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Pioneers in Capturing Public Space

Interview with Frank Pauli, CycloMedia

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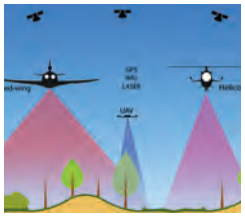

Reality models, or digital twins, are a major pillar of the smart city concept. Street level imagery plays an important role in managing cities, and as there are many interesting developments going on in mobile mapping technolgy, we have interviewed Frank Pauli, CEO of one of the pioneers in the sector. You will find the interview on page 12.

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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

Up to standard

Fit for purpose is a term used for doing no more than necessary, because of time and/or financial restraints, or otherwise explained as to 'act as efficiently as possible'. Often fit for purpose is just doing smart business, shaving costs while keeping benefits to a maximum, and acting up to standard, making it appealing to all entrepreneurs.

During the last Intergeo at end of September in Berlin (you will find a report of this trade show and conference on page 36), I had an interesting chat with several surveyors from a small family business in the Netherlands. They had been exploring surveying for the precision agriculture using drones for the past few years. While they thought this is often the best option, the UAV should often not be the preferred method for inspecting the agricultural area. Difficulties they identified were often related to the size of the area (often not very big in the Netherlands in comparison to, for instance, France or Ukraine) and of course flying regulations in a densely populated country like the Netherlands (not allowed to fly over roads). The most important factor used to determine whether photogrammetry by UAV should be used for inspecting crops in the field, is the accuracy of data needed. The surveyors mentioned on a number of occasions that farmers get loads of data they don't even know what to do with.

In the article Low-cost UAS Photogrammetry in Ukraine by Denys Gorkovchuk and Julia Gorkovchuk in this issue of *GIM International* on page 20 you will find exactly the same reasoning. The authors investigated whether low-cost UAS photogrammetry, using consumer-grade copters, is sufficiently accurate for 2D and 3D mapping of quarries. They concluded that it very well might be, with the important remark that this applies to small and medium-sized quarries. For open-pit mines larger than 50ha professional UAS photogrammetry might very well be the best solution.

Spanish energy company Viesgo shares their experience with using UAS photogrammetry in a maintenance project of a medium-voltage power line on page 29 of this issue. With 31,150 km of power line, supplying electricity to more than 720,000 customers in Spain and Portugal, disruption of service caused by contact of vegetation to power lines is of course of crucial importance. Bringing UAS technology into the process of monitoring vegetation in order to know when to prune and trim, saves large amounts of money.

▲ *Durk Haarsma, publishing director.*

It is important to recognise the pattern: budgets for surveying open-pit mines, power line networks and also agricultural areas are tight. Professional ground surveys are often quite expensive. It is here where UAV surveying comes in. But an absolute requirement for efficient deployment of a drone in surveying an open-pit mine, an agricultural area or an electricity network is to find the balance between what is needed and what is possible and combine that with the cost-efficiency that the UAV brings in: how much money does it save. When that optimum is found, the survey is really fit for purpose and up to standard.

Be Smart with Public Land

In every country the state owns land. Kevin Cahill ('Who Owns The World', 2010) argues that Queen Elizabeth is the largest land owner on Earth, as she possesses the UK, Canada, Australia, New Zealand and much more, amounting to one-sixth of the Earth's surface. More seriously, the point I want to make is that state land is often just stolen from the citizens. When Captain Cook landed at Botany Bay in Australia in 1770, he proclaimed the Declaration of Possession, based on the doctrine of 'terra nullius', bringing all land into the possession of the Crown. After the well-known Mabo case, the 'terra nullius' doctrine was overturned and the government had to create a 'native title' to which the original people were entitled long before Captain Cook's declaration.

The federal government of the USA owns about 28% of the total US land area, from 5% in Wisconsin to 80% in Nevada. Following the War of Independence, starting in 1775, the USA expanded to the west through annexation (Texas), war (Mexico), negotiations (Oregon), and purchase (Louisiana purchase). At first, the federal government considered all the acquired lands to be under temporal ownership, but later it asserted its power. In Africa, in precolonial times, people pursued their own legal systems, based on their customs and practices. In the 19th century, European states were keen to gain political interests in Africa. In 1884, the Berlin Conference even regulated the 'scramble for Africa'. Regarding British colonial rule, the 'reception clause' (the formal decision that British common law should apply in the British colonies, thus replacing their existing laws) declared all land to be Crown land. As the famous Kenyan professor Okoth-Ogendo once said: 'We were owners of our land, but suddenly we became tenants of the Crown'. After the independence of Kenya in 1963, the new Constitution stipulated that Crown Land should become Government Land, held in trust by the President.

After the revolution in Russia in October 1917, all private land was nationalized, even though in 1848 the Communist Manifesto had sought to nationalize bourgeois property but not 'the hard-won, self-acquired and self-earned property of the small peasant or petty artisan'. Article 2 of the 1918 Constitution reads : 'for the purpose of attaining the socialization of land, all private property in land is abolished'.

The examples mentioned here are just a few of the many cases, showing that state land is often land just stolen from the people. Whether it is 'terra nullius', or a 'reception clause', or 'land vested in the president', in all cases it relates to land that was formerly owned by individuals and communities. It is painful to observe how governments take their state land for granted, as if it were their own property. Apart from the social and legal injustice, state land is often weakly managed. Governments don't know how much land they 'own', where it is located, how it is used and by whom, and all the corruption issues are related to state land: land grabbing, land swaps, eviction, and the granting of state land to political friends. This cannot continue. I would advise governments to be smart with state land and to develop a sound policy; keep what is necessary for the public good, but alienate the remainder or give it back, so that land can be put to good and fruitful use.

▲ *Paul van der Molen.*

Hexagon Acquires Geospatial Information Visualisation Specialist Luciad

Hexagon has announced the acquisition of Luciad, a Belgium-based software company specialising in the visualisation and analysis of real-time geospatial information. Luciad will be fully consolidated, operating within Hexagon's Geospatial division. Luciad's visualisation technologies support live connections to dynamic sensor feeds in a 3D environment. The result is a 5D digital reality: real-time, rapid fusion of multi-source content and the ability to perform analytics on the fly. These intuitive command and control systems benefit all kinds of applications - from public safety and smart cities to defence and intelligence - enabling users to make critical decisions based on changing information in real time. This acquisition strengthens Hexagon's ability to deliver smart digital realities, enhancing the Smart M.App platform with 3D, 4D (real-time sensor feed integration) and 5D (dynamic analytics) capabilities, said Hexagon President and CEO Ola Rollén. The ability to rapidly integrate sensor data in a visually compelling environment provides the geospatial location intelligence and situational awareness necessary for mission critical operations.

▸ http://bit.ly/2gT1ZFL

Luciad is now part of Hexagon.

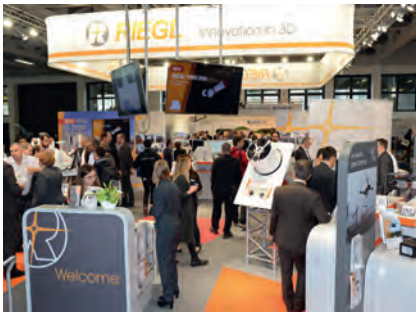
FIG Congress 2018: Istanbul

The New Mosque, Istanbul.

The 26th FIG Congress will be held in Istanbul, Turkey from 6-11 May 2018. This event is the meeting place for the international community of surveying, geodesy, cadastre, topographic mapping, valuation, land and geospatial professionals – from survey companies, professional organisations, academia, geospatial software and services providers, governments, engineering companies and interested parties. The theme of this exciting week-long conference is 'Embracing our smart world where the continents connect: enhancing the geospatial maturity of societies'. Scientists, experts, managers, policymakers and decision-makers, stakeholders and students from all over the world are invited to join the discussions on issues affecting the international surveying, land and spatial community today and in the future. The Turkish Chamber of Survey and Cadastre Engineers (CSCE) will host this main FIG event.

▸ http://bit.ly/2yXcjqE

RIEGL Launches Waveform-Lidar Sensors and Systems



RIEGL at Intergeo 2017.

Austria-based RIEGL once again introduced a new range of Lidar products at this year's Intergeo, varying from laser scanners to various software solutions. At the geospatial industry's leading international trade fair in Berlin, Germany, the company displayed airborne mapping and mobile mapping systems as well as cross-overs with other hardware and software manufacturers. For terrestrial laser scanning, RIEGL introduced the NEW RIEGL VZ-2000i 3D laser scanner. This long-range, very high-speed 3D laser scanner captures up to 1.2 million measurements per second, and covers ranges up to 2,500m with 5mm accuracy and 3mm precision. RIEGL's Waveform-Lidar technology enables high-speed, long-range, high-accuracy measurements even in poor visibility and demanding multi-target situations, and delivers reliable data even in harsh environments.

▸ **http://bit.ly/2yB4rd3**

Phase One and Lufthansa Aerial Services Sign Cooperation Agreement

Phase One and Lufthansa are now partners.

Phase One Industrial and Lufthansa Aerial Services have announced they have signed an agreement to explore collaborative development and deployment of unmanned aerial vehicles (UAVs) for a range of specialised industrial surveying and inspection projects. Under the terms of the agreement, Phase One Industrial and Lufthansa Aerial Services are testing and evaluating scenarios for UAV-based aerial equipment featuring Phase One Industrial aerial cameras. "Phase One Industrial is proud to be working with the Lufthansa Aerial Services team", said Dov Kalinski, general manager, Phase One Industrial. "This team has a distinguished history in understanding the technical needs of customers who require the highest levels of accuracy in aerial imaging", he added. "Recent pilot projects with Phase One Industrial aerial camera equipment have already yielded extraordinary mission results", said Dr Benjamin Löhr, head of Lufthansa Aerial Services. "Together, the companies are now working to evaluate other UAV-based solutions for industrial uses, based on our customers' needs", he continued.

▸ **http://bit.ly/2ipkhBX**

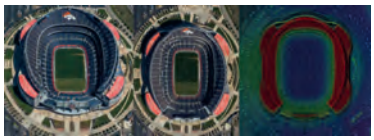
Verity-GeoSLAM Partnership Advances Real-time Construction Quality Management

The partnership between Verity construction verification software from ClearEdge3D and GeoSLAM's 'go-anywhere' 3D mobile mapping technology promises to help architecture, engineering and construction professionals significantly advance their ability to verify as-built field data with design models. The next generation of construction quality assurance/control methodology and technology is integrating simultaneous localisation and mapping (SLAM) with building information modelling (BIM). GeoSLAM and ClearEdge3D have announced an upcoming beta program that allows as-built construction data measured using GeoSLAM's hand-held, light-weight mobile laser scanners to be compared to design/fabrication models using ClearEdge3D's Verity software to quickly and easily identify installation status and out-of-tolerance or inaccurately constructed work.

▸ http://bit.ly/2yBq1hT

GeoSLAM Navisworks (left) and Verity.

Airborne Lidar Production Fully Integrated with Leica HxMap Workflow



Fugro conducted aerial surveys with HxMap.

Leica Geosystems has released the Lidar data processing capability in the Leica RealCity solution package and partnered with international asset integrity and geo-intelligence solutions provider, Fugro, to begin acquiring and processing data on multiple cities and coastal regions across the United States. Using CityMapper, Fugro conducted aerial surveys of some of North America's most densely populated urban centres, in support of their geospatial mapping services. As the world's first hybrid airborne sensor, combining oblique and nadir imaging as well as a Lidar system into one instrument, the CityMapper enables significant time and cost savings by collecting both imagery and Lidar data in a single flight. All collected data can be processed in the one unified workflow solution, Leica HxMap. The results of the airborne surveys were post-processed using the latest version of Leica HxMap, the unified high-performance multi-sensor workflow. Within a single and familiar interface common to the processing of other airborne sensors, all typical data products, from orthophotos and oblique images to point clouds, 3D meshes and models, can be quickly and efficiently produced.

▸ http://bit.ly/2yvjLc4

RIEGL's Line of UAV LiDAR Sensors

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RIEGL miniVUX-1UAV

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- max. operating flight altitude 330 ft AGL
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- accuracy 15 mm, precision 10 mm
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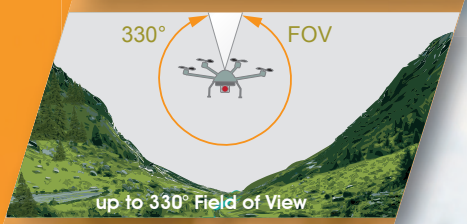
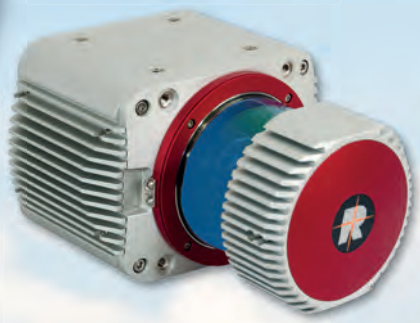
RIEGL VUX-1UAV





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- ***RIEGL* miniVUX-SYS** | miniaturized laser scanning system comprising *RIEGL* miniVUX-1, IMU/GNSS unit and optional camera(s)
- **RiCOPTER** | remotely piloted multi-rotor aircraft equipped with *RIEGL* VUX-SYS
- ***RIEGL* BDF-1** | Bathymetric depth finder for generating profiles of inland waterbodies
- **BathyCopter** | RiCOPTER equipped with *RIEGL* BDF-1

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Two Innovation Awards for LAStools Developer at Intergeo

Rapidlasso received two Innovation Awards.

Rapidlasso, the maker of the popular Lidar processing software LAStools, was awarded top honours at Intergeo in both of the categories the company had been nominated for: most innovative software and most innovative start-up. The third award for most innovative hardware went to Leica Geosystems for the BLK360 terrestrial scanner. The annual Wichman Innovation Awards have been part of Intergeo for six years now. Rapidlasso was first nominated at the inaugural event in 2012 for its open-source Lidar compressor LASzip, which eventually came in as runner-up. After receiving the two awards Dr Martin Isenburg, the founder and CEO of rapidlasso GmbH, was quick to thank the "fun, active, and dedicated user community" of the LAStools software for their incredible support in the online voting. He pointed out that it was its users who make LAStools more than just an efficient software for processing point clouds.

http://bit.ly/2yDGBhw

Trimble Introduces High-performance Tablet for Field Applications

At Intergeo 2017 in Berlin, Trimble introduced the Trimble T10 tablet, a rugged, high-performance data processing platform suitable for a variety of survey and geographic information system (GIS) applications. The Trimble T10 provides the processing power of a laptop computer in tablet form, enhancing efficiencies for geospatial users in the field. The T10 tablet is an ideal platform for large datasets such as point clouds, images, maps and other complex or processor-intensive data. According to Jason Rossback, marketing director for Trimble Geospatial field solutions, the Trimble T10 tablet gives survey and GIS professionals a single-device solution for powerful, efficient data collection and processing in the field. Previously, these professionals may have relied on a laptop computer in addition to a survey controller or data collector. With the T10's robust processing power, users can collect and process their data running a broad range of applications, eliminating the need for a separate laptop computer and speeding the time-to-results by enabling deliverables to be produced while out on the job.

Trimble T10 tablet in the field.

http://bit.ly/2zAqj6R

Earth-i's Satellite Imagery Chosen to Monitor Tree Logging in Canada

Earth-i satellite imagery of Saskatchewan.

Earth-i has been appointed by the Ministry of Environment for the Province of Saskatchewan, Canada, to help monitor the logging of trees across a forested area of some 3500km². The company will be supplying high-resolution images that will enable the Ministry to prevent illegal logging - and ensure sustainability and compliance. Canada is the world's largest exporter of softwood lumber. Its forests account for 9% of the world's forest cover and 40% of the world's sustainable forests. To help protect its commercial forests from over-harvesting, Saskatchewan's Ministry of Environment has been using satellite images for several years. Following a competitive tender that attracted Earth Observation imagery providers from around the world, Earth-i was chosen because its hi-res images will give the Ministry greater clarity of the situation on the ground. Earth-i will use the DMC3 Constellation to provide images of areas of interest over Saskatchewan. The constellation consists of three identical optical satellites in near-polar orbit, offering very high resolution (80cm detail pixels) and 3.2 metre four band multispectral data for any location on Earth.

http://bit.ly/2ir76Re

Bentley Expands BIM Modelling Possibilities for Major Projects

Bentley Systems, a leading global provider of comprehensive software solutions for advancing infrastructure, has announced the availability of the AECOsim Building Designer CONNECT Edition. This is Bentley's new building information modelling (BIM) application designed for building projects of significant size and engineering complexity, and which are typically characterised by the challenges of combining vertical construction and horizontal infrastructure (like roads, railways, utilities, etc.). On such projects, design and project delivery firms often have broad responsibilities for multiple project delivery disciplines and across subcontractors and joint-venture organisations. Users of AECOsim Building Designer V8i have demonstrated its versatility in a wide range of project types. Among Bentley's 2017 Be Inspired Awards nominations, 63 projects credited AECOsim, including 15 of the 51 finalists, in projects as diverse as bridges, airports, Olympic sports facilities, mining, manufacturing, offshore, municipal, power generation, utility transmission and distribution, and water and wastewater treatment facilities. Nominations also cited GenerativeComponents, a feature within AECOsim Building Designer that provides computational design capabilities to explore iterative design ideas and embed design intent with design constraints and relationships to improve design quality and performance. Santanu Das, Bentley Systems' senior vice president, design modelling, said this is an exciting time for Bentley as the company completes the delivery of their CONNECT Edition applications. AECOsim Building Designer CONNECT Edition enables users to improve their productivity and to collaborate across multiple disciplines by sharing content and data in a seamless workflow through a comprehensive modelling environment.

http://bit.ly/2zoIU6c

AECOsim Building Designer CONNECT Edition.

GIM INTERNATIONAL INTERVIEWS FRANK PAULI, CYCLOMEDIA

Pioneers in **Capturing Public Space**

CycloMedia is a renowned mapping company specialised in large-scale and systematic visualisations of environments. Its headquarters are situated in The Netherlands, a country that is an excellent testing ground for continuous innovation in mobile mapping solutions. *GIM International*'s Wim van Wegen took to the highway and headed south to the old town of Zaltbommel and had a talk with Frank Pauli, CEO of the developer of advanced camera and image processing techniques.

You were appointed in 2013 as CEO at CycloMedia. An important part of the company's strategy was/is the focus on the international markets. Where are we today?
It certainly is part of our strategy; we are convinced that our technology is unique. Technology that is being developed in The Netherlands, but meeting needs and supporting use cases that exist in many markets worldwide. However, in growing internationally we are quite selective: our two main priorities now are Germany and the United States. We have established two subsidiaries; one in Berkeley, California, and the other one near Frankfurt, Germany. Our focus is on the city customer, which has also been the basis of our growth in the Netherlands. There are two reasons why cities and local governments are our main customers. The first one is that these customers are using our data intensively, so that is obviously interesting in a commercial way. The other reason is that a city is a relatively limited capture area. We can capture a typical city in a few weeks or a couple of months. In Germany, we have mapped cities such as Frankfurt, Stuttgart, Mannheim, Cologne and Duisburg, to mention but a few. In the US, we did a similar rollout – Washington DC was one of our first clients there. Since then, we have signed contracts with Columbus, Philadelphia, and one of our milestones is New York City. In late 2016, we concluded an agreement with the city of New York, and then we captured the entire city in the first half of this year.

LIDAR MAKES MEASUREMENTS FAR SIMPLER, PARTICULARLY IF YOU HAVE MULTIPLE PIXELS OF THE SAME COLOUR AND STRUCTURE NEXT TO EACH OTHER

What kind of solutions do you offer that they cannot find in their domestic market?
Our core product is our panoramic imagery – what we call the Cyclorama. The main differentiator of our panoramic imagery is our positional accuracy, and this is what distinguishes us from what other vendors have to offer. None of the local vendors offer the same accuracy, and nobody offers it on a scale that we offer. The use cases in these markets are very comparable; when we look at the Netherlands, our primary use case was always tax assessment. In the US, this is similar – tax systems, not so much managed by the city but by the county. In Germany, tax assessment does not exist, but there all the other use cases are similar to the Netherlands, for example, asset management, urban planning, utilities (network planning and asset management) and safety & security. The use cases are very comparable across the markets that we address.

Your company is well-known for its 360° panoramic imagery. What are the latest technological developments when it comes to capturing the images?
We migrated from standard resolution to high resolution, and we started this in 2015 – the 100 megapixel panorama imagery. Second is accuracy, and we are continuing to invest in this accuracy, which we call the CycloPositioner. After the imagery has been captured, we are able to further enhance the accuracy by applying processing technologies and if required by integrating ground control points. A third invention which I think is very important is that we have added Lidar to our collection system. Until two years ago, we were focusing entirely on imagery, but since then we have added Lidar data to this and we are rolling it out now. In the United States next year all our mobile mapping will include Lidar, and also in other countries we are seeing more and more customers who are interested in Lidar.

And when are customers particularly interested in the application of Lidar?
Something that all our customers are interested in is the further enhancement of measurement capability. Accuracy is most important in our imagery and, based on this accuracy, customers use the imagery not only to do analysis and modelling, but also to take measurements. These measurements have always been based on imagery, and when we collect Lidar we create depth panoramas which we put behind the imagery, on the basis of which you get a 3D representation. We have added a 3D cursor which moves with the surface that is

▲ *Frank Pauli.*

in the image. Lidar makes measurements far simpler, particularly if you have multiple pixels of the same colour and structure next to each other. In this case, you need to select the right pixel using the 3D technology that we base on Lidar – that is an immediate integration in our imagery. Furthermore, I would say that application of the Lidar that we collect is comparable to other Lidar point clouds as it is typically used in engineering, simulation and asset management. The fact that we combine the two captures in one production process gives our point cloud two unique elements: the accuracy – not only for the imagery but also for the point clouds – and the combination of the imagery and the point clouds which enables us to do a better job of colouring the point clouds – taking the colours from the imagery and taking them into the point cloud.

A few years ago, CycloMedia upgraded its 3D processing technology based on point cloud and mesh processing methods. Can you tell us something about this?

This continues to be an important area in which we invest. From the technology point of view, we were quite early in developing technology that allowed us to create meshes. While talking about collecting imagery and Lidar we are looking at combining these data sources into 3D. Certainly in The Netherlands we are not only actively engaged in street level imagery but also in aerial imagery. We are looking more and more at how we can integrate street level imagery with aerial and, in particular, oblique imagery. Another area in which we are investing in 3D is on the business side of things. 3D is one of those areas where many companies are investing in moving the technology forward, which is great. However, you also need to have a clear idea about where you want to sell this kind of content. We invest quite a bit in educating the market, in working with partners and customers. It's about how we see the future of 3D becoming a reality. Technically, a lot is already possible, but in terms of platforms, use cases and users, there is still quite a bit to be done. In this context, we are involved in an initiative in The Netherlands with Kadaster, Esri, and the Delft University of Technology to work on possible national coverage on 3D. Obviously, we are employing our products and technology for this purpose, but we also find it important to invest in understanding the market and in building solutions that the market needs.

Your Lidar point cloud data can be imported into software from various companies, such as Autodesk, Bentley and Esri. How do you team up with these software suppliers to offer a joint workflow solution?

We see ourselves as a data provider, not as a software company. We have some software solutions ourselves, but that's not our core focus. Our core focus is to collect data and create content, so we are interested in teaming up with all sorts of software companies that are relevant. The relevance is largely determined by our customers. For Lidar it's a bit simpler, because Lidar has standard formats, so when you produce your Lidar in LAS or LAZ files, all the major engineering software companies support that format, so there is not that much to interact. For panoramic imagery, this is a bit different, since there is no worldwide format. Apart from our own software viewer solution we create our own API, which is available to every software company wanting to interact with us. We try to team up more closely with some software companies than with others. A good example of this is our US rollout, where we strongly cooperate with Esri. We focus on local and regional governments there and Esri is clearly the market leader, so it is also in our

▲ *CycloMedia's car-mounted street-level mapping system.*

interest to make sure the interaction with Esri works. Apart from making our API available there, we also developed some add-ins to enhance the integration of our content with Esri, and we do co-marketing programs together with them as well.

Aerial imagery is also one of the pillars of your solutions. Are there any significant technical developments in the acquisition of this data?
It's part of our solutions, but only in The Netherlands I would say. In The Netherlands we currently have a strong market position where we support many customers, and for these customers we create added value by providing both street level imagery and aerial imagery on an integrated basis. We host the data together, we have cross-referenced the data, and we have created a software solution which allows our customers to view a location in the public space both from a street level perspective as well as from an aerial perspective. So, I would say we are more of an integrator and it is actually more of a business proposition than a technical proposition. We have not created the aerial products we sell in The Netherlands ourselves. We partner with other companies and based on this we make the images available. There have not been that many technical developments in aerial imagery in the Dutch market in recent years.

Oblique airborne photogrammetry has evolved from a 'nice to have' towards an increasingly important element for the workflow of service providers. How is CycloMedia dealing with this trend?
In oblique imagery there is a lot of innovation going on. In The Netherlands, we do offer oblique imagery as part of our range. 2017 has been the third year in a row that we offer the whole country in oblique. We are seeing more and more customers using oblique imagery, so it is integrated in our viewer. In the United States, we don't offer oblique imagery ourselves, but we partner with the leading oblique providers – companies such as Pictometry and Sanborn. We are seeing many technological advancements in oblique photogrammetry. Clearly, the resolution is continuing to grow there and we are seeing a number of initiatives where camera manufacturers are integrating Lidar in oblique. The ultimate vision that we have is combining high-resolution, high-accuracy street level capturing and high-resolution, high-accuracy oblique capture which gives you a total view of everything in the public space. This is the ideal basis for the further development of 3D.

You are also involved in 3D city modelling, which plays an important role in the concept of Smart Cities. What is your view on the future of Smart Cities?
The fact that cities are getting larger is a given if you just look at the urbanization data. If governments want to continue to manage these cities, they need to embrace the smart city concept, to which we contribute in multiple ways. Before we talk about 3D, our existing imagery also plays an important role in managing smart cities. I mentioned New York, which is probably the most challenging city in the United States. The fact that the City of New York selected us to collect the imagery for the upcoming years is a great example. New York has a number of use cases, such as tax assessment, asset management, urban planning, and safety & security. To me, that is very much a smart city at work. There is a lot of talk in the industry about smart cities – people are trying to get their heads around what they really are. I would say that when we provide our data to larger cities and when I see how often those cities are using our data, this is certainly an element of the smart city. I was recently with one of our German customers, looking at their usage of data last year, and we discovered that about 4,000 people working for the city had clicked on the data more than a million times. That means heavy usage and that the larger cities in the world where we are active are using our data to manage their city in a smarter way in our standard product. That standard product is then integrated in the software solutions we spoke about before.

In moving forward, we see three directions where our content can play a role in making cities smarter. The first one is 3D and we are actively engaged in converting our panoramic imagery into 3D, which will help to manage cities better. From our perspective, the difference between imagery and 3D is not that large, but it is a good next step. A second direction involves what we call information products. These are products where we create asset databases from imagery. These can be simple assets like traffic lights, traffic signs and pedestrian ramps. These are important to the management of cities and most cities we know don't have an accurate and up-to-date database of these assets. We have developed a number of automated algorithms based on which we can create these databases. The cities either do the work themselves or we offer to do it. And as we capture our imagery on a high update frequency, typically every 12 months, we can also update these databases. The notion of what we call information products is a second element involving the development of our imagery to help cities be managed in a smarter way. The third area is what we call content collaboration, which is all about capturing data with more sensors. It is great that we can drive around the city once a year and publish new and accurate imagery, but there are more and more sensors with which you can capture imagery during the year. This can be done with different

cameras but also with other sensors like the ones in connected passenger cars and those used to measure temperature, air quality etc. Content collaboration is all about enabling our customers to integrate their own data with our data. Our data has the advantage that it is correctly positioned, so when a city also sends its people out into the streets with mobile phones to take pictures, our newly developed technology – which we call the geometric framework – can be put to use. Pictures taken with your smartphone will not be so accurately positioned, but we match them against our imagery, allowing customers to get even that kind of data correctly positioned. In short, we believe our street level imagery is an important canvas to manage the city, and on top of that canvas we are developing three sets of technology to make it even more relevant: 3D, information products based on object detection and change detection and thirdly, content collaboration.

Technological developments such as Artificial Intelligence and Machine Learning are advancing rapidly. How do you incorporate these game-changing technologies in your solutions?

R&D was and is an important ingredient for the company. We started as a spin-off from the Delft University of Technology in 1980. CycloMedia has a team of 35 R&D people in house, and the type of technologies that you mention are the basis of the products we spoke about in the previous answers. When we talk about object detection and change detection, the latest technologies in terms of machine learning and deep learning are integrated in this. Also for some of our basic products. We need to blur our images because imagery resolution is getting higher and privacy regulations are becoming stricter. We do this with deep learning in order to do it in an automated way. We make many millions of pictures per year, so it is obviously not an option to do this by hand. In The Netherlands, we have built a database in which all approximately 3 million traffic signs have been captured by using object detection technologies.

You are based in The Netherlands. What are the main advantages of this?

Expectations, norms and standards for geospatial information in The Netherlands are very high. The Kadaster (The Netherlands' Cadastre, Land Registry and Mapping Agency, editor) is considered to be one of the world's leading national mapping agencies. The Netherlands has played a significant role in the development of companies like TomTom, Tele Atlas and Navteq, and it is all based on the fact that geospatial data is considered to be important in this country. Probably the fact that 40% of the country is situated below sea level helps there, and the fact that the country is densely populated. The Netherlands is an ideal base for a company that wants to be forward-looking and technology-driven in geospatial information. On top of that, there are many well-educated, talented people here, which helps us to get the right people for our R&D department. After having developed and tested our products in our home country, it is relatively simple to bring them to other markets.

Self-driving vehicles are becoming a reality. When do you think we will be seeing self-driving CycloMedia vehicles capturing imagery all over The Netherlands and other countries?

That's a good question! We talk about it a lot, but we have no concrete plans in terms of when that will be. Other than using the technology ourselves, given the fact that our imagery is so accurate it could be one of the ingredients in self-driving vehicles. Although it's not our core business, we are already doing some work on this. I personally believe that it will still take quite some time before one of our vehicles can drive really autonomously in the city centres. Doing that on the highway is not far away. In The Netherlands we capture 160,000km, only 9,000 of which is on the highway. I think here it will still take some time before we can capture the entire road network with self-driving cars. ◂

IN THE NETHERLANDS, WE HAVE BUILT A DATABASE IN WHICH ALL 3 MILLION TRAFFIC SIGNS HAVE BEEN CAPTURED BY USING OBJECT DETECTION TECHNOLOGIES

▲ *CycloMedia captures its imagery with a high definition vehicle-mounted camera system.*

FRANK PAULI

Frank Pauli has been the CEO of CycloMedia since 2013. Prior to that he was with Navteq/HERE Maps for over five years where he headed the mapping and content business in the EMEA region. Before that he worked many years for Philips Electronics in various roles in business management and innovation, which included general manager of the DVD business unit and managing various innovation projects, including Connected TV and Blu-Ray. Pauli has an MBA from Delft University of Technology and lives in The Netherlands.

OBIA and Point Clouds

Object-based Image Analysis (OBIA) has been developed to improve the accuracy of conventional, pixel-based classification of multispectral images. Introduced around the year 2000 and implemented in various software packages such as eCognition, OBIA has been successfully applied for mapping land cover, forest and agricultural areas. Today, not only high-resolution multispectral images are available but increasingly also high-density 3D point clouds captured by airborne Lidar. Is OBIA also suited for the semi-automatic classification of Lidar point clouds? The author highlights promising prospects.

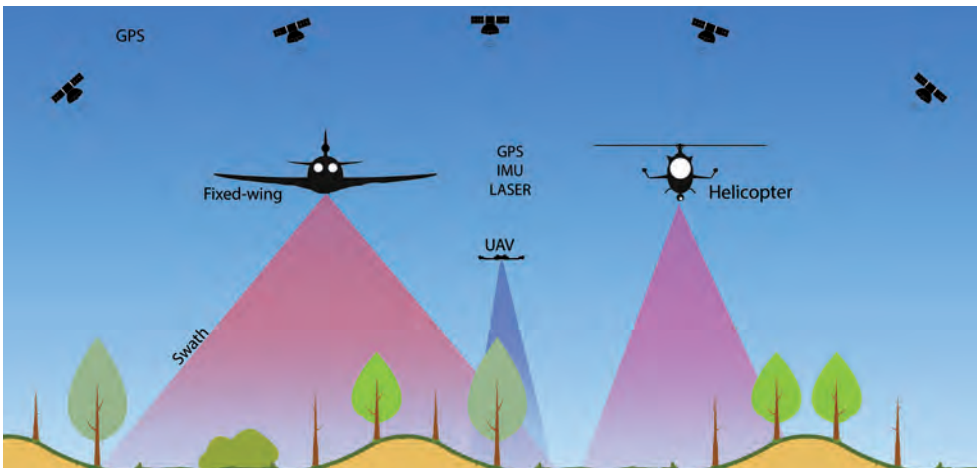
An Airborne Laser Scanner consists of various sensors. The laser ranger emits pulses to measure the distance from the sensor to where the pulse hits the surface of the Earth. To transfer the distances to X,Y,Z coordinates the pose of the sensor and its position have to be accurately measured using an inertial measurement unit (IMU) and a GNSS receiver onboard of the aircraft. Often also imaging sensors such RGB, hyperspectral, thermal or multispectral cameras are onboard. Helicopters are used as carrier for narrow swath measurements at low altitudes. They can hover thus providing point cloud densities up to 200 points/m^2 with high accuracy (Figure 1). Fixed-wing systems are suited for high altitudes, covering large areas and capturing point clouds with lower densities. Satellite-based systems are a special category and relatively rare.

BENEFITS

Wide area systems provide accurate DEMs for orthorectification and contour generation suited for crop hazard analysis, hydrologic modelling and flood plain mapping. These systems also provide information on the heights of tree stands, biomass, excavation volumes, and support other natural resources management tasks. Furthermore, they enable mapping of transportation and utility corridors and in urban areas the 3D models derived from the point clouds enable line-of-sight studies, viewshed analysis, and many more. Helicopters and UAVs are well suited for capturing transmission lines for determining thermal rating and height of canopy. Furthermore, the point clouds acquired from these platforms are beneficial for monitoring railways, highways, levees and pipelines. In addition to capturing linear objects, these platforms are suited for collecting points of areas with a limited extent. The main benefits making ALS point clouds a very interesting source of spatial data are (Vosselman & Maas, 2010):

- Very high speed of data collection for large areas with each data point having information on 3D (X,Y,Z) position, intensity of the return and echo width in case of full-waveform digitisation
- High coverage allowing – at a later stage – to identify features which may have initially been missed in the field while accurate spatial data can be easily collected
- The elevation is measured directly by the sensor and not from image matching applied to the reflectance values of images which are highly sensitive to the types of object, humidity and other atmospheric conditions
- Multiple returns per pulse are used as an invaluable source of information in vegetated areas and thus in many forestry applications. Multiple returns can also provide insight into the vertical structure and complexity of forests.

Added to this, compared to images, ALS systems can see through canopy as the pulses can penetrate small gaps in vegetation and other semi-transparent objects and thus can provide additional information on physical properties of the object.



▲ *Figure 1, Platforms and related coverage of Airborne Laser Systems.*

OBIA

ALS collects a raw point cloud consisting of irregularly distributed 3D points. These points are geometric features but do not have a meaning per se since a point cloud does not represent structures of separable and clearly delineated objects—it is a group of points fixed in an internal or real-world coordinate system. The human eye can see patterns in such representations (Figure 2) but computers need processing to assign classes and provide meaning to groups of

adjacent points. The classification of images involves assigning thematic classes to pixels. All pixels are of same size and same shape, and neighbouring pixels don't know whether they belong to the same object. Object-based image analysis (OBIA) segments an image by grouping pixels based on similarities in spectral or other properties. The basic assumption is that a segment forms an object or a part of an object. However, 'over-segmentation' is sometimes required to classify complex objects such as a rooftop consisting of plain chimneys and dormers.

▲ *Figure 2, ALS point cloud of the historical centre of Biberach and der Riß, Germany.*

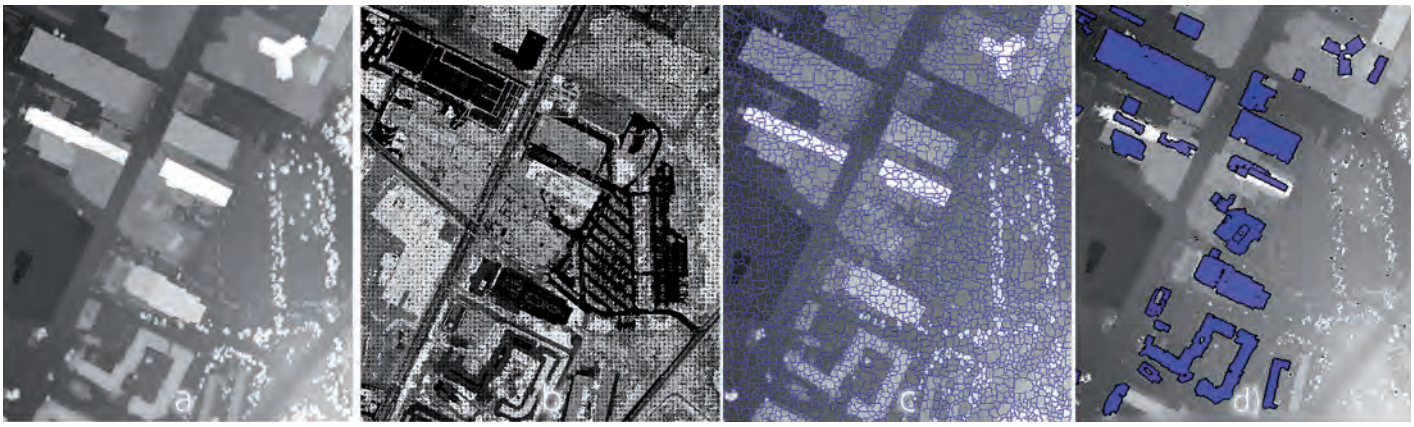
CONTEXT IS KEY

When looking at Figure 2 one may recognise buildings. In his 1982 pioneering book *Vision A computational approach*, David Marr challenged scientists: "What does it mean to see? The plain man's answer (and Aristotle's, too) would be, to know what is where by looking. In other words, vision is the process of discovering from images what is present in the world, and where it is." Similarly, OBIA aims to let computers 'see' beyond the plain pixels – what does this data represent within the real world? Context is the key. Advances in remote sensing technology in combination with higher spatial resolutions allow for more 'intelligent' image analysis including OBIA. According to Lang (2008, p.6) 'intelligence' includes in this context: (1) an advanced way of supervised delineation and categorisation of spatial units, (2) the way in which implicit knowledge or experience is integrated, and (3) the degree, in which the results contribute to an increase of knowledge and better understanding of complex scenes. So far, OBIA within geosciences has been used to partition satellite images into meaningful image-objects, and assessing their characteristics through spatial, spectral and temporal scale. Compared to pixels which have no direct counterpart in the real world these image-objects are more closely related to real-world objects. What we hopefully achieve are semantically interpretable segments. Such segmented imagery can be further processed by adding values to these objects or object candidates.

OBIA ON POINT CLOUDS

Recently, researchers started to apply OBIA to point clouds. To be suited for OBIA, point clouds usually have to be converted from a 3D representation to a 2D representation in the form of a raster, or 2.5D, that is a raster with one height value added to each grid cell. Such representations are suitable for further analysis (Figure 3). The segments which are homogeneous in height and or intensity of the return are used as input for grouping and classification. ALS point clouds do not contain RGB values. The raw data consisting of height, number of single beam reflections and intensity of the return can be enriched with information stemming from other sources. OBIA exploits size, shape, position and relationships to other segments which improves the classification results. For example, segments with straight outlines indicate buildings or streets, while fuzzy and irregular outlines may indicate vegetation. Therefore, OBIA enables an

OBIA IS SUITED FOR AUTOMATED BUILDING EXTRACTION FROM ALS POINT CLOUDS IN THE FORM OF ROOF OUTLINES



▲ *Figure 3, Rasterised representations of ALS data, from left to right: raster cells containing heights; raster cells containing intensity values; initial objects after segmentation; modified and classified objects representing buildings.*

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Phase One Industrial 190 MP Aerial Survey System

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- iX Capture - an aerial capture, control and image processing software
- Gyro Stabilized Mount - SOMAG DSM400 - was specifically designed for the Phase One 190 MP Aerial System
- GNSS/IMU system - Applanix' POS AV system that enables direct georeferencing of aerial images
- Flight Management System powered by TopoFlight - enables the planning and navigation of the aerial survey mission
- 4-Band Configuration - additional configuration for simultaneous capturing RGB and NIR images, comprises dual 90 mm lenses for capturing RGB information, and a 50 mm lens for capturing NIR information and thus providing 4-Band (R,G,B,NIR) or CIR imagery.

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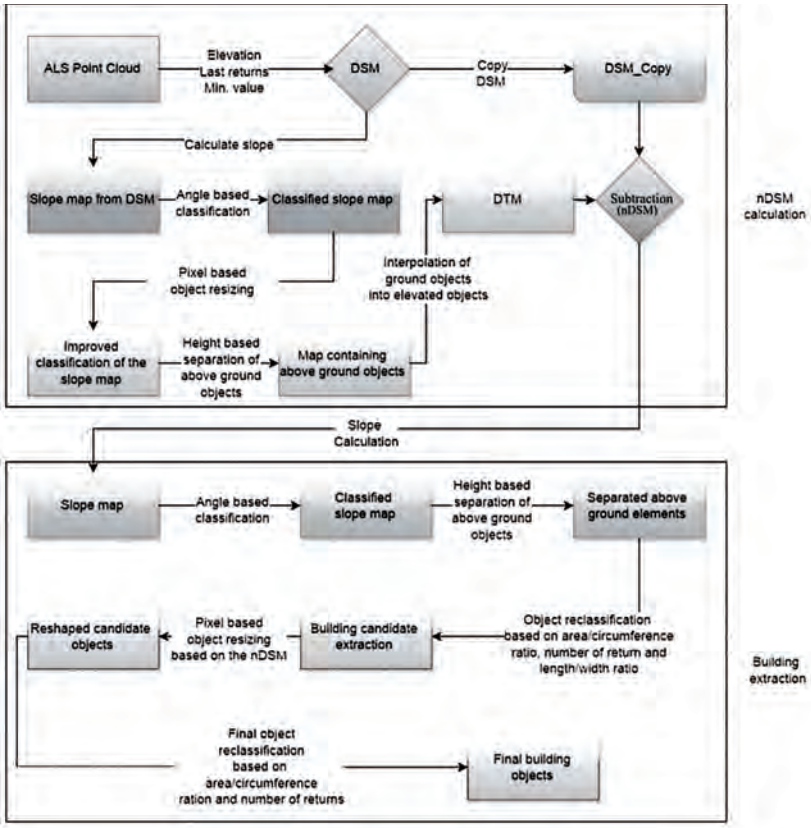
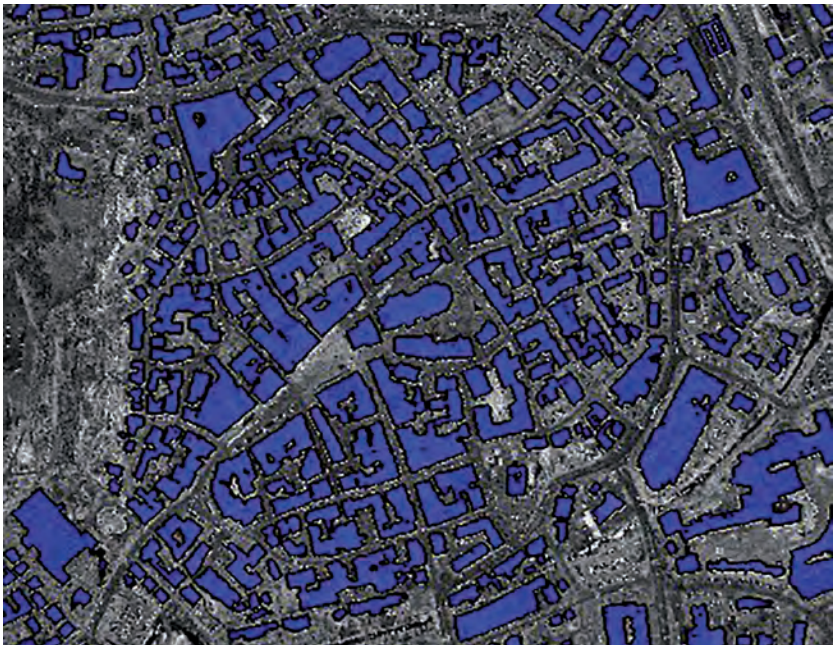


▲ *Figure 4, Flowchart of the developed approach.*

hierarchical multiple spatial scale approach, allowing to use characteristic nested scales of features for man-made or natural objects.

EXAMPLE

We developed an OBIA approach for automatically detecting and outlining buildings using the Cognition Network Language (CNL), a modular programming language within eCognition. The approach, of which an overall flow diagram is shown in Figure 4, was tested on an ALS point cloud partly covering the historical city centre of Biberach and der Riß, Germany, provided by Trimble and collected on March 2012 using a Trimble Harrier 68i system. The point cloud covers an area of 2.5km^2, consists of multiple returns with intensity values and has an average point density of 4.8 point/m^2. The old town is characterised by older, tightly compacted houses, some with sharing walls. The accurate result of the OBIA building extraction approach is shown in Figure 5.



▲ *Figure 5, Detected buildings (blue) superimposed on the ALS intensity image.*

CONCLUDING REMARKS

OBIA does not only provide good results for classifying images but is also highly suited for automated building extraction from ALS point clouds in the form of 2D polygons representing roof outlines. ◀

FURTHER READING

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BIOGRAPHY OF THE AUTHORS

Thomas Blaschke is a Professor at the Department of Geoinformatics – Z_GIS, University of Salzburg, Austria, and directs the Doctoral College GIScience. His research interests include methodological issues of the integration of GIS and remote sensing. He is author, co-author or editor of 360 scientific publications including 17 books and received several academic awards, including the Christian Doppler Prize.

Ivan Tomljenovic´ gained a PhD from the University of Salzburg, Austria on applying OBIA to ALS data. Presently he is with the Faculty of Transport and Traffic Sciences, University of Zagreb, Croatia. His reserach interests focus on Lidar point cloud processing and object-based analysis of remotely sensed data.

EXPLORING CONSUMER-GRADE COPTERS FOR QUARRY MAPPING

Low-cost UAS Photogrammetry in Ukraine

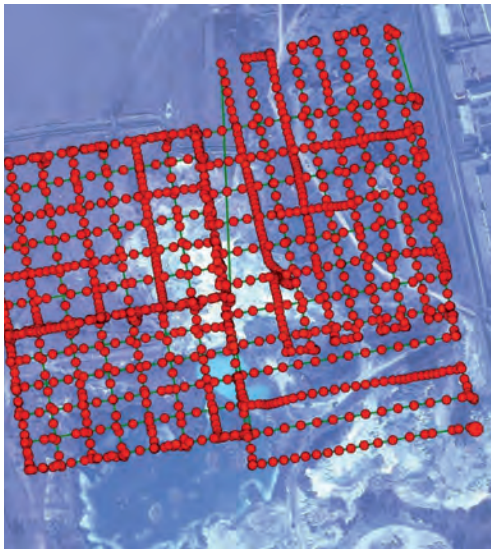
The budgets for open-pit mine surveying in Ukraine are tight and professional ground surveys are quite expensive. Unmanned aerial survey (UAS) photogrammetry has proven to be a good alternative for capturing open-pit mines, but that too is expensive when done professionally. This article investigates whether low-cost UAS photogrammetry, using consumer-grade copters, is sufficiently accurate for 2D and 3D mapping of quarries.

The Rafalivka basalt quarry, located in the Rivne region of Ukraine, produces just over a quarter of a million tonnes of crushed stone and gravel each year. The quarry covers over 70 hectares, of which 36 hectares are actively exploited today, and its depth reaches 50 metres. Surveying from the ground is not only cumbersome and tedious because of the large extent of the area, but also because many parts of the quarry are inaccessible. For example, accurate calculation of the extracted gravel volumes requires coordinates of sufficient points on steep slopes and ledges (Figure 1). Furthermore, since ongoing earthworks often destroy ground control points (GCPs) and targets, monthly checks and repairs of the geodetic reference system are required. Besides that, there are of course safety considerations; ledges are unstable, and the heavy machines make a lot of noise as they continuously move around, posing an accident risk.

LOW-COST COPTER

Capturing the area from the air helps to resolve these problems if proper hardware and software is available. UAS photogrammetry has been applied all over the world for capturing open-pit mines. The quality and usefulness of the geodata obtained are affected by weather conditions, magnetism and other natural forces. While professional solutions are robust against the impact of extreme temperatures, gusts of wind and other environmental conditions, they are also pricey. This raises the question of whether consumer-grade copters equipped with cameras are able to deliver geodata products of sufficient quality. To answer this question, the authors carried out a case study using the low-cost DJI Phantom 3 Pro quadcopter, which can be purchased for around USD1,000 and is equipped with a 12MP camera with fixed focus. The latter is advantageous because it contributes to the stability of the interior orientation parameters of the camera. The copter can stay in the air for half an hour on one battery charge, which allows the coverage of a relatively large area in one flight. Using Pix4D or DroneDeploy software, a flight plan can be preprogrammed

▲ *Figure 1, Many parts of quarries are often difficult to access for land surveyors.*



▲ *Figure 2, Flight paths of the UAS survey.*

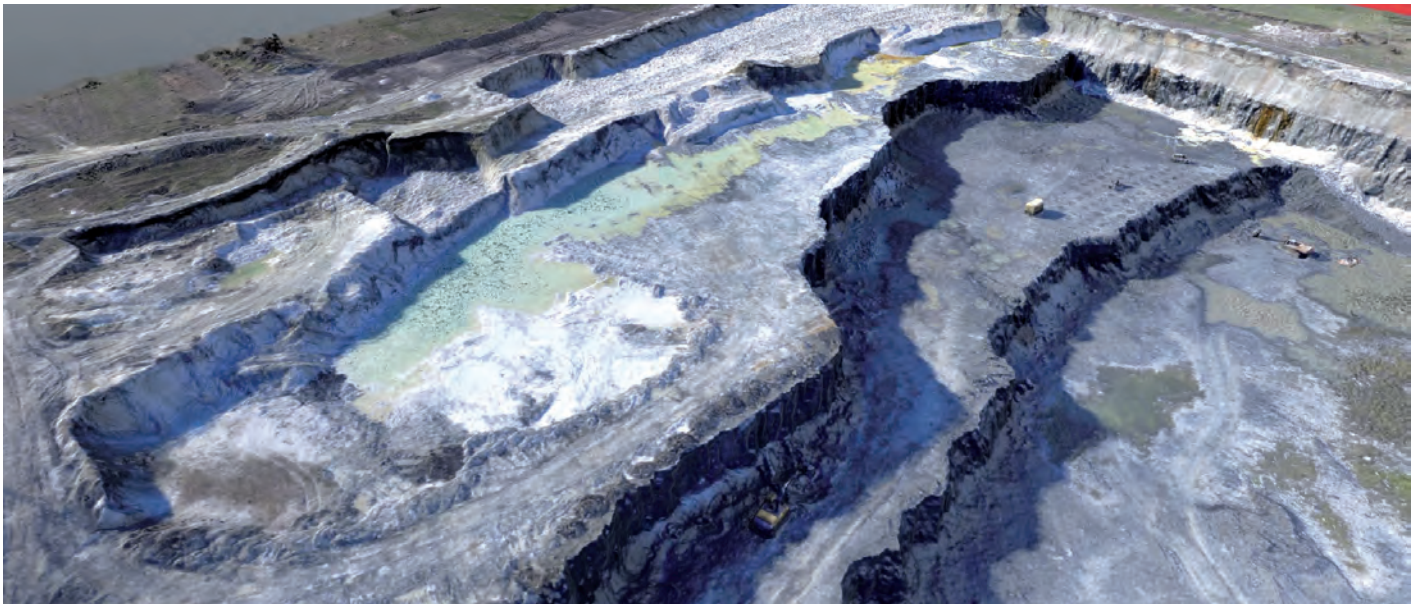


Figure 3, Part of a mesh model.

which allows images to be captured in automatic mode and eases the planning of the photogrammetric survey.

SURVEY

The authors planned to cover the area with two flights of 30 minutes each at a flying height of 120m to obtain a ground sampling distance (GSD) of 5cm and 80% along- and across-track overlap. However, at the time the survey was conducted, the temperature had dropped to below 15C° which was too cold for the battery to provide sufficient power. That problem could be solved by warming the batteries in advance, but then a second problem arose: a strong wind which blew over the quarry with a speed of over 10m/s. Once the UAS had reached the planned flying height of 120m it was caught by the wind. To avoid the UAS deviating too much from the preprogrammed path, the flying height was lowered to 60m where the wind was less strong. However, as wind affects power consumption, this halved the flight time from 30 to 15 minutes, thus increasing the number of flights necessary to cover the area from two to six. Nevertheless, it was possible to complete the survey within one workday (eight hours) with only two batteries. By the end of that day the copter had flown over 12km and covered 36ha, capturing 1,324 images with 90% overlap and a GSD of 3cm (Figure 2). Since GCPs were necessary to georeference the images and derived products in the local coordinate system used, 11 GCPs were placed at the edges of the quarry and their coordinates measured with a total station. Seven temporary GCPs were measured in the centre of the quarry aimed at computing accuracy statistics, also with a total station.

DATA PROCESSING

Photogrammetric data processing includes calculation of the focal length, principal point and other camera parameters, triangulation and georeferencing, and image matching for the creation of a DSM point cloud from which a digital elevation model (DEM) can be derived by removing non-ground points such as vegetation, buildings, vehicles and quarry machinery. Other derived products include orthomosaics, contour maps and volumes. If more than three GCPs with reliable coordinates are available, the camera parameters for each exposure can be adjusted reliably; in this project, this was done by using all 18 GCPs. This study showed that the camera parameters remained stable over time. The main problem concerned the many images. According to software specifications, high-quality calculation requires around 128GB of RAM. The processing was done on two computers: (1) a desktop with Core i7 processor, 64GB of RAM and a GTX980Ti graphic card (USD2,000); and (2) a laptop with Core i7 Mobile processor, 8GB of RAM and a GTX 960M graphic card (USD800). Processing took seven hours on the desktop computer and 26 hours on the laptop. The 64GB of RAM of the desktop computer enabled exploitation of full-resolution images, whereas the laptop could only process the images at half-resolution. The lower resolution did not significantly affect the positional accuracy; the difference was less than 3cm. The main difference was in the level of detail.

LOW-COST UAS PHOTOGRAMMETRY PRODUCES RESULTS WHICH ARE SIGNIFICANTLY BETTER THAN THE STANDARDS PRESCRIBE

The point cloud with 232 million points was used to derive other geodata products including a 3D mesh model (Figure 3), orthomosaic, contour lines (Figure 4), volume and 3D map of the quarry.

ACCURACY

A comparison of the coordinates of the seven GCPs used as checkpoints and the corresponding points in the DEM shows a planar error of 5cm and a height error of 10cm. The 3D root mean square error (RMSE) appears to be approximately 7cm. According to national standards, topographic maps of quarries are at a scale of 1:500, 1:1,000 or 1:2,000, depending on the size of the quarry. The associated accuracies are 15cm, 30cm and 60cm, respectively. Hence,

the accuracy obtained in this study is well within the standards. Comparing volumes measured periodically allows computation of the amount of rock extracted per period and this is the main indicator of productivity and profitability. The high accuracy of the DEM allows accurate volume determination of specified parts (Figure 5). Taking into the account the accuracy of the DEM, the root mean square error (RMSE) can be computed (Table 1).

Volume	RMSE	Deviation
7,264.45 m^3	±35.84 m^3	0.49%
5,661.45 m^3	±29.78 m^3	0.53%

Table 1, Computed volumes of two parts of the quarry and accuracy assessment.

The national standards of Ukraine permit deviations of 15% for volumes up to 20,000m^3 to 4% for volumes of 500,000m3 and larger. Ground surveys carried out by highly experienced surveyors usually result in deviations of 10% to 2%, respectively. This is due to the complexity of the shapes of the quarry surfaces. This case study shows that the approach is able to limit the deviations to around 0.5% for volumes less than 20,000m^3. Thus, the results demonstrate that low-cost UAS photogrammetry produces results which are significantly better than the standards prescribe, and for larger volumes this relative error will be even smaller.

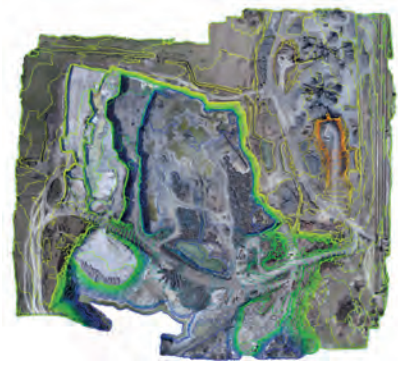


Figure 4, Contour lines superimposed on the orthomosaic for better interpretability.

EFFICIENCY

This survey covered the entire quarry, but such a complete survey is actually needed only once in three to five years. Digging is usually performed in just a small part of the quarry and that is the only part which has to be captured regularly, e.g. once a month. This significantly reduces flying time and the number of images needed to cover the area under exploitation, meaning that the on-site survey takes a maximum of one day and the data processing takes only two to three days. Hence, one survey team can capture three to four quarries in the space of one month. The accuracy can be further increased and the survey time reduced by placing permanent GCPs in the parts of the quarry which are exploited.

IF AN OPEN-PIT MINE IS LARGER THAN 50HA, THE SHEER AMOUNT OF IMAGES BECOMES HARD TO PROCESS

CONCLUDING REMARKS

This approach is efficient for periodical surveying of small and medium-sized quarries. If an open-pit mine is larger than 50ha, a low-cost UAS survey takes too long plus the sheer amount of images becomes hard to process. Therefore, other methods are preferred for larger areas.

ABOUT THE AUTHORS

Denys Gorkovchuk is specialised in terrestrial laser scanning and photogrammetry. He is technical director of the company SPM3D and lectures at Kyiv National University of Construction and Architecture.
denys.gorkovchuk@spm3d.com

Julia Gorkovchuk is vice dean of the Geoinformation Systems and Land Management Department at Kyiv National University of Construction and Architecture, and managing director of the company SPM3D.
julia.kravchenko@spm3d.com

Bohdan Hutnyk graduated from Kyiv National University of Construction and Architecture. He is a land surveyor and UAS operator.
bohdangutnyk@gmail.com

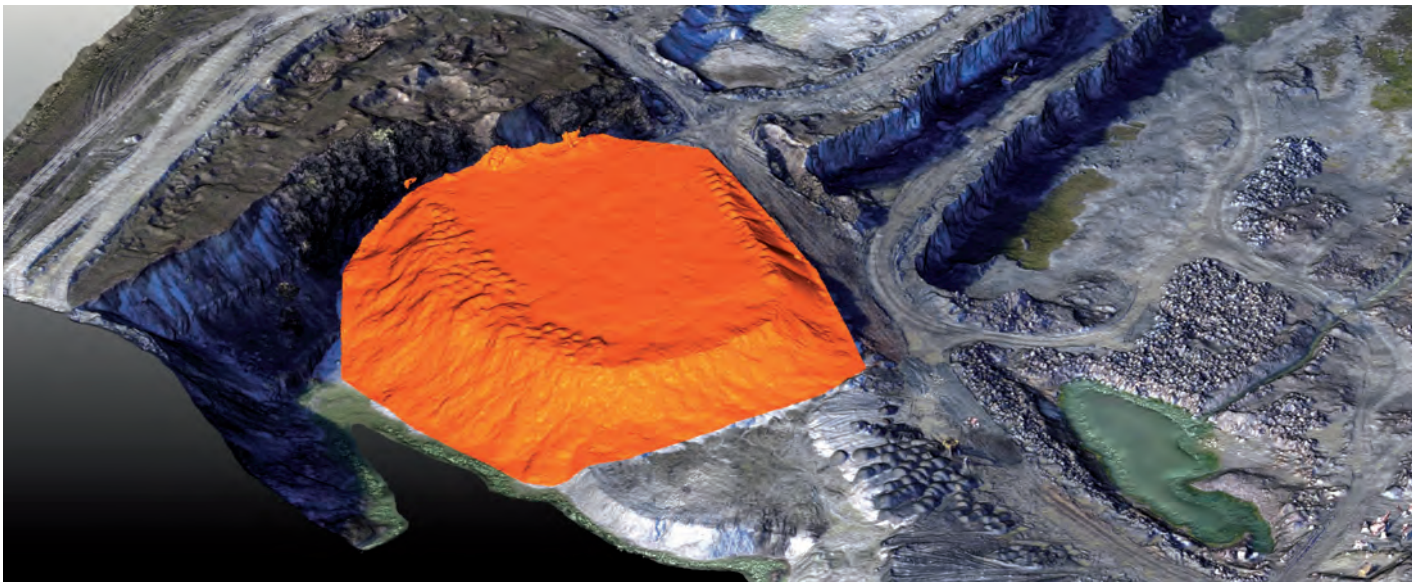


Figure 5, Volume calculation of part of a quarry.

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SERVER SOLUTIONS HOLD THE KEY

Effective Use of Geo Big Data and IoT

The heart of any geospatial analysis system, regardless of its location or configuration, is increasingly becoming the server. All face a similar challenge, whether the system is in the 'cloud', a secure data centre or on a single machine running in an office. This challenge is primarily the ability to deal with the ever increasing quantities and variety of data the world now produces at an unprecedented rate. For mission critical systems, purposely designed software is required, tested in the most demanding environments. Try it cheaper and you waste money.

Both commercial and government organisations recognise the enormous fiscal, operational and social benefits of utilising their geospatial data for analysis. However, because the volume, variety and velocity of the data is continually expanding, it generates increasing problems for those tasked with the storage, analysis and serving of the information within an organisation. In addition, companies are experiencing challenges related to the many new sensor platforms that are emerging, many of which did not exist a few years ago and which must be incorporated into future GIS applications.

RETENTION OF THE ORIGINAL FORMAT ENSURES BOTH HIGH SPEED AND ACCURACY OF PROCESSING

'MAPS GONE DIGITAL' MINDSET DISABLES

It is therefore vital that when an organisation is considering a new system, it has the ability to deal with the ever rising amount and sorts of data, whether this data is coming from georeferenced social media posts, high-resolution satellite imagery or smart energy metres. Legacy technology based on the 'maps gone digital' mindset is unable to provide the visual quality, speed and accuracy necessary to run on platforms as diverse as Windows, Linux, Amazon AWS, a Docker Container or even be deployable from a USB stick if needed.

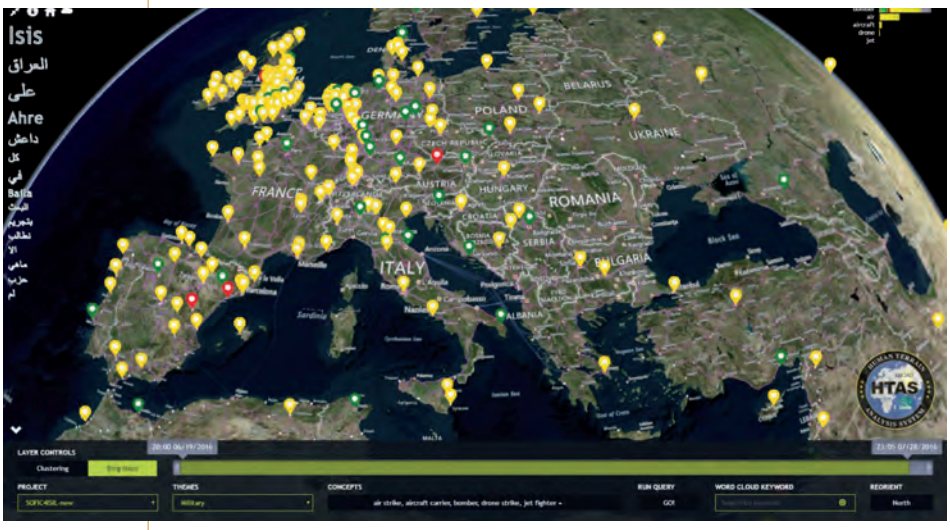
Organisations today need the industry standard system foundations for truly interactive solutions capable of analysing and visualising video, photographic, unstructured text and many forms of legacy data real-time and in a secure environment.

Equally, systems should ideally be based on proven technology, and be extensively tested within the demanding mission critical defence and aerospace sectors - the most extreme and demanding of all software operational environments. In essence, to deliver performance and accuracy without compromise for the analysis of geospatial Big Data and the location information that flows from the Internet of Things, purposely designed software is required.

For those who only have experience of legacy systems, a single unified and secure future proof server solution for data publication workflow and geospatial data management is most in demand. This is because these kinds of systems enable users to manage their data intelligently, store and process a multitude of data formats and feed data into numerous applications with varying levels of security.

A view of Los Angeles, with thematically styled buildings, using data published in LuciadFusion.

One partner of Luciad is Sc2 Corp. Conversations on social media reveal valuable information for decision-makers. Leaders have a new tool to capture and analyse posts and tweets -and keep what they find private. Sc2 Corp created the Human Terrain Analysis System. It is an application to analyse social media communication that uses Luciad technology to map where conversations occur and plot when they happened. The system also analyses what people are saying. All of this takes place in an appliance purchased by the user, not in the cloud. To monitor social media, Sc2 Corp needed to be able to analyse data in 40 languages and examine linguistics of the posts and tweets. They also wanted to be able to map and plot the times of conversations and partnered with IBM and Luciad to design the system. Users can choose to see mapped data two or three dimensionally. A concert promoter for example, can see where people are talking about particular musicians. Or retailers can gauge customer interest in particular products in their neighbourhood, etc. The application can analyse the same amount of data in half a day that it would take 20 people to analyse in a full day, and is therefore becoming popular among governments, insurance companies, investment agencies and marketing groups.



▲ *Analysing social media by keyword (what) to map where and when the communication happened.*

Features including powerful automatic cataloging as well as quick and easy data publishing are also in demand. This allows users to design, portray, process and set up advanced 3D maps in a few simple clicks.

These are requirements and demands that we have seen at Luciad over the past few years, both through our work with some of the most demanding Big Data users such as NATO and EUROCONTROL and through our work with commercial organisations such as Oracle and Engie Ineo. So, what does a geospatial server solution capable of dealing with these challenges and satisfying these demands actually require?

SPATIAL SERVER SOLUTIONS REQUIREMENTS

First, they should be able to connect directly to a multitude of geographic data formats such as IBM DB2, OGC GeoPackage, Oracle Spatial, SAP HANA and Microsoft SQL Server. This is an essential part of ensuring that they can cope with the explosion of formats that the rise of Big Data has prompted. It is also essential that these server systems move away from the Extract – Transform - Load paradigm and avoid converting the data into a fixed high cost proprietary format before analysis. This retention of the original format is recognised as the only method that ensures both high speed and accuracy of processing when dealing with the growing, dynamic datasets that now are the norm.

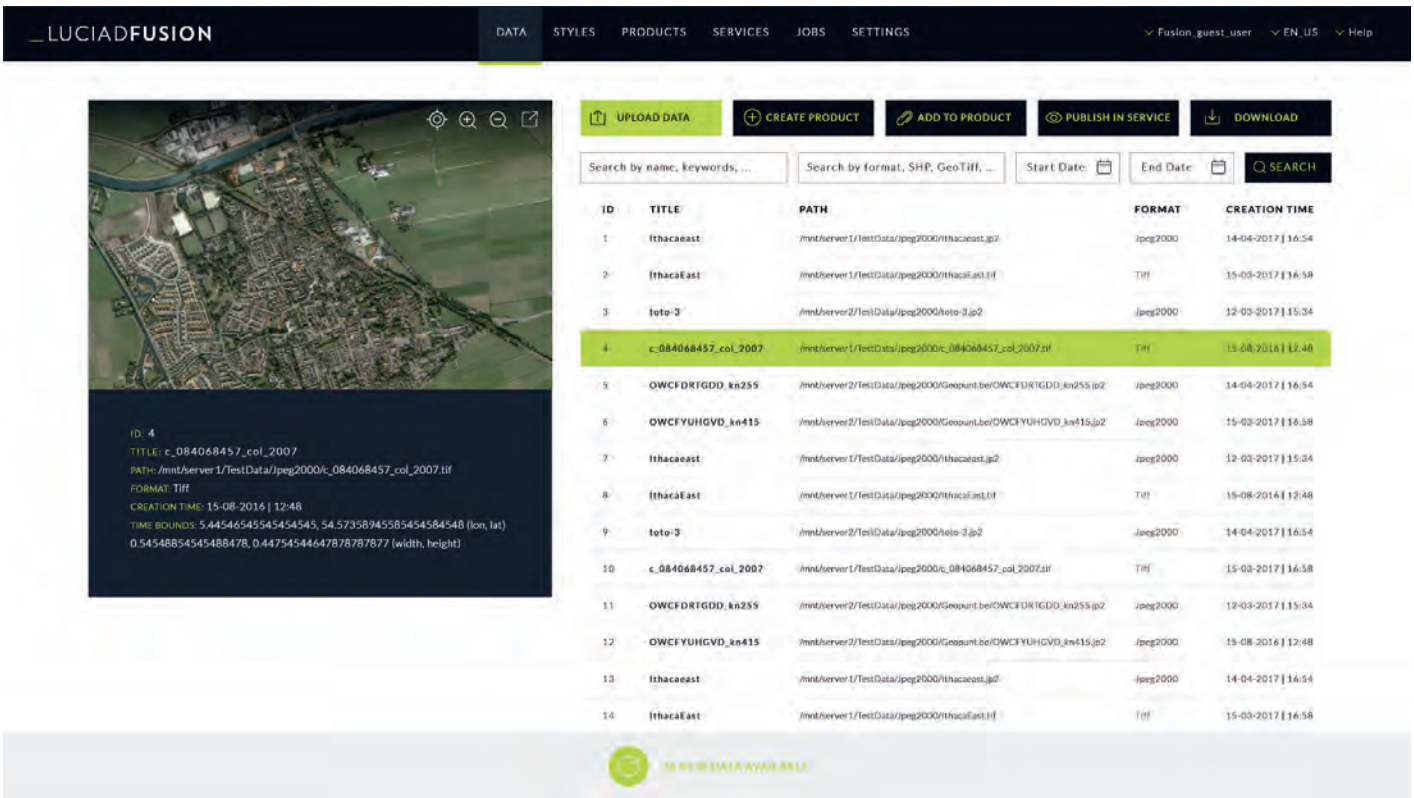
Second, in situations where a user has a large quantity of high-volume – high-quality geospatial data that needs to be published to an OGC standard, this must be achieved with a few clicks. This avoids complex, risky and time consuming pre-processing of the data or custom software code. The same ease of use is required with other common formats like ECDIS Maritime data, Shape, KML, and GeoTiff formats among many others. It is vital that this data can be accessed and represented in any coordinate reference system (geodetic, geocentric, topocentric, grid) and in any projection while performing advanced geodetic calculations, transformations and ortho-rectification. This is especially crucial of datasets such as weather and satellite information, which includes detailed temporal references and high-resolution video files that need to be visualised in 3D to include ground elevation data and moving objects.

HELP

The demands of users, however, do go beyond the server solution itself. At the heart of any decision regarding a major GIS IT or technology purchase should be an understanding of the support, training and help that will be required, plus a firm written commitment from the supplier regarding backwards compatibility. The user should also be aware of and involved with the development roadmap; a roadmap that should be driven by the needs and wishes of both the end user and the developer community.

This is something which is a recognised and concerning weakness of Open Source software, most of which offer near non-existent help and training. What training there is may well be coming from individuals with no relevant qualifications or skills and who are often all located in one global time zone, which delays responses. Where lives matter, such as in mission critical environments, Open Source is a risk. It is vital that advanced in-person and online training is available from those individuals who have an intimate close working knowledge of the software and a relationship with the original coding team backed up by detailed manuals and code examples. Training and support should only be from subject matter experts who understand the time critical commercial challenges of

WHERE LIVES MATTER, OPEN SOURCE IS A RISK



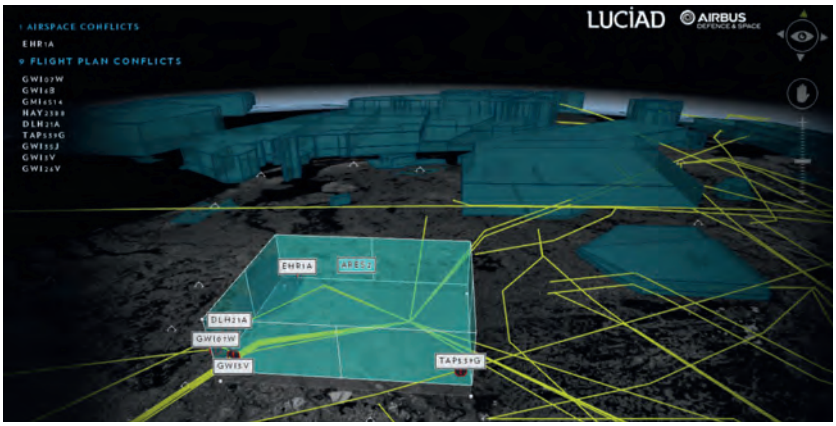
▲ *A view of the data management screen in LuciadFusion.*

business. They should also be aware of the planned development pathways for the software and the possibilities for custom code if needed for one-off projects with unique requirements.

TECHNOLOGY ADVANCES

Giving users and developers the tools to extend the solution that they have is also essential. As has been mentioned, new data formats may be introduced, and requirements may change as technology advances. This necessitates putting together a user guide that delivers clear explanations and descriptions of best practices, along with API references. They offer a detailed description of all interfaces and classes to ensure a new user is able to seamlessly add new data formats and sources as needed for a project. As an example, the development of a Common Operating Picture will require a combination of imagery, military symbology, NVG files, RADAR feeds and always changing types of other data, in one system, in near real-time and with the minimum of delay.

GIS can help build the future of a community, assist in the security of a country, form the basis of a mission planning system and can open new avenues of revenue and profit for a company. However, this can only be realised if the right system is specified and purchased. Too many organisations have wasted time, money and resources attempting to save money or cut back on the initial assessment requirements. Research shows that systems proven in the crucible of deployed operations have the robustness required to deliver in other markets. ◀



▲ *Together with Airbus Defence and Space, Luciad developed the Collaborative Airspace Provision Service/Application with which ATM stakeholders can reserve airspaces and minimise conflicts with neighboring airspaces and flight paths throughout Europe.*

ABOUT THE AUTHOR

Glyn Arthur is vice president of Business Development at Luciad. Previously he was responsible for building Luciad operations in Africa, Middle East and Turkey regions. Glyn Arthur has worked in the defence and aerospace industry for over 25 years and is a subject matter expert in geospatial defence, simulation training solutions and Air Traffic Management.
Luciad, founded in Belgium in 1999, is a provider of geospatial situational awareness solutions for mission critical operations, from safeguarding critical assets to creating the digital infrastructure for smart cities. The company is a world market leader in these solutions for the aviation and defence industry.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HOW DRONES BENEFIT ENERGY COMPANIES

UAS Use in **Vegetation Inspections**

If vegetation comes into direct contact with power lines it can cause service disruption, not to mention fires or even electrocutions. To avoid such undesirable consequences, most energy companies spend approximately half of their budget for managing the vegetation in the proximity of their power line network on inspections. Maintenance staff often conduct visual inspections on foot, or may use other means such as road vehicles or helicopters. The incorporation of UAS technologies into the pruning and trimming activities will bring interesting efficiency results to the sector, as demonstrated in a pilot project by Viesgo in Spain.

Energy company Viesgo recently worked on a medium-voltage power line maintenance project that required three-dimensional (3D) modelling of existing vegetation.

PREDICTIVE MODELS OF VEGETATION GROWTH WERE ALSO USED, BASED ON EXPERTISE IN PRECISION FARMING

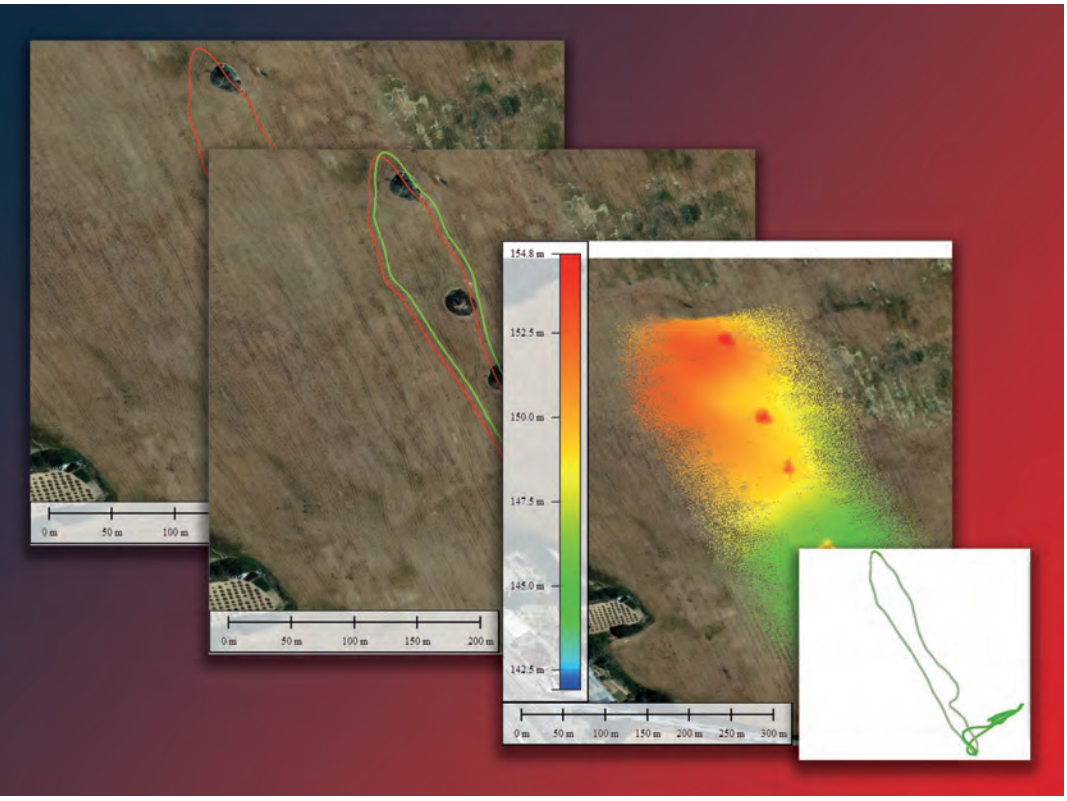
The company had previously experimented with Lidar systems shipped on various platforms; this time the company wanted to try Lidar combined with an unmanned aerial system (UAS or 'drone') and launched a pilot project for some of its power lines. With a thousand employees, Viesgo serves more than 720,000 customers in Spain and Portugal, not only in the power distribution market but also in the power generation and gas & power trading markets. Viesgo currently distributes electricity through a network that stretches 31,150km and has 4,150MW of conventional and renewable power generation capacity.

Viesgo's requirements for the project included:
- a point cloud density of at least 10-15 points/m²
- a topographic accuracy of 20cm in absolute coordinates
- capturing all elements within an exhaustive acquisition of target power lines (tower structure, power cables, insulators and, especially, crossing lines)
- inspecting various corridors with widths varying from 15m to 40m
- maintaining continuous and homogeneous data acquisition to ensure visibility of every cable and crossing line
- monitoring the temperature of the different elements, at all time, with an expected geodetic datum of UTM ETRS89 H30.

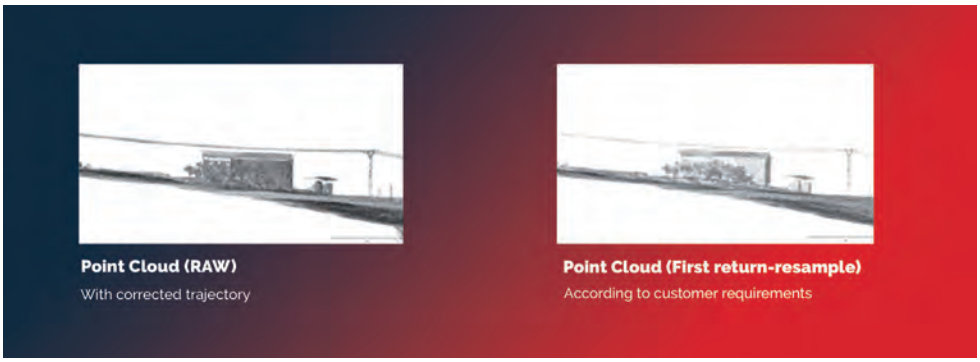
EQUIPMENT AND POST-PROCESSING

Viesgo chose as its project partner HEMAV, a Spanish drone service provider offering B2B analytics services, particularly focused on optimisation and maintenance of power grids. Using a surveyor Lidar system from YellowScan and flying at a height of approximately 20 metres above the power lines, HEMAV can map corridors with a width of 50m or – when mapping corridors with very few elements at ground level – up to 180m. Hence Viesgo's corridor width requirements presented no problems.
In order to obtain a complete and optimally accurate analysis, the project team also embedded a thermographic and a visual camera on the multi-rotor system named

▲ *The Lidar system has to be properly embedded on the UAS to increase stability of the platform and to collect high-quality images.*



▲ *Correction at post-processing level to make sure that the flight trajectory exactly corresponds with the appropriate GPS coordinates.*



Point Cloud (RAW)
With corrected trajectory

Point Cloud (First return-resample)
According to customer requirements

Point Cloud Density

	RAW (POINTS)	FIRST RETURN(POINTS)	POINTS/m²	RESAMPLE	POINTS/m²
Section 01	43.246.444	42.623.516	744.71	2.200.361	20.53
Section 02	86.771.111	83.979.272	902.55	4.888.149	34.90
Section 03	52.369.571	51.295.716	1,378.13	1.902.219	24.06
Section 04	111.220.422	109.394.397	847.90	5.877.581	53.75

HIR9. Successful integration called for two actions: firstly, the laser module needed to be placed as close as possible to the centre of gravity of the UAS in order to achieve the best possible stability of the drone during flights and to reduce any vibrations not absorbed by the damping system. Secondly, the GPS antenna needed to be placed on the top part of the drone, because the best GPS reception is achieved when the antenna is completely exposed to the open sky with no obstacles. Of course, the distance between the antenna and the sensor needs to remain fixed at all times. A GPS ground station at a maximum distance of 15km from the target area ensured absolute accuracy at centimetre level.

In the post-processing, a combination of POSPac UAV suite software and a GPS station with known coordinates was used to obtain a corrected trajectory, applied to a selection of flight lines of interest. Finally, all resulting data was exported in LAS file format. The main issue faced during post-processing was to deal with the gap within primary GNSS navigation data. This problem was solved by identifying GPS time within trajectory and recalculating trajectory correction after sub-dividing it into several trajectory segments as required.

ANALYSIS AND RECOMMENDATIONS

Once the point cloud files had been generated, the data analysis was performed and all requirements were delivered. One difficulty faced while working with Lidar was that the radar was initially unable to distinguish between high-voltage cables and medium-voltage ones, but the proper density was quickly found.

"A SAVING OF BETWEEN 20 AND 30 PERCENT IS A REALISTIC ESTIMATION"

Concerning the calculated tree pruning, it was possible to give Viesgo recommendations about specific volumes of trimming in order to be certain of compliance with regulations. The company also received information about side fall areas and steep slopes so that it could avoid trees falling onto the power lines or surrounding objects. Interestingly, HEMAV developed new additional value by using predictive models of vegetation growth, based on its expertise in precision farming. This allowed delivery of risk models in the form of maps showing the risk of a fire due to the proximity of vegetation to a power line and the risk of service disruption due to a tree fall.

Another element worth mentioning is the minimum distance compliance at every crossing line area. In view of the fact that certain towers would receive two different line crossings at some point, it was very important that the regulations were respected

concerning the distance at which the cables cross the towers. In performing this check, the project team was able to take into account the constant movement that an electrical cable has due to 'normal' natural climate conditions.

ONE IMPORTANT TREND IS THE USE OF PUBLIC-REFERENCE VEGETATION DATABASES, INCLUDING SATELLITE IMAGES

FUTURE OUTLOOK

The pilot project was a success for both parties. First of all, it proved that data acquisition operations really can be done with lighter sensors for these types of activities. It is not easy to put a figure on how much money it saves, because circumstances and previously used methods vary. In HEMAV's experience, however, a saving of between 20 and 30 percent is a realistic estimation. Obviously, the helicopter could still be the more economical option in large-scale surveys, e.g. a flying distance of 200km. However, UAS technology can also be a great tool to access areas with orographic complexity, such as mountain ranges and elevated land masses.

In terms of the trends that suggest more opportunities for savings in the near future, an important one is that the use of public-reference vegetation databases will become easier in the years ahead. In combination with the right analytical software and predictive models, energy companies (or their advisors) will have a new instrument enabling them to plan the trimming and pruning campaigns without having to inspect everything themselves. That can also include satellite images; HEMAV has already worked on some projects of this kind. Since this type of information covers the whole planet, those files can be used as a first step to identify zones on which the power grid actors should focus. Once the public database has been checked, a second step is to add field data collected using UAS technology to further improve the accuracy of the public data. ◂

ABOUT THE AUTHOR

Loïc Pavard is responsible for the International Business Development at HEMAV. He is an engineer, educated at the Ecole Centrale d'Electronique in Paris, France. In the last ten years he has been active in the IT sector, especially with telecom operators. HEMAV, head office in Barcelona, Spain, combines powerful data processing technology with the use of UAV platforms in order to generate valuable services for businesses in energy & industry, precision farming, topography services for the construction sector, and for business case studies for future applications.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EXTENSIVE USE OF THE INSPIRE GML CADASTRAL PARCEL

Smart Cadastral Tools for Real Estate Registration

The tools, systems and protocols as developed by the Spanish Directorate General for Cadastre are well accepted and widely used. A smart system of coordination between the Cadastre and the Property Rights Registry in Spain is now working and showing results. Agents working in the real estate market are now involved too.

In Spain, the Cadastre and the Property Rights Registry are two separate institutions with differentiated mandates and competences, both working in the domain of land administration. The Spanish Law 13/2015 implements an effective coordination of transactions executed by both institutions. Today the real estate transactions are performed with increased legal certainty. While georeferenced spatial information of parcels is incorporated into the Property Rights Registry, cadastral mapping forms the basis of the graphic representation used. The cadastral data is updated simultaneously with the Property Rights Register.

INSPIRE GML FORMAT

The Cadastre, registries and notaries have worked together to design a technologically advanced model of institutional interaction for this coordination purpose. This model enables the application and use of georeferenced spatial information throughout all real estate transactions. The georeferencing of the parcels, expressed through the INSPIRE GML format of a cadastral parcel, is now widely used by all agents involved in property transactions in Spain. Information is continuously exchanged electronically between citizens, professionals and the various institutions involved. As a consequence, the Cadastre is aware and informed of any alterations to the real estate property recorded in a public deed or in any other object of registration, with a sufficient level of detail to carry out its unattended automatic updating.

OBJECT DESCRIPTION

The object present in real estate transactions must be identified at the start of each transaction. This must then be known and agreed upon by all stakeholders. The information derived from the cadastral spatial database is then processed in order to be correctly transcribed into the public transaction document and to be incorporated into the Property Rights Registry. The technical solution developed by the Directorate General for Cadastre allows the list of coordinates as present in the INSPIRE GML format to be linked with its graphic visualisation without the need for specialised GIS tools.

The cadastral cartography, and in particular the 'descriptive cadastral and graphic certification', has been chosen as the instrument to achieve the correct graphic description of the registered properties. This guarantees the coherence of the graphic information that is registered, ensures that there are no overlaps on neighbouring parcels or on neighbouring public land, and guarantees the graphic coordination with the Cadastre. The certified graphic information of the cadastral parcel is expressed in the INSPIRE GML cadastral parcel format (see Figure 1).

REPRESENTATION OF PHYSICAL REALITY

In cases where the cadastral cartography does not sufficiently reflect the physical reality, procedures have been defined for updating the graphic data of the parcel involved through the use of alternative georeferenced graphic representations. These alternative representations are expressed again in the INSPIRE GML Cadastral Parcel format and can be generated from various computer applications. A simple internet search shows the plethora of tools available,

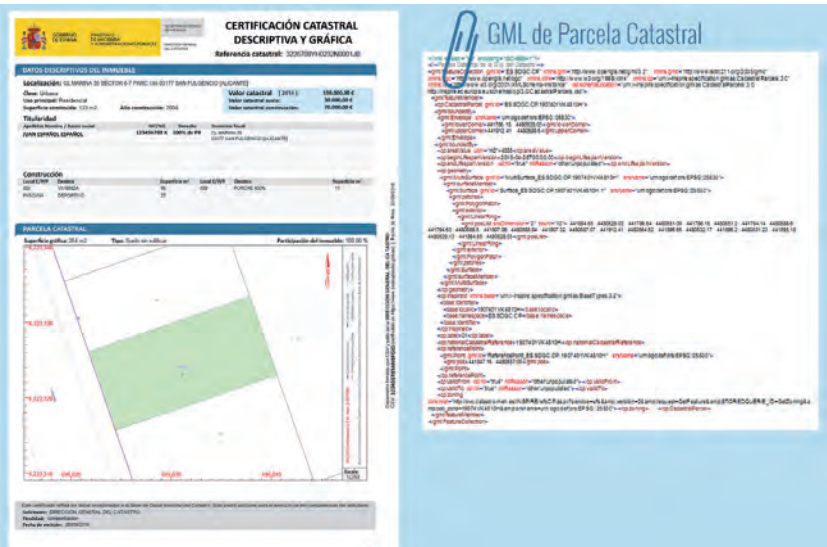
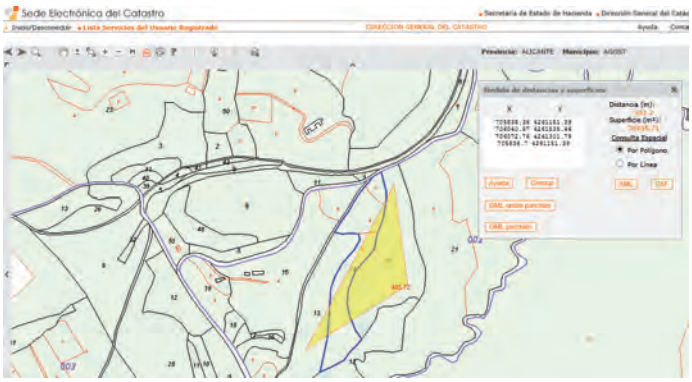
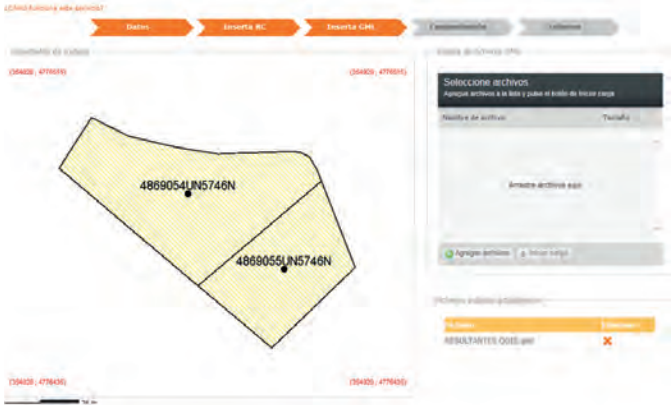


Figure 1, Cadastral certification with attached INSPIRE GML file.



▲ *Figure 2, Generation of the INSPIRE GML file on the Cadastre's website.*



▲ *Figure 3, Generation of the graphic validation report.*

appearing as free and open software tools, tools provided by professional institutions as well as tools from specialised commercial firms. Other options include free plug-ins for AutoCAD, QGIS or gvSIG as well as the tools presented on the Cadastre's website (see Figure 2).

VALIDATION

An alternative graphic representation must comply with certain technical conditions established in the relevant development resolutions. It must be represented in the cadastral cartography and the delimitation that already exists in the cadastral cartography must be respected. The accreditation of these conditions is verified by means of the 'validation service of alternative georeferenced graphical representations' on the Cadastre's website, http://www.sedecatastro.gob.es (see Figure 3). This results in the 'graphic validation report' as shown in Figure 4.

LATENT DEMAND

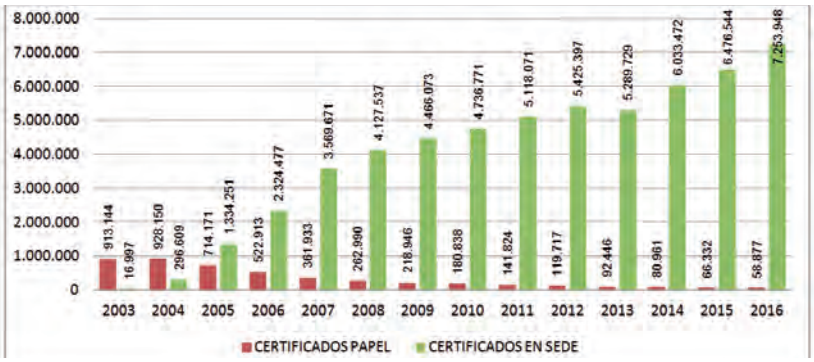
The key parts of the technical solution, the cadastral certification and the graphic validation report of the new, alternative georeferenced representation, can be obtained via a web service by citizens and professional users from the Cadastre's website.

Over the course of 2016, more than seven million certificates and fifty thousand reports were issued, practically all of them electronically. Beyond the substitution effect of the face-to-face channel by the online channel, this shows the clear and ongoing emergence of a latent demand for cadastral information. Between the implementation of the Cadastre's website in 2003 and today, the number of cadastral certificates issued has multiplied by seven, and last year saw an increase of more than 10 percent (see Figure 5). It must be emphasised that only 15 percent of certificates are obtained by private citizens. The other 85 percent are being directly obtained by professional users – the notaries, registrars and authorities that need them. These are obtained not only interactively, but also by utilising the electronic web-based services enabling automatic data exchange between the information systems.

AUTHENTIC DOCUMENTS

The INSPIRE GML of the graphic situation of the cadastral parcel as certified by the Directorate General for Cadastre is embedded in the cadastral certification and the graphic validation report. The Directorate ensures the authenticity and integrity of its contents. This circumstance is achieved thanks to the fact that both products are electronic documents, signed using a secure 16-digit verification code. This code unequivocally identifies the document in the Directorate General for Cadastre's catalogue. The exchange between the various stakeholders requires only the 16-digit barcodes (see Figure 6). This avoids the need to physically exchange computer

▲ *Figure 4, Positive graphic validation report.*



▲ *Figure 5, Evolution in the number of certificates issued. Red = on paper, Green = electronically.*

FURTHER READING

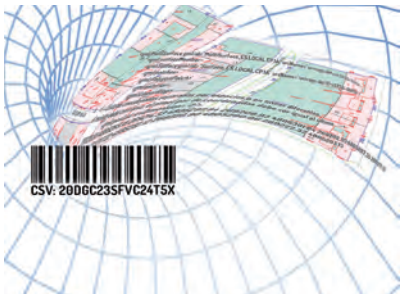
Video showing how the various tools work: http://www.catastro.minhafp.es/documentos/19_02_07_secuencia.html

Website: http://www.catastro.minhafp.es/

files, allows the visualisation of the new representation without GIS tools and enables the automated capture of its contents, thus preventing possible transcription errors.

CONCLUDING REMARKS

The introduction of this system has enabled strong progress in the coordination between the Cadastre and the Property Rights Registry. The system contributes to standardising the internal processes of all the stakeholders involved in the real estate sector. Interoperability between stakeholders' systems is enhanced and at the same time administrative procedures are simplified, costs are reduced and legal security is increased. Cadastral data has been incorporated and has been marked as coordinated in the Property Rights Registry, and the data related to delimitation, location and area is considered to be true for all legal purposes. This promotes transparency in real estate transactions by establishing an adequate procedure for generating spatial descriptions of real estate objects. This is principally based on cadastral cartography, and allows citizen participation by offering access for citizens to rectify and/or update the real estate object's description. ◂



▲ *Figure 6, The graphic information is condensed into a 16-digit barcode.*

ABOUT THE AUTHORS

Carlos Alonso Peña works as an advisory member of the Management Board in the Directorate General for Cadastre in Spain's Ministry of Finance. He has been working in cadastre for the past 20 years, leading different e-government projects developed in the Directorate General for Cadastre. One of the main projects developed recently is the smart model of coordinated interaction between the Cadastre and the Property Rights Registry.

Amalia Velasco Martin-Varés is international affairs coordinator at the Directorate General for Cadastre in the Ministry of Finance. She has been working there for 29 years, in various technical and management roles with an increasing degree of responsibility. Since 2007 she has been the Spanish Cadastre's representative in meetings and working groups of the international cadastre-related associations.

Transition from Solution Providing to Value Partnership

Intergeo 2017, the world's leading fair and conference on geodesy, geoinformation and land management, recently took place in Berlin and provided an open global environment for the geo-information community and geomatics technology sector to see the current state of the art and look into the future.

In addition to Intergeo's role as marketplace for the geomatics industry itself, it helps the global sector to position itself in the changing world economy set in a digitalised world.

CHARACTERISTICS OF INTERGEO 2017

Compared to the last three Intergeo events, Intergeo 2017 was the first to attract more than 18,000 visitors from 107 countries, with about 1,400 conference delegates participating in parallel sessions of 200 talks and presentations. There were 577 companies from 37 different countries exhibiting, a quarter of these for the first-time.

In spite of the variety of communication channels such as internet and social media in a networked-business environment, where access to information is at your fingertips, the expanding Intergeo reflects the growth in the geospatial sector and demonstrates the importance of face to face communication, on site presentations and the (potentially) excellent interlink between trade fair and conference. It should be noted that an increased programme in English would be a big plus. With all its unique characteristics, Intergeo 2017 provided a natural platform for showcases, live interaction, promotion of new products, networking between customers and technology producers, and extending global marketing and reselling networks.

▲ *Messe Berlin during Intergeo 2017, entrance at the Southern gate.*

In addition to the main topic of digitalisation, Intergeo 2017 provided the backdrop for exhibiting solutions and presenting applications on a number of topics, including Smart Cities, BIM, Virtual Reality (VR), UAV and smart cartography.

KEYNOTE ADDRESSES AND LEADING TOPICS

In his keynote address at the plenary session, Klaus Vitt, State Secretary from the German Ministry of the Interior, broadly outlined the use of geospatial open data for public, urban and environmental protection in a digitalised society, placing particular emphasis on the privacy and protection of data. In his keynote speech, Dr Jürgen Dold, president, Hexagon Geosystems, described digitalisation by making an analogy with Paul Simon's song 'You Can Call Me Al', where he compared the two most well-known words and their misinterpreted meanings – 'digitising' and 'digitalisation' – with the misunderstandings in the song. He connected the concepts of

creating a model of the real world in a digitAL frame to make better, intelligent decisions about the world and how digitALisation would contribute to the construction sector from the point of view of productivity and cost saving.

A NEW PHASE OF INNOVATION

As the geospatial sector has been engaged in various forms of innovation for years, the characteristic of Intergeo 2017 was the effort to adapt to the new requirements of a digitalised world. The innovative geo-technologies at the trade fair and the presentations, which provided a concise summary of best practices at the conference, have shown that the sector is in transition from the phase of providing solutions with tightly integrated-systems of hardware and software to a phase of collaboration and sharing in understanding, monitoring and managing the multifaceted problems of today's society from security to the digitalised administration of urban areas, and from autonomous navigation to the smart sensor web.

NEW SERVICES AND NEW INFRASTRUCTURES

Germany's new open data programme and the first open data products in the OpenStreetMap format, as well as generalised data from cadastre (ALKIS) to topographic (ATKIS) models, were presented by BKG (the Federal Agency for Cartography and Geodesy) and AdV (Working Committee of the Surveying Authorities of the Länder). BGIC (Bundeswehr Geoinformation Centre) introduced a fully equipped battlefield mobile mapping vehicle with multiple sensors, including laser scanning and imagery capture, to support soldiers in real-time and a 3D model of the battlefield. German SDI (GDI-DE) presented a new administration team to strengthen the initiatives of INSPIRE, UN-GGIM and GSDI with registry, geoportal, and metadata services, and interface to geodata services. The Copernicus Program of the European Commission and partner companies introduced the wide use of free satellite data services comprising multispectral imagery and radar for the purpose of environmental protection, agriculture and security.

VIRTUAL REALITY

Virtual Reality (VR) is becoming a new media for visual communication, measurement and design in the geomatics sector, although it has been used in the gaming and filming industry for a long time. With the enabling laser scanning technology, mobile mapping or 3D point clouds from any source, a properly prepared 3D model may leverage VR and AR (Augmented Reality) as a new form of visual language and permit interaction between the real world and a digital model allowing robotic access to environments of interest. VR systems attracted many visitors from different backgrounds and were presented by various companies such as UVM and Leica Geosystems. The well-established geo-technology sector with its legislative limitations and precise standards, and surveyors with their traditional way of working, will ultimately need to put further effort into changing and transforming the surveyor's working environment into a 3D digital twin of the real world.

▲ *This year's Intergeo attracted many students and young professionals.*

DIGITALISATION OF URBAN MODELLING AND MANAGEMENT, BIM, SMART CITIES

The increase in the number of geo-solutions for BIM and smart cities by geoinformation sector leaders such as Esri, Autodesk, Bentley (Microstation), and Pitney Bowes (Mapinfo), with their core solutions and more sector-oriented solutions from their partners and resellers, proves that the market for BIM

▲ *Outdoor demo flight in the Intergeo flight zone.*

and Smart Cities is increasing as well. Many professionals and companies interested in the business digitalisation of urban modelling visited the booths of the companies providing these services.

GEOMATICS FOR OTHER SECTORS: CONSTRUCTION, TRANSPORTATION, MINING AND AGRICULTURE

Geospatial technology has been traditionally helping urban management, land management, and utilities with fit-for-purpose solutions. In recent years, many of the companies in the geo-technology sector have been providing new technological capabilities with their new cost-cutting solutions and services that promise a wave of productivity improvements for sectors including construction, transportation, mining and agriculture. Intergeo 2017 witnessed an increasing number of mature solutions and products which create value for these four sectors. Following the proven success of the pioneers in the market, there are now new players attempting to take a share of the market. In this respect, Intergeo 2017 hosted first-time exhibitors from Asia to support construction surveying with a particular focus on survey equipment and hardware.

TRANSITION IN THE UAV SECTOR

This year, more than a quarter of the exhibitors were directly or indirectly providing OEM, products or services demonstrating maturity of drone operations. The exhibitors and talks at the conference focussed on particular problems by using almost standardised sensors, and methodology with some examples of best practices such as continuous calculation and monitoring of stock piles from successive DEMs in mines; inspecting infrastructures; and monitoring vegetation growth by means of a vegetation index from multi-spectral sensors.

ABOUT THE AUTHOR

Abdulvahit Torun holds a BSc in geomatics from the Defense Geodetic Surveying and Mapping Academy, Turkey, an MSc in geodesy from Istanbul Technical University, Turkey, an MSc in geoinformatics from Twente University (ITC), The Netherlands, and a diploma in CS/CE from Middle East Technical University (METU), Turkey. He has extensive experience in the geoinformatics sector, is founder of Aperigae Information Technologies Consulting and an adjunct professor in engineering surveying at METU.
abdulvahit.torun@aperigae.com

▲ *Intergeo 2017 was all about digitalisation.*

SERVICES, DATA PRODUCERS, IMAGE PROCESSING, SENSORS, SOFTWARE

Many companies, including Cloudeo, GAF, Luciad and Harris exhibited their SaaS (software as a service) for the purposes of agriculture, location-based services, traffic, soil moisture, and water masks through their portal.

An increasing number of companies from Asia, along with German and Central European companies, are engaged in the business of providing surveying equipment, OEM parts, multispectral sensors, and 360-degree cameras. In contrast to previous Intergeo exhibitions, there were more service companies using software development kits (SDKs) or OEM technologies (both software and hardware) to facilitate the infrastructure of smart cities and to provide services in conventional fields such as data capture, (aerial) mapping, image processing and all areas of surveying. The number of software solutions of structure from motion based UAV photogrammetry slightly exceeded conventional photogrammetry software for 3D modelling and data capture.

NEW SURVEYING TECHNOLOGY, GNSS AND MULTI-SENSOR SURVEY SYSTEMS

Integrated survey systems composed of multiple sensors such as rail-track survey systems and road surface monitoring systems have been familiar products at Intergeo for some years. Now radar-based systems such as ground penetration radar (GPR), which supports reverse-engineering for utility networks such as gas and water pipelines, and terrestrial InSAR (Interferometric Synthetic Aperture Radar), a technology for deformation, subsidence and displacement monitoring, were exhibited at Intergeo 2017 by Leica Geosystems and MetaSensing respectively. Multi-constellation laser scanners on trolleys, backpacked, handheld and mounted on different platforms were supplied by many producers to survey difficult areas. There was no change in indoor navigation methods, other than visual, but there was a decreasing number of exhibitors of OEM products for GNSS and INS.

BUSINESS NETWORKING, SEEKING JOBS

On the second day of the event, there was a visible – and encouraging! – increase in the number of young professionals visiting the booths to explore the technology, attending presentations on new products and solutions and making contact with companies.

INTERGEO 2018

The highly dynamic geomatics sector will be present at Intergeo 2018 in Frankfurt, Germany from 16-18 October, with innovative new ideas and technologies as well as mature products. On the evidence of Integeo 2017 the future looks particularly bright for VR, BIM, digitalised urban management, geo-technology solutions for autonomous car navigation, and the operation of multi-drone flights with intelligent collision avoidance. ◀

More information
www.intergeo.de
www.gim-international.com

FIG at Intergeo

The large Intergeo trade fair that was held in Berlin from 26 to 28 September 2017 was a good occasion for FIG to meet and greet both familiar and new people in the FIG network. FIG had a stand and was visited by several active FIG representatives spanning from young surveyors, long-term active people in FIG, existing corporate members, potential new corporate members and many others who either wanted to meet with FIG or to hear more about the work of FIG. Further to this, part of the presence at Intergeo was to promote the large upcoming Congress 2018 that will take place from 6 to 11 May 2018. Co-conference director Orhan Ercan attended the fair together with two further members of the local organising team, Muzaffer Kahveci and Muhittin Ipek, and they were also represented by the president of the Chamber of Surveying and Cadastre Engineers of Turkey, Ertuğrul Candaş. FIG was represented by FIG president Chryssy Potsiou, vice president Rudolf Staiger and director Louise Friis-Hansen.

Thanks to all who came by!

FIG/ESRI WEBINARS ON MODERNISING LAND ADMINISTRATION

A new initiative that FIG is proud to offer is a Webinar Series that Esri, one of our FIG platinum corporate members, is organising together with FIG. The webinars will highlight special topics in GIS for land administration. Whether you are working with a new or fit for purpose cadastre system, or are fully equipped with the latest capabilities, the webinars are intended to update you on current technology. Each webinar is scheduled to be one hour, and is a unique opportunity to become updated with the latest knowledge in a short time without travelling costs.

The first webinar took place on 18 October with the theme: Getting Started with Fit for Purpose Land Administration. This webinar was held at a time that suited the time zones in Europe and Africa. Webinar 2 will take place in time zones primarily suitable for Asia/Pacific but is also applicable for the US time zone. This webinar will be about 'Modernise Your Land Administration System Off-the-Shelf GIS Technology for Modern Cadastral Operations' and is planned to take place on 27 or 28 November, depending on your location.

Louise Friis-Hansen

More information
www.fig.net
http://go.esri.com/LandAdminWebinars

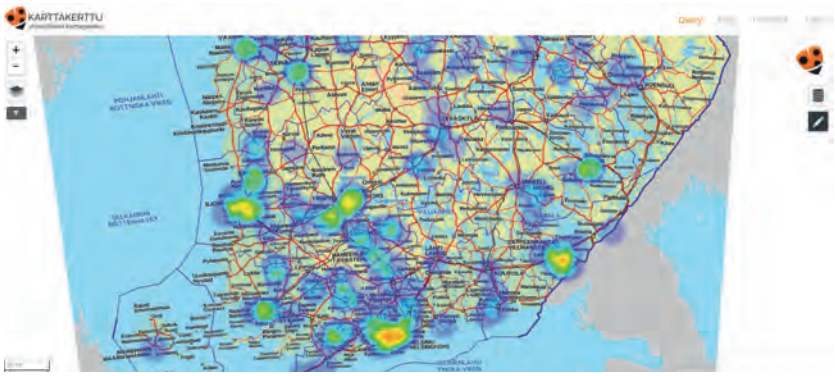
There was lively traffic at the FIG stand where both FIG in general and especially the FIG Congress 2018, that will take place in Istanbul from 6 to 11 May 2018, were promoted.

FIG president Chryssy Potsiou visited Intergeo and had meetings at the FIG stand. She is shown here together with co-conference director of FIG Congress 2018, that will take place in Istanbul from 6 to 11 May 2018, Orhan Ercan, and Julius Friis-Hansen.

GSDI Member Spotlight: NLS of Finland Testing Map Update Through Crowdsourcing

The National Land Survey of Finland (NLS) is testing crowdsourcing as a means of collecting map data [1]. The pilot project is an attempt to test whether the observations of individual users can be used to improve the updating frequency of topographic data.

Information is collected using the social mapping service, Karttakerttu [2]. The service is open to all and imported data can be viewed by anyone. Karttakerttu went online at the end of March this year, and it has quickly attracted hundreds of users. More than 500 new map objects have been



imported into the service. The greatest number of additions concern footpaths, which are not included in the National Land Survey's map data.

Senior research scientist at NLS, Mari Laakso, points out, "Often local people know their familiar surroundings best." The idea of crowdsourcing the map is to get people's local knowledge on maps.

In Karttakerttu, users can put a variety of objects on the map that were not there already, such as campfire sites or footpaths. They can add objects on the map by directly marking the base map or aerial photograph. Also, they can upload route information from their mobile phones and then show it in Karttakarttu. All data collected through crowdsourcing are available immediately in Karttakerttu. Data will be checked against aerial photography and laser scanning before being added to other maps.

The Karttakerttu pilot project and the National Topographic Database programme are a part of the project for the Public administration's common spatial data platform. Finland strives to have a spatial database that harmonises the spatial data of the state, provinces and municipalities and makes them available to companies and communities. The results of the Karttakerttu pilot will have an impact on the role that NLS places on pooled data collection for land surveying data. Also, the architecture, server and interface services, implementation tools and platforms, and user interface functionality are being assessed so that recommendations can be made as to how and for which data items the information gathered is to be useful.

More information
[1] http://www.maanmittauslaitos.fi/en/topical_issues/maps-updated-through-crowdsourcing-summer

[2] http://karttakerttu.fi/fi/map/yhteisotaso_2

Unified Analysis Workshop 10-12 July 2017, Paris, France

Unified Analysis Workshops (UAWs) are co-organised by the IAG's Global Geodetic Observing System (GGOS) and the International Earth Rotation and Reference Systems Service (IERS). This was the 5th in a series held every few years to discuss issues that are common to all the space-geodetic measurement techniques.

Participants of the UAW in Paris, France.

The discussions during the first session concerned the source of errors and biases in the techniques and resulted in recommendations to mitigate them. For GNSS, this included recommendations to improve the force and background models including the use of modern static and time variable gravity models, improved diurnal and semi-diurnal EOP models, improved solar radiation pressure models, improved calibrations of GNSS antennas, and the use of arcs longer than 24 hours. Recommendations regarding VLBI, SLR and DORIS were also made, and can be found at the UAW website.

The 'Site Survey and Co-location' discussions resulted in recommendations to develop in situ site-dependent GNSS antenna calibrations, to survey sites that have not yet been surveyed, to develop an optimised strategy to employ different surveying techniques at the same site, and to examine the discrepancies between the local site surveys and the results of space-geodetic analyses.

The activities of the three IERS ITRS Combinations Centres (CCs) were presented at the 'Reference Systems and Frames' session as well as presentations comparing the three independent solutions to each other, and the results of adopting ITRF2014 by the different IAG Services. It was recommended that the three CCs consider the possibility of updating their frames between determinations, that the Services provide the CCs with the information that they need to update their frames, that the IERS identify reference frame users who will benefit from time series reference frames and how these reference frames will satisfy their needs, and that the IERS provide up-to-date locations of discontinuities in the coordinate time series of the four techniques.

During the 'Conventional Mean Pole' session, consensus was reached to develop and use a linear mean pole to replace the mean pole model currently defined in the IERS Conventions. There was considerable discussion in the 'Standards, Conventions, and Formats' session about a wide range of issues and recommendations. The objective of the 'Interoperability of Portals and Metadata' session was to begin a dialogue between the Services and GGOS to develop interoperable web portals that interface to and are discoverable by the portals of other organisations such as GEO.

Richard Gross (JPL), Tom Herring (MIT)

More information
www.iag-aig.org
http://bit.ly/UAW2017

Showing the World

Associated with every International Cartographic Conference (ICC) is a series of exhibitions providing interest, demonstrating innovation, stimulating opinion and promoting knowledge for every delegate outside of the formal conference sessions. Most of the exhibitions are arranged at the conference venue, but there are always displays put on by a range of outside agencies who take advantage of the conference being 'in town'. In Washington DC, for example, in July this year, the Commission on the History of Cartography had the opportunity to visit the Map Vault of the Geography & Map Division of the Library of Congress in the Madison Building, whilst the most prominent collection of early modern (pre-1800) maps and atlases in the Washington area was viewable at the Folger Shakespeare Library nearby. Inside the ICC venue itself, the Washington Marriott-Wardman hotel, contemporary American artist Mary Edna Fraser presented her large-format artwork in the ancient medium of batik incorporating aerial photography, satellite imagery and modern dye technology. Hanging several metres from the atrium ceiling these stunning artworks demonstrated the way in which maps can contribute to the creative processes of many people who would never call themselves 'cartographers'.

Also in the conference venue, the Technical Exhibition showed how developments in technology are affecting the everyday work of the cartographer. Hardware and software suppliers, publishers and educational providers, production organisations and professional bodies, all presented their expertise to the conference. The Children's Map Exhibition is a regular highlight, and 193 drawings from 34 countries were shown at ICC2017. The competition was judged by a 10-strong international panel, chaired by Pilar Sánchez-Ortiz Rodríguez of Spain. The winning entries can be seen at http://icaci.org/petchenik/ where the outstanding creativity of the world's children in mapping their planet is widely evident. The popular winner of the public vote was 15 year old Champ Turner from Austin, Texas, whose submission 'Our path for exploration' demonstrated wit, drawing ability and environmental concern in an excellent map.

The International Map Exhibition showcases the best cartography of the member nations of ICA. The standard of high-quality mapping was evident in each of the six categories: atlases; flat hard-copy charts; maps on panels; digital products; educational cartographic products; and other cartographic products. The jury, chaired by Ken Field of the UK, had a difficult task to select first, second and third places in each class, and a public vote of each category was also held. The winning maps can be viewed at http://icaci.org/recipients-of-the-ica-map-awards-2017/

The world is on display at each ICC: we look forward to the next, in Tokyo in 2019.

More information
www.icaci.org

Champ Turner's world map. He was the public vote winner of the Barbara Petchenik Children's Map Competition 2017.

ISPRS Geospatial Week 2017

The Geospatial Week 2017 (GSW 2017), approved by the ISPRS Council and held by Wuhan University from 18 to 22 September, was successfully closed in Wuhan. Thanks to the great efforts of the Local Organization Committee and the Programme Committee, and the guidance of the International Scientific Committee and ISPRS Council, GSW 2017 was a great success. More than 1200 participants from 33 countries and regions joined this great event, and 40 companies in the field of geo-informatics highlighted their products. Ten workshops attracted more than 650 submissions from about 300 institutes from all over the world. After carefully reviewing the entries, 395 manuscripts were accepted as oral and poster presentations. The accepted submissions were also published in ISPRS archives or ISPRS annals. At the grand opening ceremony, chairman of GSW 2017, Deren Li, and ISPRS president, Christian Heipke, delivered the welcome addresses, followed by a splendid Chinese dance. During the five-day meeting, an abundance of academic and social activities took place. Six keynote speakers and 35 invited speakers delivered the latest research outcomes and insights in the field of geo-informatics, including autonomous driving and artificial intelligence, and about 240 oral sessions and 80 posters were presented. Moreover, 3 tutorials were organised by Esri and two professors to inform the participants about related geo-spatial topics. Six travel grants, 10 best oral presentations and 8 best poster presentations were awarded with certificates and cash prizes at the GSW 2017 closing ceremony, after having been carefully reviewed by the workshops chairs. GSW 2017 provided a good platform for researchers of geo-informatics to present their latest research activities and explore the opportunities and challenges. "It was great to see more and more young researchers and professors in the world present their research outcomes and share their ideas at GSW 2017", as said by Prof. Deren Li, the chairman of GSW 2017. At the closing ceremony, ISPRS Council was pleased to announce that the ISPRS GSW Selection Committee elected Dubai to host the GSW2019, which will be held from 24 to 28 March 2019.

More information
www.isprs.org
www.acrs2017.org

AGENDA

2017

NOVEMBER

THE 7TH CHINA SURVEYING, MAPPING AND GEOINFORMATION TECHNOLOGY & EQUIPMENT EXHIBITION
Nanjing, China
from 8-10 November
For more information:
www.tleerw.com/en

THE COMMERCIAL UAV SHOW 2017
London, UK
from 15-16 November
For more information:
www.terrapinn.com/exhibition/the-commercial-uav-show

LOWCOST 3D 2017
Hamburg, Germany
from 28-29 November
For more information:
http://lc3d.net/

2018

FEBRUARY

GEODESY, MINE SURVEY AND AERIAL TOPOGRAPHY CONFERENCE
Moscow, Russia
from 15-16 February
For more information:
www.con-fig.com

MARCH

GISTAM 2018
Madeira, Portugal
from 17-19 March
For more information:
www.gistam.org

GI4DM 2018 - GEOINFORMATION FOR DISASTER MANAGEMENT
Istanbul, Turkey
from 18-21 March
For more information:
www.gi4dm2018.org

MAY

26TH FIG CONGRESS
Istanbul, Turkey
from 6-11 May
For more information:
www.fig.net/fig2018

GEO BUSINESS 2018
London, UK
from 22-23 May
For more information:
www.geobusinessshow.com

JULY

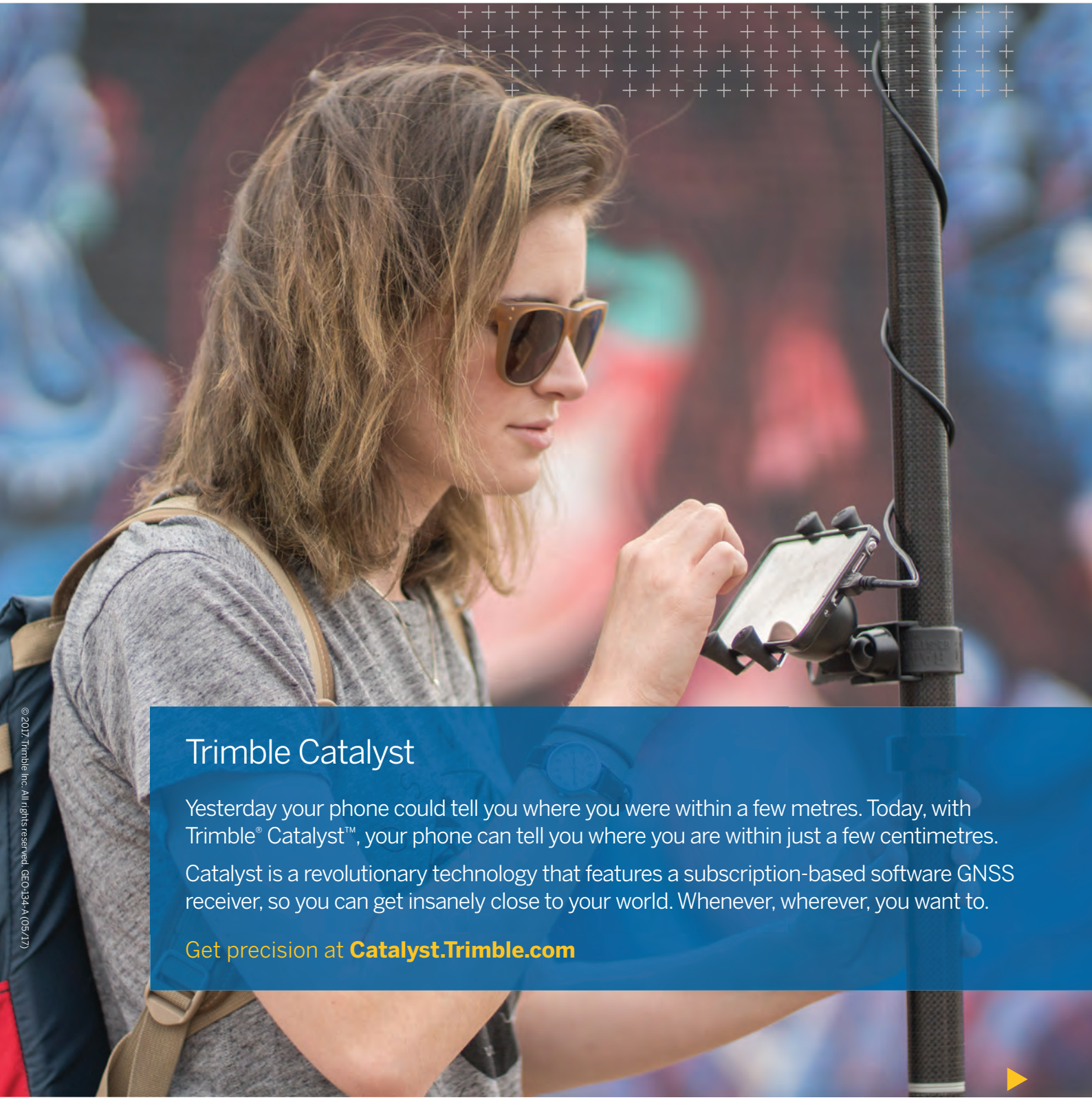
42ND COSPAR SCIENTIFIC ASSEMBLY AND ASSOCIATED EVENTS
Paris, France
from 14-22 July
For more information:
www.cospar-assembly.org

OCTOBER

INTERGEO 2018
Frankfurt, Germany
from 16-18 October
For more information:
www.intergeo.de

CALENDAR NOTICES
Please send notices at least 3 months before the event date to: Myrthe van der Schuit, account manager, email: myrthe.van.der.schuit@geomares.nl

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



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TRANSFORMING THE WAY THE WORLD WORKS

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