many people in the geomatics branch feel drawn to UASs. Are they better informed?

No, apart from a handful of them. I have spoken with many geomatics professionals all over the world; they see dollar signs in front of their eyes and dream of building sexy aircraft or opening up a geo-drone shop. But when I tell them about the liabilities, they look at me as if I want to rain on their parade. Your company will be torn apart if there's an accident with a drone! They don't realise that the aviation world is a totally different ball game than ground-based surveying and geomatics. They think drones are toys

WHEN I TELL GEOMATIC PROFESSIONALS ABOUT THE LIABILITIES, THEY LOOK AT ME AS IF I WANT TO RAIN ON THEIR PARADE

website that will focus on awareness and understanding. Last October the European Commission awarded the 'Drone-Rules.EU Consortium' a contract to create the definitive European reference web portal. The final version should become ready in the third quarter of 2017. It will increase awareness and facilitate understanding of the legal environment and constraints in relation to light RPAS operations (safety, privacy and data protection, insurance, etc.), with a focus on non-commercial operators. The portal will also facilitate access to the European market for commercial operators and showcase the opportunities for economic and job market growth. UVS International has already created www.rpas-regulations.com to make rules and regulations, as well as related reference documents, available to the international RPAS community. This website monitors 267 countries and overseas territories and includes a section with information about Europe. The annual RPAS conference (www.rpas-conference.com) also provides a good view of what is happening in Europe. For the

because the devices are easy to use, but you have to be very well insured and the insurance companies' certification demands increase in relation to the complexity of the flight mission. For small and medium-sized companies, the real profit lies not in the application of the aircraft but rather in the data collection, processing and analysis.

What will UASs still not be able to do by the end of 2017?

Let me rephrase the question, because in two years' time the professional systems will certainly be technically capable of doing almost anything that is currently done by a surveyor, aerial photogrammetry, Lidar or a very-high-resolution satellite – and with the same or higher precision, faster and at a fraction of the total cost. But what will a UAS still not be able to do legally in two years' time? It's all about insurance. If you're not insured, you are acting illegally and you will not be able to present a good enough business case. Looking to Europe, within approximately two years from now there will be one set of European rules

FASTER, FARTHER, LIGHTER

ZTS-360R

- Compact, lightweight design
- High-performance MCU STM32
- Powerful 600m reflector - less measurement capability
- Dust and water protection IP66

FCC CE



IP66



HI-TARGET

www.hi-target.com.cn info@hi-target.com.cn



which an insurance company will force you to comply with. The rules may be different in the rest of the world, but I think the European rules will spread like an ink blot. In any case, the possibilities will be limited to flights under 500 feet (150 metres) since above that height there is too great a risk of possible collision with other aircraft. For a while, the second limit will be – as a rule – that the drone has to be in sight of the remote pilot at all times. But the nice thing about the existence of a formal legal framework is that you can arrange exceptions for specific projects.

Will the surveyor become obsolete?

I believe that aerial photogrammetry as we know it today for mapping purposes will become obsolete, but the surveyor will not. Surveyors will still be needed in dense urban areas. Flying in urban canyons is complicated and new technologies must be developed for situations in which buildings are close together or there are different building lines. In the meantime, surveyors will have to help determine the air corridors for the flight plan, and they can of course operate the drones.

What is the current focus of the largest, non-military R&D investments?

The biggest investment is being made in air-traffic management: manned and unmanned aircraft in the same airspace and at airports. In the EU's Single European Sky ATM Research (SESAR) programme alone there are 19 projects working on developing innovative technological and operational solutions. The funding amounts to EUR500,000 per project, which is actually a rather low budget. The total sum is enormous when all national and European investments are added together but there is a large degree of overlapping, duplication and re-inventing the wheel. What would save a huge amount of money is a register, because nobody knows what is being done worldwide. All those researchers and engineers travel around the world from one conference to the next, but they focus on minor differences between their research plans to defend their spending. There should be a worldwide database – or just a European one for starters – containing all research projects that are even remotely related to UAS technologies. Who is involved, what are the goals, the programme, the budget, evaluations, contact data and so on? Then everybody can verify whether what they want to do is really new, and the large



companies can use it to see what interesting research is already being done and, of course, who the promising students are. Such a register would cost only a few million to build and maintain, but the added value would be enormous. Most universities say they would like to participate, but when it comes to building the system they don't have the time. Perhaps it's not in their interest to have such openness?

Which development will shift everything up a gear?

We're now aiming at pushing product safety. UVS International has initiated the RPAS Autopilot Validation Tool Group, which has developed an inspection algorithm for autopilots – one of the most crucial parts of a remotely piloted aircraft. The study group brings together important industry players from Europe as well as Canada, China and the USA. They have determined the required functional capabilities which the algorithm has to fulfil.

This model will be integrated in a laptop which will be hooked up to the autopilot of the aircraft that has to be inspected. The laptop will be used to program the various flight missions that the autopilot has to perform. Those missions will be flown virtually and during the flights the autopilot will be presented with internal and external events. How does the autopilot react? How precisely is the flight plan executed? The algorithm will measure the results. Depending on the grading, the system would then the European CE quality mark of product. This would set a very useful industrial standard. If the autopilot does not obtain the predetermined grade, it will be difficult to obtain insurance for the related drone system. The next step now is to supply the study results to the European authorities so they can use them as the basis for a public tender to produce the required algorithm. ▲

This article was originally published in the GIM International UAS Special 2016.

ABOUT PETER VAN BLYENBURGH AND UVS INTERNATIONAL

Peter van Blyenburgh has been involved with unmanned aerial systems since 1987 and supplies advisory services in this field to corporate and governmental entities in Europe, the Middle & Far East and North America. He is president of UVS International (www.uvs-international.org) which he founded in 1997. Van Blyenburgh is an active participant in many RPAS-related international working groups and advisor to EUROCARE WG73, honorary member of the European Group of Institutes of Navigation, The European Institute (in the USA), UVS France and a member of the Air Traffic Control Association.

Operating out of Paris, France, UVS International is a non-profit organisation that represents over 2,800 stakeholders in 44 countries in the field of remotely piloted systems. Manufacturers, operators, service suppliers, research organisations and academic institutions are represented on a worldwide basis in all the competence areas that matter. The annual publication RPAS: The Global Perspective is regarded as the world's leading reference work on RPAS (1st edition in 2003). See www.uvsinfo.com.

Cadastral Boundaries from Point Clouds?

Proponents of the new era for land administration argue that countries must explore alternatives to accelerate land administration completion. As an example, fit-for-purpose land administration is based on the use of printed imagery, community participation and hand-drawn boundaries. Digital solutions then convert the generated analogue data into useful digital information. However, the approach is manually intensive, and simple automation processes are continually being sought to cut time and costs. One approach gaining traction is the idea of using image processing and machine learning techniques to automatically extract boundary features from imagery – or point cloud data – prior to even entering the field. The approach could speed up activities both in the field and in the office. The authors report on the ongoing developments.

The feasibility of using point cloud data to support fit-for-purpose land administration is being actively explored. Building from early investigative work undertaken in The Netherlands and the related domain of 3D cadastres, a workflow for semi-automated extraction of cadastral boundaries from airborne laser scanning (ALS) data was developed and trialled for urban and rural areas in Port-Vila, Vanuatu. The site was selected because recently collected point cloud data, orthoimagery and also a cadastral parcel map were already available. This would enable comparison of the automated outputs against ‘real’ cadastral data.

80% ‘VISUAL’ BOUNDARIES

An initial statistical analysis revealed that around 80% of cadastral boundaries in the study area ‘double’, ‘align’ or ‘overlap’ with topographic or visual objects. Specifically, in dense urban areas, road edges and building walls coincide with the majority of cadastral boundaries. In suburban areas, hedgerows and constructed fences played an important role in marking a parcel border. Therefore, constructing a map that depicts these features could contribute a lot to expedited cadastral mapping.

WORKFLOW DEVELOPMENT

A semi-automated workflow was developed that focused on extracting digital

representations of the physical objects according to the morphology of parcel boundaries. First, points were classified into semantic components. The outline of planar objects, such as building roofs and road surfaces, were then generated using the α -shape algorithm. Centrelines delineated from the approach were fitted into the lineate objects or fences. A manual post-refinement phase was used to ‘tidy up’ the output.

50% SUCCESS

Afterwards, the workflow performance was quantitatively evaluated by comparing it against the reference cadastral map. The workflow achieved a promising result: around 80% completeness and 60% correctness on average (an aggregation of the results from several study areas). That is, around 50% of the parcel boundaries were successfully extracted. Even at these levels, it can be expected that a semi-automated extraction workflow could greatly speed up cadastral mapping – although better quantification of the post-refinement time and cost is needed.

CONTEXT MATTERS

Working with the workflow, a rudimentary parcel map can be created within several hours. If one brings the algorithm-generated parcel map to field for verification, only incorrect boundaries need to be digitised

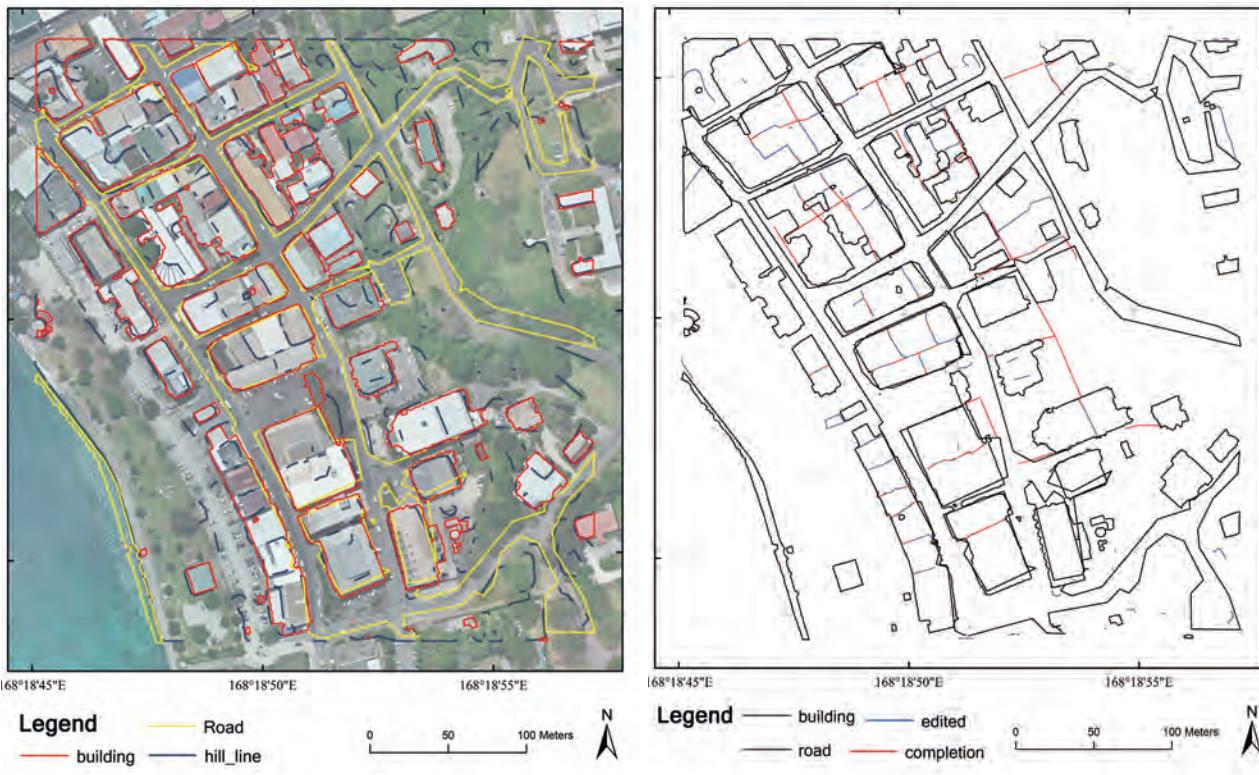
afterwards. However, the spatial accuracy of this workflow is still modest; most steps of the workflow introduce errors. Moreover, the workflow is context-specific; it is highly dependent on the amount of alignment between cadastral and visible boundaries. It may not be suitable for irregular areas such as those found in dense urban slums, pastoralist landscapes or places where traditional livelihoods prevail.

CANOPIES AND HEIGHTS

The most significant advantage of the use of point cloud data over aerial imagery is the ability to penetrate through a vegetation canopy. This contributes significantly to fence line extraction. Fences are widely used as cadastral markers but are often invisible in aerial images. Another strength of using point cloud data is that it provides height information: point cloud data can provide high-accuracy XYZ measurements. Height often plays an important role in object recognition and this could be highly useful in the cadastral domain where boundary features are often at regular heights, such as fence lines, hedgerows or treelines.

POINT DENSITY TRADE-OFF

The level of detail that point clouds provide is dependent on the point density. Extracting small objects such as the fences occurring in the test site required a high point cloud



▲ Overview of automated extraction results overlaid on imagery from a sample region.

density. However, a higher point density also means a larger dataset size to deal with, plus higher data acquisition costs. This is considered a key disadvantage of the approach, particularly in developing contexts where cost is the primary concern.

FUTURE IMPROVEMENTS

The output generated was considered rather undeveloped and could be improved with the addition of several constraints and additional processing. For example, an overly 'zigzag' look is evident for many of the generated lines. For road lines, calculating and enforcing a fixed width could remove the unwanted effect. In addition, when generating building outlines, the workflow only considered XY coordinates. If the α -shape algorithm was extended to 3D, closed roof planes could easily be separated by height. Moreover, combining the point cloud data with multispectral images could enrich the spectral information and would assist point-based classification. Further to this, an object-based approach could be used to investigate the relationship between objects and parcel boundaries. In urban areas, cadastral boundaries tend to be close to a building outline, whilst in suburban areas cadastral boundaries may evenly partition an area. These parameters could

be taken into consideration for predicting parcel range and location by means of machine learning. The post-refinement phase is also considered time consuming, but could be automated by integrating these activities into the automated line generation processes. For example, simple topology checks and line simplification algorithms could be embedded into the automated workflow. This could significantly reduce

the time and cost involved in the post-refinement phase.

ACKNOWLEDGEMENT

The authors wish to acknowledge the support of Government of Vanuatu (Paul Gambetta and Brian Phillips), Land Equity (John Meadows and Kate Rickersey), and the CRC-SI in helping to source and make available the data underpinning this work. ▲

XIANGHUAN LUO

Xianghuan Luo is a PhD candidate at The Hong Kong Polytechnic University. She obtained her MSc degree from the Faculty of Geo-information Science and Earth Observation (ITC), with a specialisation in land administration.

ROHAN BENNETT

Rohan Bennett is director of the School for Land Administration Studies, associate professor at University of Twente, ITC Faculty, Netherlands, and project coordinator of Euro Commission Horizon2020 project 'its4land' (its4land.com).

MILA KOEVA

Mila Koeva, ITC Faculty, University of Twente, The Netherlands, is an assistant professor working in 3D land information.

NATHAN QUADROS

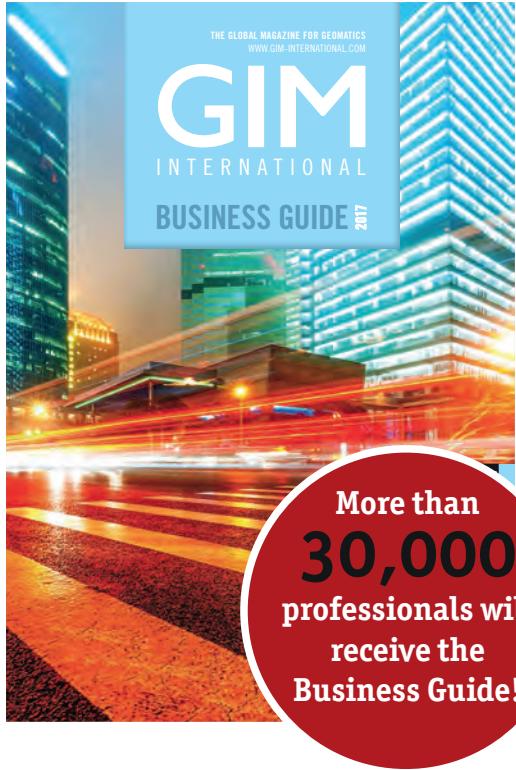
Nathan Quadros manages the Rapid Spatial Analytics research program at the Cooperative Research Centre for Spatial Information in Australia. He has experience in leading major remote sensing projects across Australia and Asia-Pacific.



SIGN UP NOW

for the GIM International

Business Guide 2017!



*The GIM International Business Guide,
the most extensive reference source for
professionals working in geomatics!*

Business Guide 2017

- An edition for you to keep and refer to throughout the year
 - The latest trends and developments in the geomatics industry
 - Overview articles on various fields of geomatics applications
 - Company classified listings
 - Extensive product and market reports
 - And more...

Distributed with the 2017 January issue and at key trade shows worldwide!

ADVERTISING PACKAGE

1/2 page ad package: € 1,790

1/2 page ad + company classified + online profile for 1 year

1/1 page ad package: € 2,290

1/1 page ad + company classified + online profile for 1 year

Classified package: € 700

Classified (text 250 words, logo, contact details) + online profile for 1 year

Prices are in EUR and excluding VAT if applicable.

Pricing for premium positions on request.

For more information about advertising options please contact:

Sybout Wijma, key account manager

Sybout.wijma@geomar.de T. +31 (0) 514 561854

GIM INTERNATIONAL

Mapping the world

HOME | NEWS | BLOGS | THEMES

EXAMPLE PROFILE

Hexagon Geospatial

5051 Peachtree Corners Circle
Norcross, GA 30092-2500
United States

[geospacial@hexagongeospatial.com](mailto:geospatial@hexagongeospatial.com)

+1 770 778 3400
+1 770 778 3500

[VISIT THE WEBSITE](#)

HEXAGON GEOSPATIAL

About Hexagon Geospatial

Hexagon Geospatial helps you make sense of the dynamically changing world. We enable you to envision, experience and communicate geographic information. Our technology provides you the form to design, develop and deliver solutions that solve complex, real-world challenges. Ultimately, this is realized through our creative software products and platforms.

CUSTOMERS. Globally, a wide variety of organizations rely on our products daily, including local, state and national mapping agencies, transportation departments, defense organizations, engineering and utility companies, and businesses serving agriculture and natural resource needs. Our portfolio enables these organizations to holistically understand change and make clear, reliable decisions.

TECHNOLOGY. Our priority is to deliver products, platforms and solutions that make our customers successful. Hexagon Geospatial is focused on developing technology that displays and interprets information in a personalized, meaningful way. We enable you to transform location-based content into dynamic and usable business information that creatively conveys the answers you need.

PARTNERS. As an organization, we are partner-focused, working alongside our channel to ensure we succeed together. We provide the right platforms, products, and support to our business partners so that they may successfully deliver sophisticated solutions for their customers. We recognize that we greatly benefit our reach and influence by cultivating channel partner relationships both inside and outside of Hexagon.

Find us on

 geomares
PUBLISHING

CAPABILITIES FOR PRECISION FARMING AND HEAT MAPPING

Multispectral and Thermal Sensors on UAVs

Mini and micro unmanned aerial vehicles (UAVs) in combination with cost-efficient and lightweight RGB cameras have become a standard tool for photogrammetric tasks. In contrast, multispectral and thermal sensors were until recently too heavy and bulky for small UAV platforms, even though their potential was demonstrated almost a decade ago. Nowadays, however, lightweight multispectral and thermal sensors on small UAVs are commercially available. The authors investigate their capabilities for use in precision farming and heat mapping.

The multispectral cameras and thermal infrared (TIR) sensor in the authors' performance tests were mounted on an eBee from senseFly. Based in Cheseaux-Lausanne, Switzerland, and founded in 2009, senseFly manufactures fixed-wing UAVs and equips them with customised lightweight cameras developed by Airinov, which is based in Paris, France. Focusing on precision farming, Airinov modifies Canon cameras into multispectral sensors and manufactures the multiSPEC 4C multispectral camera and the thermoMAP thermal infrared sensor. This study tested the Canon S110 NIR and a prototype version of the multiSPEC 4C, both of which are multispectral cameras, as well as the thermoMAP, a TIR sensor.

UAVS AND SENSORS

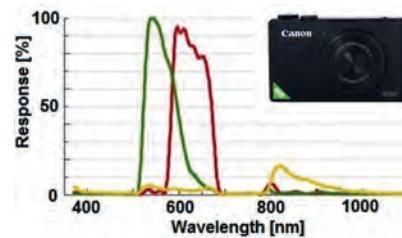
The lightweight fixed-wing eBee can be operated fully autonomously, requires hardly any piloting skills and is ideal for covering larger areas. The eBee family is marketed in conjunction with customised sensors which

can be controlled by the autopilot of the fixed-wing UAV. The Canon S110 RGB is a low-cost colour camera, the Canon S110 NIR and S110 RE are low-cost multispectral cameras while the multiSPEC 4C is a high-end system. The Canon multispectral cameras are equipped with modified Bayer colour filters – instead of recording blue, green and red, the green (G), red (R) and near infrared (NIR) bands are captured. Just one lens is needed resulting in precisely co-registered spectral channels with overlapping spectral sensitivities (Figure 1). In contrast, the multiSPEC 4C has four lenses and four monochromatic CCD sensors; the colour separation takes place at the optical units via band-pass interference filters with well-defined central frequencies and bandwidths (Figure 2).

A zenith-looking panchromatic sensor enables the images to be normalised. Table 1 provides details of the above-mentioned sensors.

TEST FIELDS

Test fields of the Agricultural Centre Liebegg (AG, Switzerland) with different crops were



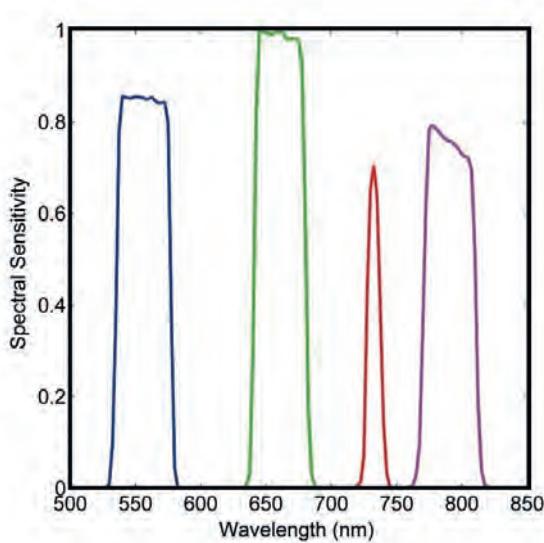
▲ Figure 1, Spectral sensitivities of the Canon S110 NIR normalised with respect to the green band (100%).

captured by the Canon S110 NIR and multiSPEC 4C. A rape field was flown aimed at determining optimal harvesting time and crop yield estimates related to species and treatment. A second study captured several fields, including:

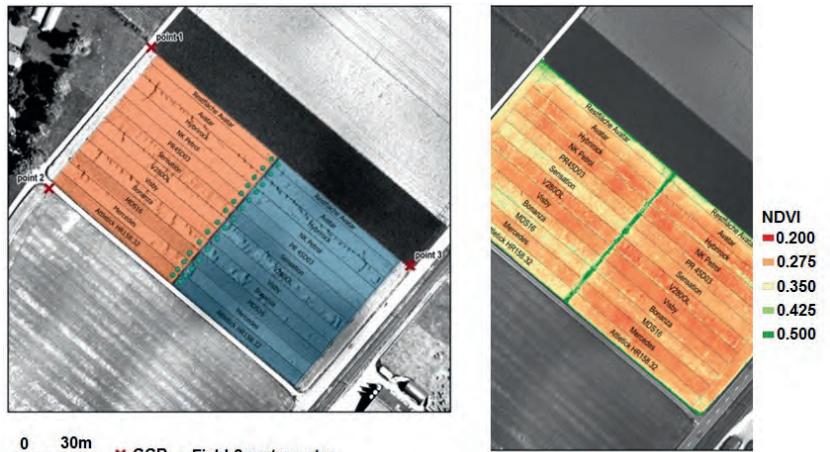
- a wheat field with different fertilising strategies
- a beetroot field with potential fungal infestation
- a potato field aimed at determining the optimal time for crop desiccation and monitoring of potato blight, a devastating

Sensor property	Canon S110 NIR	multiSPEC 4C Prototype	multiSPEC 4C Commercial	ThermoMAP
Pixels per sensor	12MP (Bayer pattern)	4 sensors, 0.4MP each	4 sensors, 1.2MP each	0.3MP (640 x 512)
Sensor size [mm]	7.44 x 5.58	4.51 x 2.88 (per sensor)	4.8 x 3.6 (per sensor)	10.88 x 8.70
Pixel size [μm]	1.33		3.75	17.0
GSD at 100m AGL	3.5cm	20cm	10cm	18.5cm
Spectral channels (central frequency/opt. band width) [nm]	G (550) R (625) NIR (850)		G (550 ± 20) R (660 ± 20) RE (735 ± 5) NIR (790 ± 20)	7,000-16,000
Approx. price [EUR]	900	Prototype	8,000	10,000

◀ Table 1,
Main
features of
the sensors
in the tests.



▲ Figure 2, Spectral sensitivities of the MultiSPEC 4C normalised with respect to the green band (100%).



▲ Figure 3, Rape test field (left) with fungicide treatment (orange) and without treatment (blue) and the NDVI map derived from MultiSPEC 4C data, GSD 10cm.

disease which caused the Irish potato famine of the mid-19th century
In each field, three to seven ground control points (GCPs) were established with a horizontal and vertical point accuracy of 2cm.

- orthoimage generation and mosaicking
- calculation of reflectance maps and vegetation indices
The processing of MultiSPEC data was preceded by a radiometric calibration of the

$= (\text{NIR} - \text{R}) / (\text{NIR} + \text{R})$] no calibrated or normalised reflection values are needed. The NDVI ranges from -1 to +1. On average the NDVI values of the multiSPEC 4C deviate by -0.04 from the reference values. For the S110 NIR sensor the average difference is -0.260. This large value is caused by the overlap in the spectral channels.

The vitality of the plants and the potential for crop yield estimation were assessed based on the NDVI values of the rape test field. Although the flight campaign had been delayed due to bad weather in summer 2014 and could only be conducted a few days before harvest, distinct vitality differences could be detected between individual species and between areas with fungicide treatment and untreated areas (Figure 3). Treatment with fungicides leads to a prolonged plant activity up to harvest time. The normalised correlation coefficient between crop yield and NDVI values for treated fields was calculated as 0.78. For untreated fields the coefficient was calculated as 0.35.

TIR SENSOR

To determine the capabilities of the thermoMAP sensor, two campaigns were carried out on 13 March 2015 immediately before and after sunrise. The images were captured with a GSD of 15cm and 30cm. In order to create a DSM of the area using dense image matching, overlapping RGB images were taken with a Canon S110 RGB during the daytime, capturing images with a GSD of 5cm. The data was processed to obtain TIR orthoimages with a GSD of 15cm, a pan-sharpened TIR orthoimage using the

DATA

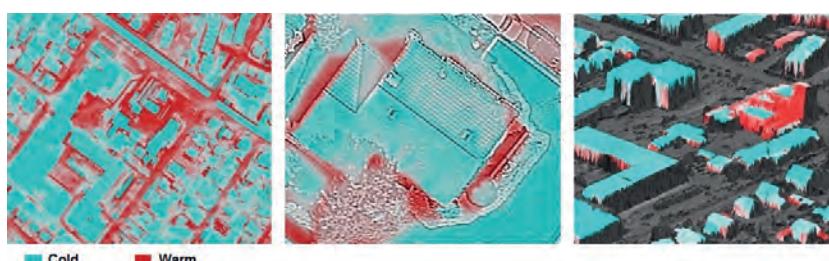
A total of 24 flights were carried out, each lasting 20-40 minutes and capturing 40 to 900 images, each with a ground sampling distance (GSD) of between 2.5cm and 10cm. The multiSPEC 4C prototype showed some limitations due to its reduced sensor dimensions and resolution and high power consumption. The processing of the imagery was done with the standard software Postflight Terra 3D and included:

- image orientation/bundle block adjustment
- generation of a digital surface model (DSM) by means of dense image matching

individual channels, carried out using images of a calibration table. The accuracy (1 sigma) of the image orientation was 0.2-0.3 pixels, equivalent to 1.5-4cm in object space.

RESULTS

The multiSPEC and Canon S110 NIR images were compared with data captured by a calibrated portable field spectrometer, which records the range of 360-1000nm with a spectral resolution of 3.3nm and features a zenith-directed reference channel. As the normalised difference vegetation index (NDVI) is based on reflectance ratios [NDVI]



▲ Figure 4, TIR orthoimage with a GSD of 15cm (left), pan-sharpened TIR orthoimage with a GSD of 5cm (middle) and 3D roofscape.

RGB imagery for sharpening resulting in a GSD of 5cm, and a DSM overlaid with the TIR orthomosaic resulting in a 3D roofscape (Figure 4). During these first experiments, the thermoMAP showed firmware problems which prevented the conversion of the measured values into surface temperatures. Nevertheless, the data provides valuable information for building-energy experts.

CONCLUDING REMARKS

The high-quality measurements, irrespective of lighting, by high-end multispectral sensors, make them suitable for monitoring vegetation over time without a need for laboriously acquiring spectrometer reference data in the field. Low-cost multispectral sensors combined with a high GSD up to the centimetre level are well suited for monitoring in-field variability and for detecting plant diseases in, for example, very expensive specialty crops. ▲

This article was originally published in the GIM International UAS Special 2016.

FURTHER READING

- Nebiker, S., Annen, A., Scherrer, M., Oesch, D. (2008) A Light-weight Multispectral Sensor for Micro UAV – Opportunities for Very High Resolution Airborne Remote Sensing. *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*. Beijing, China: ISPRS, pp. 1193–1200.
- Nebiker, S., Lack, N., Abächerli, M., Läderach, S. (2016) Multispectral and Multitemporal Imagery from UAV for Predicting Grain Yield and Detecting Plant Diseases. To appear in: *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*. XIII ISPRS Congress, Prague, Czech Republic.

STEPHAN NEBIKER



Stephan Nebiker is professor for photogrammetry, remote sensing and geoinformatics at the Institute of Geomatics Engineering of FHNW University of Applied Sciences Northwestern Switzerland, with a focus on 3D imaging, mobile mapping and UAV-based photogrammetry and remote sensing.

✉ stephan.nebiker@fhnw.ch

NATALIE LACK



Natalie Lack is a senior researcher at FHNW with a focus on environmental monitoring and UAV remote sensing.

✉ natalie.lack@fhnw.ch

GIM
INTERNATIONAL

Mapping the world

Stay informed with *GIM International* - anytime, anywhere

GIM International, the independent and high-quality information source for the geomatics industry, focuses on worldwide issues to bring you the latest insights and developments in both technology and management.

Sign up for a free subscription to the **weekly newsletter** which brings you:

- News and developments
- Product innovations
- Job vacancies
- Congresses and trade shows

www.gim-international.com/newsletter



geomares
publishing

STOP LAND THEFT: ABOLISH ARTICLE 34(6)

Fair Treatment of Property Rights

How is it possible that so many poor, vulnerable people and small farmers are the ones to suffer when their land is grabbed by the state, large investors or local elites? Doesn't the Universal Declaration on Human Rights (1948) state in Article 17 that "everyone has the right to property and no one shall arbitrarily be deprived of it"? Doesn't the African Charter on Human and Peoples' Rights (1981) state in Article 14 that "the right of property shall be guaranteed, upon which only may be encroached in the interest of the public need"? This article attempts to bring a solution for the victims of land grabbing – a path to the recognition and fair treatment of their property rights, even if they have difficulty proving evidence of their rights because a decent cadastre is absent in their country. In Africa, however, where land grabbing is reported to occur on a large scale, a 'small' obstacle still has to be abolished, namely Article 34(6) of the Protocol to the African Court on Human and Peoples' Rights (1998): an article that makes it virtually impossible for individuals and NGOs to take a case to court.

THE HUMAN RIGHT TO PROPERTY

The inclusion of a human right to property has always been controversial. After World War Two, when the United Nations Commission of Human Rights prepared the Universal Declaration, these controversies first focused on the political understanding about property. Was individual property the foundation of society (capitalist countries) or did property belong to the people

(communist countries)? Furthermore, owning property was the prerogative of the rich, and the question arose as to why the wealthy should be protected by a human right, especially when the origin of that property ownership was not always thought to be fair. Questions also arose about whether states were obliged to give property to anybody, or whether states should only create the social and economic conditions to make

property ownership possible. African states pointed out various forms of property on their continent, such as customary, clan and family property. Was that also 'individual' property or something else? And if there would be a human right to property, how could states control socially desirable land use, limit it or even expropriate a property in the general interest? It was a small miracle that, after extensive debate, a human right to property was nevertheless introduced in the Universal Declaration. However, as most people know, the Declaration as such is not binding. What are binding are the two emanating protocols, one on civil and political rights and the other on economic, cultural and social rights. And this is where things went wrong: a resolution to not include property in the first one was accepted, but another resolution on the inclusion of property in the second one was adjourned...and that is how things still stand today.

REGIONAL TREATIES

The right to property had more luck in the regional human rights treaties, although remarkably at first sight not in the European Convention on the Protection of Human Rights and Fundamental Freedoms (1952).



▲ Permanent Representatives, African Union.

The controversies in the Council of Europe between western and eastern member states prevented inclusion. However, after much deliberation, a human right not to property but to possession was introduced in the binding elaboration, the first Protocol: Article P1-1 states that every natural or legal person is entitled to the peaceful enjoyment of his possession. The African Charter on Human and Peoples' Rights (1981) was more straightforward. The attitudes of African states towards property were ambivalent in those days just after independence. Why bother protecting property, when it was still in the hands of the former colonisers? On the other hand, if poor people did own property, why exclude them from protection? The African leaders found a compromise in Article 14 which states that the right of property shall be guaranteed, but vests in the state a rather absolute form of ownership over all its country's wealth and natural resources. The American Declaration (1948-1969) and the recent ASEAN Human Rights Declaration (2012) also contain protection for property, but they are less relevant here because land grabbing occurs mainly in Africa, and less so in Asia and the Americas. In the context of this article, it is necessary to explore how the human rights treaties protect property *de jure* and *de facto*.

THE COURTS OF HUMAN RIGHTS

The Universal Declaration 1948 did not create a court. Complaints can only be lodged by UN member states and appear before the UN Commission of Human Rights. The regional treaties, on the other hand, did establish courts. Considering only Europe and Africa here, the European Council established the European Court of Human Rights in Strasbourg (France) in 1959. This is not to be confused with the European Court of Justice created by the European Union in Luxembourg which is focused on enforcing EU law. The European Court of Human Rights in Strasbourg allows individuals – besides states – to apply to the court when human rights covered by the Convention are allegedly breached. A logical condition is that local remedies should be exhausted. To date, the European Court of Human Rights in Strasbourg has ruled on about 3,000 cases regarding an alleged breach of the right to peaceful enjoyment of possession. In the European context, many cases regard contested expropriation and restitution matters. What can we learn? In the first place the Court is generous when it



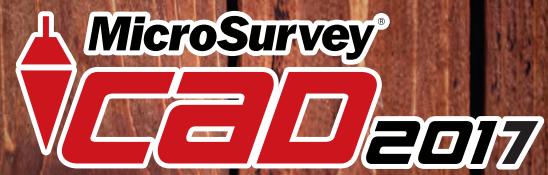
▲ African Court of Human and Peoples' Rights.

comes to what 'possession' entails; the Court accepts it as a broad concept. Deprivation is possible when it serves a legitimate objective, when the intervention strikes a fair balance between the demands of the general interest and the individual (the intervention should thus be proportionate) and when the intervention complies with legal certainty (compensation). Case law clarifies that when one of these conditions is not met, the intervention is considered to be in conflict with the Protocol. A different situation can be observed in Africa. As long ago as 1987, the African Union installed a Commission on Human and Peoples' Rights as part of its organisation. The Commission supervises the application of the African Charter. Besides states, individuals also have access to the Commission and can lodge a complaint in written format. Many individuals have already done so. However, the Commission's decisions are not binding – they only form a guideline for interpretation of the African Charter. In 1998 the African Union accepted a protocol to create an African Court on Human and Peoples' Rights. After the required formalities, the Court came into being in 2006, based in Arusha (Tanzania). The judgements of the Court are – as with the European Court – binding. If countries do not comply, they have to appear before the African Union that holds them accountable. But who has access to the Court? All states which ratified it, of course, and the African Union (through its Commission of Human Rights). Unfortunately, however, the Protocol only gives access to NGOs and individuals when summoned member states submit a declaration that they accept the Court's jurisdiction in this particular case. So far only

a handful of African states have done this, *de facto* blocking individuals from asking for the Court's judgement in matters of property rights. A complicating factor in Africa is that in 2003 the African Union decided to create an African Court of Justice which similarly limits access for individuals. Furthermore, in 2008 it decided to endorse a proposal of President Obasanjo (Nigeria) to merge the existing Court on Human and Peoples' Rights with the still-to-be-formed Court of Justice into an African Court of Justice and Human Rights. So far, the merged Court is still waiting for sufficient member states to ratify it. In both the draft Protocol for the African Court of Justice and the merger Protocol, the restricted access for individuals and NGOs is confirmed.

LAND GRABBING

There is a lack of precise insight into the current land grabbing situation. Recent publications speak of 80 million hectares of fertile agricultural land that has been sold or leased to large-scale foreign investors, mainly in Africa, but warn that the figures should be taken with a degree of caution. Likewise, publications stating that all those cases of sale and leasing of land to large-scale investors were illegal are nuanced. What remains, however, is the indication that land which is owned by local communities and small individual farmers is being sold or leased to investors. Eviction is reported more than once. In addition there are signs that small farmers are increasingly being pushed aside by local elites who see midsize farms as a good investment. The bottom line appears to be that local and indigenous land rights are being systematically neglected, partly based



WE LISTENED

MicroSurvey takes great pride in our connection with our customers. We listened to feedback and created useful features that will help increase productivity and simplify workflows. The new MicroSurvey CAD 2017 includes Smart Polyline functionality, Shapefile support for GIS compatibility, and the powerful new IntelliCAD 8.2 engine.

www.MicroSurvey.com/2017

1-800-668-3312

Enhanced Point Objects

GIS Compatibility

Smart Polylines

IntelliCAD 8.2

And More.

on the argument that land belongs to the state (or e.g. to a president, who holds it in trust for the people). Be that as it may, wouldn't it be marvellous if evicted communities and individuals could ask the African Court to consider their case? Propositions by states that they are the sole owners of the land, and that local farmers are no more than users by the grace of the state who can be evicted whenever the state wants, can be examined by the Court. Even if a decent cadastre is not in

place, property can still be recognised by the Court based on a wide interpretation of what possession entails. That also brings on board tenure in the form of common or customary property. States can be accountable for their intervention in all private property rights, whether the general interest sufficiently legitimises an expropriation of property, and whether the intervention strikes a fair balance between general and individual interest. And subsequently, if an expropriation is legitimate (which is of course also possible, despite all the negative reporting in the media), the matter of whether the state respects the rule of law in adequately compensating the victims.



▲ Protest against land grabbing.

A WAY FORWARD

The human rights approach shows a way forward in which land grabbing can be examined from the viewpoint of general and individual interests. If only African states would show political will to make themselves accountable in property matters and to allow individuals to lodge a property case to the African Court of Human and Peoples'

Rights. African NGOs have already addressed this matter, but this article is once again an appeal to the African Union to quickly abolish Article 34(6) of the Protocol and its successor, the Protocol for the Court of Justice and Human Rights. Luckily the African Union has the opportunity to improve the protection of the human right to property. In contrast, Asia does not even have a court for human rights yet, unfortunately. To achieve decent protection of the human right to property, much more work is needed there. Meanwhile, in Africa, a quick decision to abolish Article 34(6) appears to be enough for the time being. ▲

PAUL VAN DER MOLEN



Paul van der Molen is an emeritus professor in cadastre and land administration at the University of Twente (Faculty ITC) in Enschede (The Netherlands) and a former director of Kadaster International in Apeldoorn. He is an honorary member of the International Federation of Surveyors (FIG).

SANDING

GNSS POSITIONING SYSTEM

T66

- Innovative design with smallest size 12.9cm X 11.2cm
- Bluetooth 4.0
- Tilt survey up to 30°
- Electronic bubble calibration
- Wide Range of Satellite signals
- Trimtalk Protocol

<http://www.sandinginstrument.com>

MY TOUCH SOLVING LAND PROBLEMS



PETER FOSUDO,
MASTER'S STUDENT GEO-INFORMATION SCIENCE AND EARTH OBSERVATION AT ITC

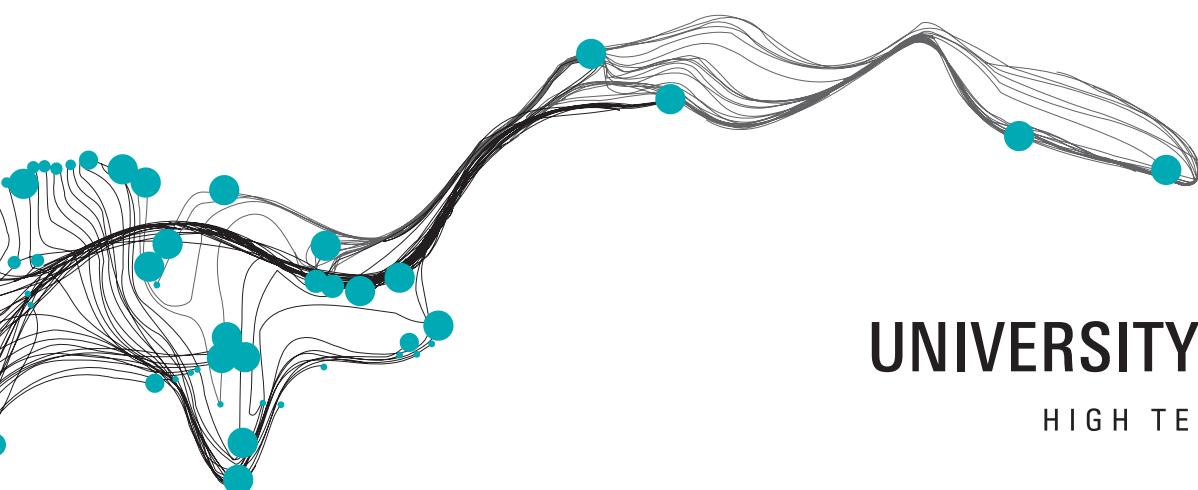
"I decided to study at ITC in order to obtain more knowledge and skills to be able to share with others. I want to be able to make even better use of my professional and scientific expertise. I opted for ITC because of its good reputation in the field of geo-information sciences and remote sensing. I eventually want to help solve problems in the field of land usage."

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

- APPLIED EARTH SCIENCES
- GEOFINFORMATICS
- LAND ADMINISTRATION
- NATURAL RESOURCES MANAGEMENT
- URBAN PLANNING AND MANAGEMENT
- WATER RESOURCES AND ENVIRONMENTAL MANAGEMENT

Add your touch. Join the world's pioneers in geo-information science and earth observation.

FOR MORE INFORMATION VISIT WWW.ITC.NL
OR E-MAIL US AT INFO-ITC@UTWENTE.NL



UNIVERSITY OF TWENTE.

HIGH TECH HUMAN TOUCH

PART 1: CARTOGRAPHIC ORCHESTRATION

Ordnance Survey Ireland Shows New Perspectives

The Republic of Ireland is leading the way in national geospatial activities within the international mapping arena. As of this September, Ordnance Survey Ireland (OSI) is the first national mapping agency in the world with the capability to produce 1:1,000,000 cartographic products and services from its 1:1,000 topographic database in a fully automated flowline. OSI has populated a standards-based, object-oriented data model and implemented orchestrated, rule-based production workflows to achieve this result.

One of the primary roles of a national mapping agency is to provide the authoritative view of the real world through the publication of mapping products and services. In OSI's case, this means providing products and services at mapping scales ranging from

1:1,000 to 1:1,000,000. Traditionally, OSI's production methodologies have been geared towards the publication of cartographic products that were aesthetically beautiful. They focused solely on geographic reference (Easting/Northing and Latitude/Longitude)

This article focuses on OSI's new rule-based production workflows. A second article, to be featured in the January edition of *GIM International*, will focus on how OSI transforms these new work processes into 'Mapping as a Service'.

and involved managing a national mapping coverage of over 5,000 individual maps. Today, OSI represents real-world features in a more intelligent way and maintains a single, high-resolution digital landscape model comprised of over 50 million uniquely referenced objects.

DATA INTEGRITY

In 2007, as part of OSI's National Mapping-as-a-Service strategy, OSI decided to create a scale-independent, object-oriented, spatial data storage model called PRIME2. OSI first reviewed advances in the area, both in Europe and further afield.

"We identified best in breed and took the opportunity to learn. We also focused



For OSI's surveyors, the new PRIME2 data model and management systems were a quantum change.
Photo courtesy: Jeroen van Berkel.



▲ Colin Bray: "Maintaining our investments meant not infecting the new re-engineered data with old work practices." Photo courtesy: Jeroen van Berkel.

on implementing non-proprietary industry standards where appropriate," says Colin Bray, CEO of OSi. In 2011, OSi began re-engineering its existing data into PRIME2. It transformed its databases into the new data platform, including full rules-based orchestrated maintenance workflows. In 2014, OSi went live with these data-maintenance flowlines. "Maintaining the investment in PRIME2 meant not infecting the new re-engineered data with old work practices," explains Bray. OSi implemented the orchestrated workflow based on 1Spatial and Oracle technologies. The data collection systems that were introduced ensured that new input from surveyors and other parties

OSi's surveyors, the new PRIME2 data model and management systems were a quantum change," recognises Colin Bray, being a surveyor himself. "When we, as surveyors, looked out of the window, our concept of modelling the world was completely different to what is asked of us today. 'Geographic location' used to be everything in our profession. Now we work in a digital society and it's all about the data. 'Location' is now considered an attribute of an object – it enables us to relate the object to the real world."

The workflow has changed dramatically. Now, when the surveyor is notified about an available job, they must extract multiple

made in authoritative data – we absolutely have to maintain the integrity of the data."

MULTI-RESOLUTION DATA STORE

The next phase in OSi's flowline is an automatic update of the model across multiple resolutions. When the photogrammetrist or the field surveyor makes a change to the PRIME2 national map, the change in that object is automatically updated across all the various resolutions of the digital landscape model. Correspondingly, OSi's digital cartographic models are updated and translated into vector, raster and web services. This automated approach is based on processes and workflows designed and built by OSi cartographers.

This September, OSi has completed a multi-resolution data store (MRDS) project with ESRI, which delivers the capability for OSi to optimise the automated workflows. Bray states: "Our staff have now gained the capability to create automatically generated products using the new process before year end. I am very proud of this, because it means that we are the first mapping agency in the world to generate products from 1:1,000 to 1:1,000,000 in a 100%-automated flowline." These new workflows provide the capability to create additional resolutions of the core digital landscape model at local, regional and national level. In addition, cartographic models have been created that automate map-making and generalisation regarding

CHANGES IN AN OBJECT ARE AUTOMATICALLY UPDATED ACROSS ALL THE RESOLUTIONS OF THE LANDSCAPE MODEL AND IN ALL PRODUCTS AND SERVICES

was compliant with the PRIME2 data model. Another part of the project involved documenting OSi's core operating procedures. This gave OSi the opportunity to reduce the risk associated with any significant loss of corporate intelligence (particularly because of upcoming retirements).

CHANGES TO DATA CAPTURE

OSi uses a combination of photogrammetric and field-based data capture methods to maintain its national geospatial platform. "For

objects covering the area of interest and load the extracted job to their tablet. On every interaction a surveyor has with the data, over 200 rules are run simultaneously to ensure that the data captured is compliant with the PRIME2 data model. When uploaded, only those objects that have actually changed will be posted back to the core database. Bray continues: "An additional 400 server-based rules are then run against the newly captured data before they are adopted into the national map. That's how we look after the investment

topographic consistency, cartographic displacement, geometric simplification, etc. Bray is content: "And with that we have the different products available in raster, vector, web services and the paper products. MRDS is putting us in the position to spin up automated flowlines for any future new product or service."

CARTOGRAPHER'S CHANGING ROLE

Cartography remains a crucial requirement to visualise the national map at different resolutions. The role of the OSi cartographer is now very much a systems expert, operating rule-based, orchestrated cartographic production flowlines and systems to create various products and services. The CEO stipulates: "You will struggle to see a difference between a manually produced map with traditional techniques and the one produced from our ESRI-based, automatically generated flowline. But our cartographers do much more than follow rules of traditional cartography. The data changes its look and

feel depending on the resolution – there's no longer just one single view of an object."

WHAT'S NEXT FOR OSi?

"We believe our core data holding is now suitable for use in modern GIS environments and is future-proof based on our current understanding of market requirements," says Bray. In addition to consulting with the user base, and as part of its data-collection strategy, OSi is now creating semi-automatic production workflows for collecting 3D objects from remote sensing: "OSi has collected in 3D for 25 years with digital photogrammetry, and in 2017 we are developing a new flowline for 3D object maintenance, starting with cities." OSi also intends to focus on image processing to enable imagery to be stored at pixel level in rows and columns within a database. Bray is convinced: "That is going to be the next generation. We will get the intelligence of our remote sensing data as attribution into the national map." ▲

WHO AND WHERE?

Colin Bray is chief executive and chief survey officer of OSi. He took up the position of CEO in 2013 after a career as CIO and professional surveyor with OSi since 1998. He is a chartered geomatics surveyor, vice president of the Society of Chartered Surveyors Ireland, and a member of the Public Service Chief Information Officer Council.

Ordnance Survey Ireland is the Republic of Ireland's national mapping agency. It is a state body and its funding model is made up of commercial revenue (81%) from both the public and private sectors. 19% comes from a Service Level Agreement with the Department of Justice & Equality for national interest mapping. In total, 60% of its commercial income comes from the public sector. In addition to the head office based in Dublin, OSi has six regional offices and a total staff of 223.

The Republic of Ireland is located in Western Europe and has total land area of 70,273 square kilometres (27,133 square miles) and a population of 4.7 million people. Its capital city is Dublin.

GINTEC

Android SurPad
Android System survey Software

SurPad 3.0
Android System survey Software

NEW CHOICE NEW FUTURE

Multi Language, Windows Mobile / Android System **Survey Software**
Free of Charge

<http://www.gintec.cn> E-mail: overseas@gintec.cn

UASs for Cadastral Applications

In recent decades, imagery-based methods have gained legitimacy in the domain of cadastral data creation. Contemporary experiences from Rwanda, Ethiopia and Lesotho, along with older activities from Thailand, already demonstrate the potential of conventional aerial imagery and high-resolution satellite imagery. More recently, unmanned aerial systems (UASs) have received increasing interest in the field of land administration. Already documented trials and demonstrations are evident for Albania, Namibia and Rwanda. The exploratory work continues; results from trials undertaken in Indonesia are presented here with a view to identifying the opportunities and challenges for embedding the technologies in a fit-for-purpose way into the existing cadastral processes.

Indonesia's existing cadastral data acquisition processes are coordinated by the National Land Agency ('Badan Pertanahan Nasional' or 'BPN'). Methods employed are primarily terrestrial, including use of measuring tape, total stations and global navigation satellite systems (GNSSs). Indonesia has a challenging topography – often hilly and with dense vegetation – and this creates problems for terrestrial surveying methods.

THE IMAGERY OPPORTUNITY

Imagery-based methods provide the opportunity to expedite the initial cadastral

establishment process, which at current speeds suggests that four further decades of work are needed. However, use of imagery-based methods is not widely practised in the country, primarily due to the lack of base imagery at the required scale. UASs could help to sporadically fill specific gaps in the base map in a cost-effective and timely manner. Utilising the imagery developed, participatory mapping activities could be used to undertake the boundary mapping exercises.

EXPLORING REGULATIONS

Many countries are actively developing –

and redeveloping – rules for civilian and commercial UAS operation. In Indonesia, new regulations were issued in mid-2015 and these have implications for the use of UASs for cadastral purposes. The regulation defines restricted areas for UAS operation (e.g. flight operation areas) and also stipulates that UAS operation below 150 metres does not require registration. These rules need to be taken into account to ensure appropriate site selection and suitable flight planning. However, as yet, there are no specific rules for the use of UASs in cadastral applications – although, any UAS-based approach would need to adhere to existing cadastral requirements.

DESIGNING A WORKFLOW

Beyond clear understandings of the existing policies and legal frameworks relating to UASs and cadastres, a flowchart for UAS-based cadastral data collection was developed. It



▲ Low-cost rotary-wing UAV with low-cost camera on-board



▲ Field test location in Lunuk Ode, Sumbawa, Indonesia



▲ Community participation was used in the delineation of parcel boundaries

included an adaptive procedure of orthophoto generation and subsequent participatory mapping. A field test in Lunyuk Ode, Sumbawa, Indonesia, was conducted using a low-cost rotor UAS with an onboard low-cost camera. In addition, a methodology was developed to utilise the orthophotos and to encourage community participation in the delineation of parcel boundaries. The procedure was based upon participatory mapping approaches. Participatory mapping is designed for and by communities; it seeks the acknowledgement of all parties involved through the boundary agreements made in the field.

FLYING AND CREATING

The test flight was planned in accordance with all legal and technical cadastral requirements. This resulted in a designed flight above the altitude of 70m with a high overlap setting: 90% forward overlap and 60% side overlap. Average ground sampling distance (GSD) was 2.99cm. In total, 532 images covering 32ha including around 240 parcels were captured. Using GNSS real time kinematic (RTK), 26 distributed ground control points were surveyed in order to improve the accuracy. The flight delivered output of imagery with 3cm horizontal accuracy, conducted within 720 minutes for five parcels and with costs of around USD80 for each parcel. The cost figures were derived using the Costing and Financing of Land Administration Services (CoFLAS) guidelines by the Global Land Tool Network (GLTN). It is suggested that the approach greatly overestimates the cost and time needed per parcel; when applied at a scale beyond a single pilot area, several key costs (e.g. equipment) would not scale as they are fixed.

FIT-FOR-PURPOSE EVALUATION

The entire process was evaluated against fit-for-purpose criteria including 'participatory', 'attainable', 'reliable' and



▲ Results demonstrated the UAS-based method was cost and time effective

'affordable'. Overall, good levels of adherence were measured; the process was considered participative and is considered to be reproducible. Compared with conventional approaches, the UAS-based method was shown to be more cost and time effective in creating parcel records. The approach also produced highly accurate spatial outputs. Whilst not explicitly evaluated, other fit-for-purpose criteria – 'flexible', 'inclusive' and 'upgradable' – appear to be supported by the approach. The approach can adjust to spatial accuracy needs, different purposes, temporal requirements, different user-group demands and geographical characteristics and can be used to upgrade qualities in a sporadic fashion over time. Taking the above into account, with regards to the participatory mapping approach, there are no (global) standard guidelines or prescribed quality control measures for conducting boundary surveys using imagery with community involvement. Further studies regarding this issue are needed: ones that consider quality assurance and issues of certainty, amongst other criteria.

LOOKING AHEAD

In recent decades, Indonesia has made steady gains with respect to the spatial coverage of its cadastral system. However, much work remains to be done – particularly in the more remote, hilly and highly vegetated areas of the complex and diverse archipelago. The approach developed here is not intended as a panacea; UASs are not suitable for all cadastral applications. Instead, the mix of UASs and participatory mapping techniques

offers a niche fit-for-purpose solution for specific areas and communities where land rights remain unrecorded, yet are legitimate and deserving of being formally acknowledged. ▲

FURTHER READING

- FIG (2014), Fit-For-Purpose Land Administration. FIG Publication No. 60, Copenhagen, Denmark
- GLTN (2015), Costing and Financing of Land Administration Services (CoFLAS) guidelines, UN-Habitat, Nairobi, Kenya.
- <http://www.gim-international.com/content/article/uavs-revolutionise-land-administration>

SHEILLA RAMADHANI

 Quality and control analyst for survey and mapping in the Ministry of Agrarian and Spatial Planning/National Land Agency, Republic of Indonesia.

ROHAN BENNETT

 Director of the School for Land Administration Studies. associate professor at University of Twente, ITC Faculty, Netherlands. Project coordinator of Euro Commission Horizon2020 project 'its4land' (its4land.com).

FRANCESCO NEX

 Assistant professor at University of Twente, ITC Faculty, The Netherlands. Chair of the ISPRS ICWG I/II on UAS & Small Multi-sensor Platforms: Concepts & Applications.

Aiming at the future together!

PENTAX



D-200
Multicopter



H-1000C
Unmanned
Helicopter
System



R-400VN
Reflectorless Total Station

Efficient accuracy
at your fingers!

R-1500N
Reflectorless Total Station

Total surveying
solution

R-2500N
Reflectorless Total Station

Advanced Pentax
EDM technology

W-1500N
Windows CE Total Station

A truly integrated
system

G3100-R2
Positioning System

Precision satellite
surveying,
with wireless
communications

W-800N
Windows CE Total Station

A highly
sophisticated
system with auto
focus function

TI Asahi Co., Ltd.

International Sales Department
4-3-4 Ueno Iwatsuki-Ku, Saitama-Shi
Saitama, 339-0073 Japan
Tel.: +81-48-793-0118
Fax: +81-48-793-0128
E-mail: International@tiasahi.com

www.pentaxsurveying.com/en/

Frankfurt: Lack of Open Data Frustrates Researchers

The words of Chancellor Angela Merkel, welcoming victims of armed conflict to her country, led to over a million refugees arriving in Germany. The city of Frankfurt (more than 700,000 inhabitants) has taken its share. The Department of Geoinformation and Public Works at Frankfurt University of Applied Sciences launched a project to find housing for the thousands of migrants, but the scientists found many barriers standing in the way of them obtaining the spatial data they needed.



▲ *Fabian Thiel: "All the IT instruments and European and national guidelines for easy data exchange are there on the table, but the reality is different."*
Photos © Jeroen van Berkel

As a lawyer and geographer, Professor Fabian Thiel is frustrated by the lack of use of spatial data for land management issues in the Frankfurt region of Germany. At Frankfurt University of Applied Sciences, he has supervised a number of projects and he always reaches the same conclusion: for researchers, success in obtaining regional data to combine with the base maps in their geographic information system (GIS) is the exception rather than the rule. And the latest project – to find housing opportunities for groups of refugees – was no different. “With this project, I hoped we could close

the gap between theory and practice. The refugee housing problem could be a new chance for the municipality to show the open data philosophy,” he says. But he was disappointed.

UNKNOWN DEMAND

Problem 1: how large is the demand? Frankfurt already faced a considerable housing problem, even before the refugees started arriving. It is not known how many extra parcels or buildings are needed because, although the official figure stands at 6,000, the real number of refugees in the

city is unknown. After being registered upon crossing the border into Germany, refugees are obliged to go to large, temporary housing facilities all over the country. But many of the young men fail to show up at such centres and go instead to places where they hope to find work – such as Frankfurt, with its strong economy. They find shelter wherever they can, often sharing a room with many others in unused buildings. Even for those who receive an official permit to stay, the housing issue is just as troublesome. Thiel: “Refugees who get admitted are responsible for their own housing situation, but very few will find a





▲ The refugee housing problem could be a new chance for Frankfurt – the financial capital of Germany – to demonstrate the open data philosophy.

house on the private market in Frankfurt or the surrounding area. So they will stay on the streets. Nobody is thinking about this yet, but it will be a nightmare. The accommodation we are looking for could also be a step in between the asylum seekers' centres and the private market." When looking for suitable properties, the project team has to take into account certain guidelines: no more than 300 people per building, and individual properties housing refugees must be at least one kilometre apart. Furthermore, according to the Human Rights standard, each refugee must have a minimum of 7m² of floor space.

LULU, NIMBY AND BANANA

Problem 2: is refugee housing a priority for the city planners? Fabian Thiel: "It's a form of real estate investment; most refugees will stay here for many years, if not forever. But

per day by 2020. For the state of Hesse (Germany is a federation of states), of which Frankfurt is the largest city, that equates to a maximum of approx. one hectare per day by 2020. However, there are many ongoing building projects in Hesse and it is unlikely that those goals will be met. As the pressure on the market continues to increase, will investments in housing for refugees move higher up the agenda? "NIMBY and LULU," the professor answers. "All the enthusiasm is focused on the Frankfurt Skyscraper Development Plan. The aim is to build at least 20 more skyscrapers before 2030, also because of 'Brexit' and an influx of financial companies and employees from the United Kingdom."

INTEROPERABILITY

Problem 3: is there a culture of cooperation? In Germany the government is normally organised by the principle of subsidiarity: don't do anything centrally that can be done at a more local level. "So, in the case of land management, it is the mayor of Frankfurt who is the absolute, undisputed king: he decides about the spatial planning. Also within the city each department is its own kingdom," says Thiel, speaking from experience. "Each has its own systems and datasets and they don't match. They use common base maps and the cadastre data platform, but they are at liberty to use their own data as well, so there are as many versions of datasets as there are kingdoms. Keeping the power at the lowest

responsibility. Calls and emails to the federal agencies and the other government layers all got the same reaction: 'You have to be with somebody else'. Even the team in Frankfurt that is responsible for local refugee housing failed to answer our questions: 'Sorry, no time'. All the IT instruments and European and national guidelines for easy data exchange are there on the table, but the reality is different. That's been my experience in several projects now. They are clearly not interested in cooperating with knowledge institutions."

WALK THE STREETS

Problem 4: how to get the right data? The students on the project, Nabil Bohlender, Koral Usul and Philipp Lott, created a GIS application using the large-scale map of Frankfurt and the cadastre real estate map with building polygons. They searched for large, uncultivated land parcels and for large, vacant buildings where several hundred refugees could be accommodated by the municipality. "We didn't find a formal registration of empty land parcels, so we made a rough selection based on the spatial data we had. After visiting the possible options of unused land, we were left with three to four large plots that are suitable to build a housing facility, for instance based on temporary modular units." They have also selected ten large properties, mainly office buildings, of several thousand square metres. They cannot be sure of the possibilities and additional costs because they were not allowed to enter the properties or did not know who they were owned by. Again, they found those buildings not as a result of their application, which in the end they could only use as a means of presentation of their search results, but simply by walking around the city to see what was empty. "There seems to be no register of empty buildings or even plots such as brownfields. The private landowners do not cooperate with the local planning authorities. And if there are systems with pure facts about the buildings in this city – square metres, number of floors, year of building, building plans, etc. – we were not able to find them," say the members of the project team.

OWNERSHIP DATA

Professor Thiel narrowed down the question and asked the state of Hesse and the city of Frankfurt to give him a dataset with the region's (empty) buildings that are public property. "I drew a blank; they told me there is no such overview. For instance,

'KEEPING THE POWER AT THE LOWEST LOCAL LEVEL MAKES IT DIFFICULT TO SHARE IT, DATA INCLUDED'

rather than being a priority, making buildings where refugees can live safely is regarded as locally unwanted land use (LULU). In many cities, the main informal guidelines for spatial planning of refugee housing seem to be based on the 'not in my backyard' (NIMBY) principle, but also on 'build absolutely nothing anywhere near anybody' (BANANA)." However, it is no problem in the current emergency circumstances to use land for other purposes than its formally agreed function, e.g. to install temporary modular units on grassland or to use a vacant office building for housing. This is also influenced by the federal goal of reducing land consumption. In Germany today, 80 hectares of greenfield land per day is converted into land for new buildings and infrastructure, but the target is 30 hectares

local level makes it difficult to share it, data included. Under the flag of the European INSPIRE Directive there is the aim to make data interoperable, standardised, open – but it remains difficult to find data, let alone use it."

What makes everybody even more uneasy is the fact that the policy issue of refugee housing leaves several layers of responsibilities intact: the federal government in Berlin with its general migration policy, several levels of the state of Hesse, and the municipality. "The planning hierarchy for this particular challenge does not fit into the normal hierarchy of subsidiarity. German civil servants are very poorly prepared for that. There is a cultural mismatch, and the lack of harmonised data makes itself felt. Nobody accepts

the students selected a potentially suitable building of 10,000m² over four floors that has been standing empty for 15 years. It's ideally located near the main station with a large greenfield site next to it. Everybody thinks it is owned by the Finance Ministry of Hesse, but they cannot confirm that. Or don't want to."

Grassroots movements are emerging in which volunteers are being asked to report empty houses and buildings, with the intention that the municipality takes action to improve the housing situation for the citizens of Frankfurt. The atmosphere echoes that of the 1970s and 80s, when left-wing youngsters in Western Europe occupied empty buildings in protest at the inadequate housing situation and the profits made by real estate investors. But this crowd-sourced dataset is not well managed and is not up to date, the students found. The same is true for the formal dataset of ownership data; there is no reliable data source available. The dataset is not only privacy-protected, but it may not even be used for scientific reasons. Furthermore, Fabian

Thiel is certain that it is not up to date: "I have seen parts of it, but the local planning authority has the same experience as I have: access to the data is blocked, the update frequency is not high enough and, as far as public property is concerned, the governments don't know exactly what they own."

Perhaps the proposed new tax on property will be helpful, because then there will be more information about land use and building data. Every ten years, all buildings in Hesse will have

to be (re)valued based on the core data of the building and market value. Unused land will also be taxed. Fabian Thiel concludes: "That will put pressure on updating the ownership registration, and it will give the authorities insight into the quality of the buildings and a registry of unused land. Then, the only challenges left are to harmonise their data and deliver on the open data policy. In a few years' time, multi-criteria GIS analysis of land management and real estate policy will also be possible in Frankfurt." ▶

Since 2011, Fabian Thiel has been professor of planning law, real estate and property valuation in the Faculty of Architecture, Civil Engineering & Geomatics, Department of Geoinformation & Public Works, at Frankfurt University of Applied Sciences. As a lawyer and geographer, he focuses on teaching and researching fields such as land law, planning law, constitutional law, land policy and property valuation, in national and international markets. The university has 12,471 students; the faculty has 2,000 students, of which approximately 10-15 per year obtain a master degree with a substantial spatial analysis and GIS component. Before this post, he was active as integration expert / consultant at the Center for International Migration & Development and the German International Cooperation in Frankfurt and Phnom Penh, Kingdom of Cambodia.

KOLIDA GNSS

THE PURSUIT TO
NEW HEIGHTS WILL NEVER STOP

WWW.KOLIDAINSTRUMENT.COM

The advertisement features a dramatic black and white photograph of a snowy mountain range. In the foreground, two climbers are seen scaling a steep, rocky cliff face. To the right, a KOLIDA GNSS surveying equipment is mounted on a tripod, its antenna pointing towards the sky. The equipment consists of a grey receiver unit and a yellow base station. The overall theme is one of precision, exploration, and reaching new heights.

SPOTSCALE

The Quest for Large Urban 3D Scenes without Visual Artefacts

Swedish company Spotscale, based in Linköping and Stockholm, is a reconstruction software start-up that develops cloud services for 3D reconstruction of the built environment. The primary input data source for Spotscale is currently imagery, often captured using multicopters. What makes the company unique is its focus on urban scenes only, captured from all possible angles at close range.

Spotscale was founded 2013 in the aerospace and image processing Mecca of Sweden where other enterprises like VICON (SAAB), Sectra and Autoliv are currently thriving. The region of Linköping, including its university, have a long history in computing, visualisation and computer vision stretching back to the early days of computers. Ludvig Emgard, who was the head of product

development at C3 Technologies, saw the emerging technology in multicopter drones and started Spotscale together with an early drone entrepreneur, Jonas Lindqvist. Jonas also founded Intuitive Aerial, a manufacturer of drones for film makers.

Since 2013, the company has grown from three to nine employees, most of whom

are mathematicians/programmers within computer vision, simulation and cloud computing. Today the company is led by the founder, Ludvig Emgard, together with COO Katarina Nylander, another high-profile member of the Swedish geospatial community and a former colleague of Ludvig's. Over the years, Spotscale has focused on developing superior methods and



▲ Ludvig Emgard and Katarina Nylander. Photo: Anders J Larsson

technology for the capture, reconstruction and visualisation of building imagery. "Each urban setting provides new problems to solve, in order to automatically deliver a truly realistic 3D rendering of the place, and we love tough challenges," says Ludvig Emgård.

VIRTUAL WORLDS

The goal for Spotscale is to deliver virtual worlds that are on the same visual level as modern computer games with a very high degree of automation. This of course implies not only delivering a geometrically correct point cloud of a scene, but to visualising each material with its true characteristics using modern methods of meshing, texturing and light simulation. To achieve this, many disciplines need to be combined. It has been a crucial success factor for Spotscale to gather all of the right theoretical skill sets under the same roof and to work together towards this common goal.

In a true tech start-up style, the members of the development team are all based out of one big office space in an old apartment downtown. The culture is open minded and casual, and most of the communication is informal and collaborative. The company is also a start-up from a financial perspective in the sense that it is dependent on venture capital. Therefore, it is investing heavily in technology for the future, rather than harvesting the market of current opportunities.

Spotscale has found its first customer groups in real estate development, where early adopters are leveraging the new visualisation capabilities. In addition, a few future-oriented architect firms have picked up on the new possibilities from Spotscale to leverage moving-picture and interactive solutions for their customers as opposed to 2D photo collages and illustrations. Large construction companies are using the technology for internal projects and Spotscale recently signed a strategic agreement with the construction giant Swedish NCC. "We have been seeking a provider that can help us all the way from 3D reconstruction to useful visualisation and planning tools," says Viktor Davidov, digital business developer at NCC. "We like to have our own staff in the field, capturing with drones, and then instantly get planning tools in the office."

HIGH-END 3D MODELLING

In the summer of 2016, the company decided



▲ 3D rendering of Norrköping, Sweden. Image by Spotscale

to stretch the limits of drone-produced 3D content in inner city environments when it processed a neighbourhood of 40 city blocks into a high-resolution 3D model. "This high-end neighbourhood model is unique in its kind," says Ludvig Emgård, who sees huge possibilities for larger areas in high detail. This size of model enables more high-fidelity geospatial applications than anyone has been able to deliver before – a perfect base for computer games or more large-scale planning projects, even though very computationally intense. "Heavy parallelisation on the cloud and lots of tricks for 3D data merging have been developed during this project," adds Ludvig.

Moving forward, Spotscale will continue to invest in its quest for perfect realism in the models and to remove the visual artefacts that come naturally with computer-vision-

based reconstruction. It will also focus more on expanding its business to other countries similar to Sweden, where the legislation has evolved to the point where drones are allowed to fly inside city boundaries. The UK, Malaysia and certain Latin American countries are on the company's radar, along with the USA. Therefore, Spotscale is now actively seeking drone operators all over the world who want to bring advanced 3D services to their local real estate development communities. ▲

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



▲ Three of the Spotscale developers at the office. Photo: Thor Balkhed

Land Consolidation and Land Readjustment for Sustainable Development

Over 200 participants took part in the three-day event on land consolidation and land readjustment for sustainable development, held from 9-11 November 2016 in Apeldoorn, The Netherlands. The event was related to the celebration of 100 years of land consolidation in The Netherlands. Co-organisers were the Food and Agricultural Organisation of the UN, Landnet, the International Federation of Surveyors and Kadaster, Netherlands, with support from UN Habitat, the Global Land Tool Network and the World Bank. Focus was on the urban and rural environment and on applications for sustainable development. The participants came from 50 countries around the world.

Essentially, the topic of land consolidation and land readjustment is about improving the structure of people-to-land relationships for one or more purposes. This is usually associated with broad economic and social reforms. As an implementation tool for spatial planning this can be combined with the development of infrastructure, public services and water

management. The principles of both tools are basically the same: pooling of all the land parcels in a particular area and planning them as a unit and then dividing up the land again to the original land owner or user. A proportion of the land can be used for public purposes such as infrastructure, nature and public space.

Experts presented their research and project results during the parallel sessions of the symposium. The global perspective contributed to a collection of examples of how land consolidation and readjustment can contribute to the Sustainable Development Goals of the UN.

The symposium was concluded with the 'Apeldoorn declaration on land consolidation and land readjustment for sustainable development'. This states that there are some common principles in the use of the tools, but no one-size-fits-all solutions for land consolidation and land readjustment exist. A comprehensive approach in land consolidation and land readjustment favours sustainable

development in the way that it benefits the people, planet and economic profit. The spatial component of these instruments is a very powerful asset of land consolidation and land readjustment to manage land use. The spatial rearrangement of land rights can help mitigate the negative effects of, for example, climate change such as extreme rainfall or drought, rising sea levels, global warming, salination and the decline of suitable habitat for species (biodiversity). However, it becomes even more powerful when it is combined with additional policies and measures to address the causes of unsustainable development. Surveyors and agronomists should closely cooperate with ecologists in order to design reallocation plans with 'green fingers'. The FAO Voluntary Guidelines, the UN 2030 Agenda for Sustainable Development and the New Urban Agenda from UN Habitat should guide the application of land consolidation and land readjustment. In all cases it is important to recognise a plurality of tenure types that are relevant in negotiations around – and planning for – land consolidation and land readjustment.

The potential within this area of expertise to design resilient landscapes is enormous. It is necessary to raise awareness of the benefits that the tools can bring – especially for politicians and policymakers.

Paula Dijkstra, Marije Louwsma and Christiaan Lemmen

More information
www.lcsymposium.nl



Marine SDI Capacity Building at the GSDI Association

The GSDI Strategic Project 'Marine SDI Best Practice' began in November 2015. The project conducts research into effectiveness of marine information geoportals and other aspects of delivering successful marine/coastal SDIs, policy and governance

challenges – and successes – including land-sea information requirements. The results of the project, which will end on 31 October 2017, are presented in papers, at relevant SDI and marine sector-related conferences, via workshops and in a series of

webinars, the first of which was offered on 4 November 2016.

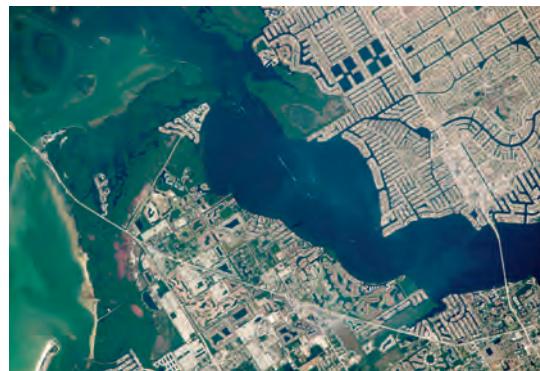
There are also links to many past coastal/marine SDI workshops that have been offered in the past by GSDI members, as well as

background documents which support the workshops and webinars. All materials are made available under the Creative Commons – By Attribution licences (except where noted for certain background documents).

In 2017, the Marine SDI Best Practice Capacity Building webinars will cover:

- Quarter 1: Marine/coastal SDI policy issues, including data access and sharing policy good practice, use and re-use of marine/coastal data, IPR and licensing policy (and tools), liability, privacy, database protection and more.
 - Quarter 2: Marine data geoportal research and good practice, including updates and analysis of the marine geoportal research that underpinned the project from 2014, standards for web services, marine geoportal case studies and examples of best practice, including tools for online web services being used by the coastal and marine sectors, the role of metadata and benefits of data and services interoperability.
- The project will also deliver workshops at the INSPIRE 2017 and CoastGIS 2017 conferences and the UN-GGIM Europe 2017 meeting, among other venues. Additional financial support has been secured for 2017-2018 from EuroSDR, a not-for-profit organisation linking national mapping and cadastral agencies with research institutes and universities in Europe for applied research in spatial data provision, management and delivery. The project staff

- Quarter 3: Marine open data and big data challenges, covering current international trends in open data for coastal and marine information across society, examination of open data business models and transnational initiatives in tackling the challenges posed by big data mining and analytics in the marine realm.



are also engaged with the International Hydrographic Organization's Marine SDI Working Group and the UNESCO IOC IODE International Coastal Atlas Network (ICAN) project.

For more information, contact Roger Longhorn at secgen@gisdi.org

More information

www.gisdi.org

IAG Commission 1: 'Reference Frames'

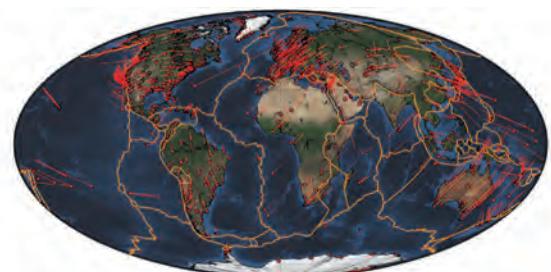


Reference systems and frames are of primary importance for all geodesy and geospatial applications. For example, a precisely defined reference frame is needed for an improved understanding of the Earth's rotation and its gravity field, sea level change with time, tectonic plate motion and deformation, glacial isostatic adjustment, geocentre motion, deformation, local subsidence and other crustal displacements. It is also critical for practical applications in geoinformation, mapping and navigation.

The activities and objectives of IAG Commission 1 are concerned with the theoretical aspects of how best to define reference systems, how reference systems can be best realised as reference frames, and how they can be used for practical and scientific applications. Topics covered include the definition, establishment, maintenance and improvement of geodetic reference frames, along with the development of advanced terrestrial and space observation techniques. The objectives also encompass the definition and establishment of vertical reference systems at the global and regional levels.

Commission 1 is closely linked to the other IAG Commissions, to the Inter-Commission Committee for Theory (ICCT), and to all IAG geometric services (such as the IVS, IGS, IDS, ILRS, and IERS), including their Working Groups and Combination Centres. In addition, the new Commission 1 objectives include building links to activities such as relativistic geodesy with height measurements by frequency comparisons of atomic clocks, or the co-location of techniques in space with new missions such as GRASP and E-GRASP/ Eratosthenes. Commission 1 is also known as Sub-Commission B2 within COSPAR.

In the term 2015-2019, Commission 1 consists of four Sub-Commissions with in total eight Working Groups, one Joint Study Group and five Joint Working Groups. The Sub-Commissions are: SC 1.1: Coordination of Space Techniques (Chair: Urs Hugentobler), SC 1.2: Global Reference Frames (Chair: Xavier Collilieux), SC 1.3: Regional Reference Frames (Chair: Carine Bruyninx), and SC 1.4: Interaction of Celestial and Terrestrial Reference Frames (Chair:



▲ ITRF2014 velocities as provided at http://itrf.ign.fr/ITRF_solutions/2014/

Zinovy Malkin). Sub-Commission 1.3 also includes the regional entities for Europe, South and Central America, North America, Africa, Asia-Pacific and Antarctica. The Commission 1 website is at <http://iag.geo.tuwien.ac.at/c1>. The Commission 1 meeting on Reference Frames for Applications in the Geosciences (REFAG) is planned for autumn 2018.

More information

www.iag-aig.org

In Italia Ci Piace Mappe



▲ A Vietnamese ministerial delegation visiting the AIC in Rome, September 2016.

Italy is one of the 13 founding member nations of ICA and Italian cartography has a notable history and record of innovation. In the past, ICA has benefited in various activities from the participation of, and hosting by, Italian cartographers. Such engagement is expected to increase in the years leading up to the 30th International Cartographic Conference in 2021, which has been awarded to the city of Firenze (Florence) by the most recent ICA Executive Committee meeting.

The ICA member organisation representing Italy is the Associazione Italiana di Cartografia (AIC) which, under its long-serving president, Prof Giuseppe Scanu, has been regularly active within the country throughout its 54-year history. Its aim is to contribute to the development, study and research of cartography, to improve the professional cartographic culture among individual members and to promote Italian cartography abroad through international cooperation. The

LINERTEC

LGP-300 Series
WinCE Reflectorless
Total Station



LTS-200 Series
Reflectorless
Total Station



LTH-02/05
Electronic
Theodolite



LGN-200 GNSS



A-100 Series
Automatic
Level



**Cutting-Edge Technology
at an Affordable Price**

TI Asahi Co., Ltd.

www.tilinertec.com | contact us at trade@tilinertec.com

association has individual and organisational members that participate in various activities, including publication of a journal: The Bulletin of the Italian Cartographic Association. This journal collects works submitted by Italian and international authors into a peer-reviewed online journal with three issues per year. Since 2015, the common parts of the Bulletin are published in both Italian and English, and it is distributed as an open access journal by the University of Trieste Press (EUT) (www.openstarts.units.it/dspace/handle/10077/9933/). A parallel, more informal, section of the Bulletin, named Percorsi, aims at gathering web-GIS-based tourist paths or experiences linked to scientific papers on thematic cartography (www.openstarts.units.it/dspace/handle/10077/9911/).

The executive and scientific committees of the AIC include de jure representatives from all relevant national bodies (including the Military Geographic Institute, the Naval Hydrographic Institute and others), and engagement with members is enhanced by active Facebook pages. The association's annual conferences are held around the country, most recently in cities including Padua in the north, (2012), Sassari in Sardinia, (2013), Rome (2014), Salerno (2015) and San Benedetto del Tronto on the Adriatic coast (2016). The most recent national report on Italian cartography, submitted to the ICA General Assembly in 2015 and available at http://icaci.org/files/documents/national_reports/2011-2015/italy.pdf, gives a comprehensive account of the organisation of

the association, and it also details the work of the national mapping agencies, the extent of private sector cartography and the extent of education in cartography in Italy. In one of the most geologically interesting countries in the world, the Geological Survey of Italy has a complex task, reflected in its recent exhibition at the annual SGI conference in Naples. Embracing the idea of International Map Year, a stunning display of posters on the theme 'We Love Geological Maps' was presented (accessible through http://www.socgeol.it/923/statistiche_download.html).

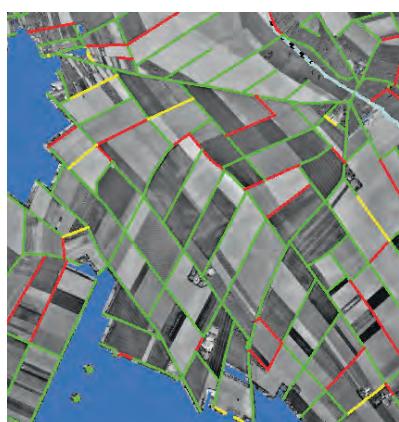
More information
www.icaci.org

ISPRS Hannover Workshop: A Mix of Geometry and Semantics from Images



Sensor calibration, image orientation, object extraction and scene understanding from images and image sequences are important research topics in photogrammetry, remote sensing, computer vision and geoinformation science. In these tasks, geometry and semantics both play an important role, and high-quality results require proper handling of all these aspects. While individual algorithms differ according to the imaging geometry and the employed sensors and platforms, all mentioned aspects need to be integrated in a proper workflow to solve most real-world problems. This observation has led to the launch of a common event for a number of well-established scientific meetings all under the same roof: the ISPRS Hannover Workshop, 6-9 June 2017. While High Resolution Imaging from Geospatial Information (HRIGI) and the European Calibration and Orientation Workshop (EuroCOW) are more on the geometric side, City Models, Roads and Traffic (CMRT) and Image Sequence Analysis (ISA) have a legacy in automatic object reconstruction and trajectory computation. The joint event addresses experts from research, government and private industry. It consists of high-quality papers, and provides an international forum for discussion of

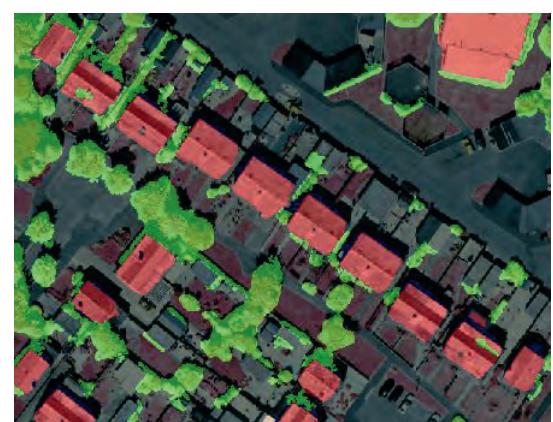
leading research and technological developments as well as applications in the field. Prospective authors are invited to submit a full paper (deadline: 31 January 2017) or an extended abstract (deadline 28 February 2017). Full papers will undergo a rigorous double-blind review process; accepted papers will be published in the ISPRS Annals series. Abstracts will also be peer reviewed; upon acceptance authors will be invited to submit a regular paper which will be published in the ISPRS Archives series. Both the Annals and the Archives are indexed in the Web of Science.



Gold sponsor of the event is Leica Geosystems. The meeting is also supported by geonumerics, Vexcel, Pix4D and IGI. More information is available at <https://www.ipi.uni-hannover.de/hrigi17.html>. We look forward to meeting you in Hannover, Germany, in June next year.

Christian Heipke, on behalf of the workshop organisers

More information
www.isprs.org



►2017

► JANUARY

GLOBAL SPACE CONGRESS

Abu Dhabi, United Arab Emirates
from 31 January - 1 February
For more information:
globalspacecongress.com



► APRIL

GISTAM 2017

Porto, Portugal
From 27-27 April
For more information:
www.gistam.org/?y=2017

► MAY

XPOENTIAL 2017

Dallas, USA
from 8-11 May
For more information:
www.xponential.org/xponential2017

► SEPTEMBER

UAV-G 2017

Bonn, Germany
from 4-7 September
For more information:
uavg17.ipb.uni-bonn.de

ISPRS GEOSPATIAL WEEK

Wuhan, China
from 18-22 September
For more information:
zhuanti.3snews.net/2016/ISPRS

FIG WORKING WEEK 2017

Helsinki, Finland
from 29 May - 2 June
For more information:
www.fig.net/fig2017

► JULY

INTERNATIONAL CARTOGRAPHIC CONFERENCE

Washington, USA
from 2-7 July
For more information:
icc2017.org

CALENDAR NOTICES

Please send notices at least 3 months before the event date to: Trea Fledderus, marketing assistant, email: trea.fledderus@geomares.nl

For extended information on the shows mentioned on this page, see our website: www.gim-international.com.

- Professional GNSS satellites tracking (GPS, GLONASS, Galileo, Beidou)
- Multiple communication modules: Bluetooth, Radio, GSM, 3G(optional)
- Superb storage:
Internal memory is 16GB standard(32GB/64GB optional). Supports extended memory(up to 128GB)
- Incline Measuring:
Get the right point data by automatic correct system with the pole tilted in ±30°
- NFC technology:
Achieves automatic Bluetooth paring once PDA touches A60 (Provided that PDA is equipped with NFC module)
- WIFI Connection:
Realizes WebUI control which is designed to modify settings and monitor the receiver status



www.foif.com

SUZHOU FOIF CO.,LTD.

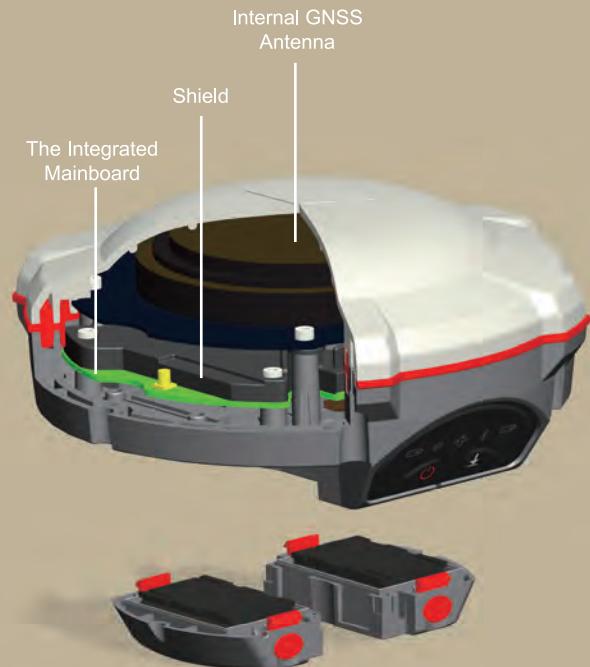
FOIF®



Pocket Size

A60 GNSS Receiver

GNSS RECEIVER T300



THE NEXT LEVEL RTK

GNSS RECEIVER M300 Pro



THE NEXT GENERATION CORS RECEIVER

SinoGNSS®
By ComNav Technology Ltd.

www.comnavtech.com
ComNav Technology Ltd.



* SinoGNSS® is the official trade mark of ComNav Technology Ltd., registered in People's Republic of China, EU, USA and Canada.

AND THEN THERE WAS **ONE**

INTRODUCING THE



The Trimble® SX10 total station is a revolutionary piece of surveying equipment—one machine with full **total station technology** plus a **high-precision scanner**, united at last. Welcome to innovation powerful enough to redefine an entire industry.

EXPERIENCE THE REVOLUTION AT TRIMBLE.COM/SX10

© 2016, Trimble Inc. All rights reserved. GEO-114 (10/16).