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UAS Photogrammetry for Mapping Mountains

Rapid 3D Mapping of Mount Erciyes

MONITORING COASTAL EROSION WITH UAV LIDAR

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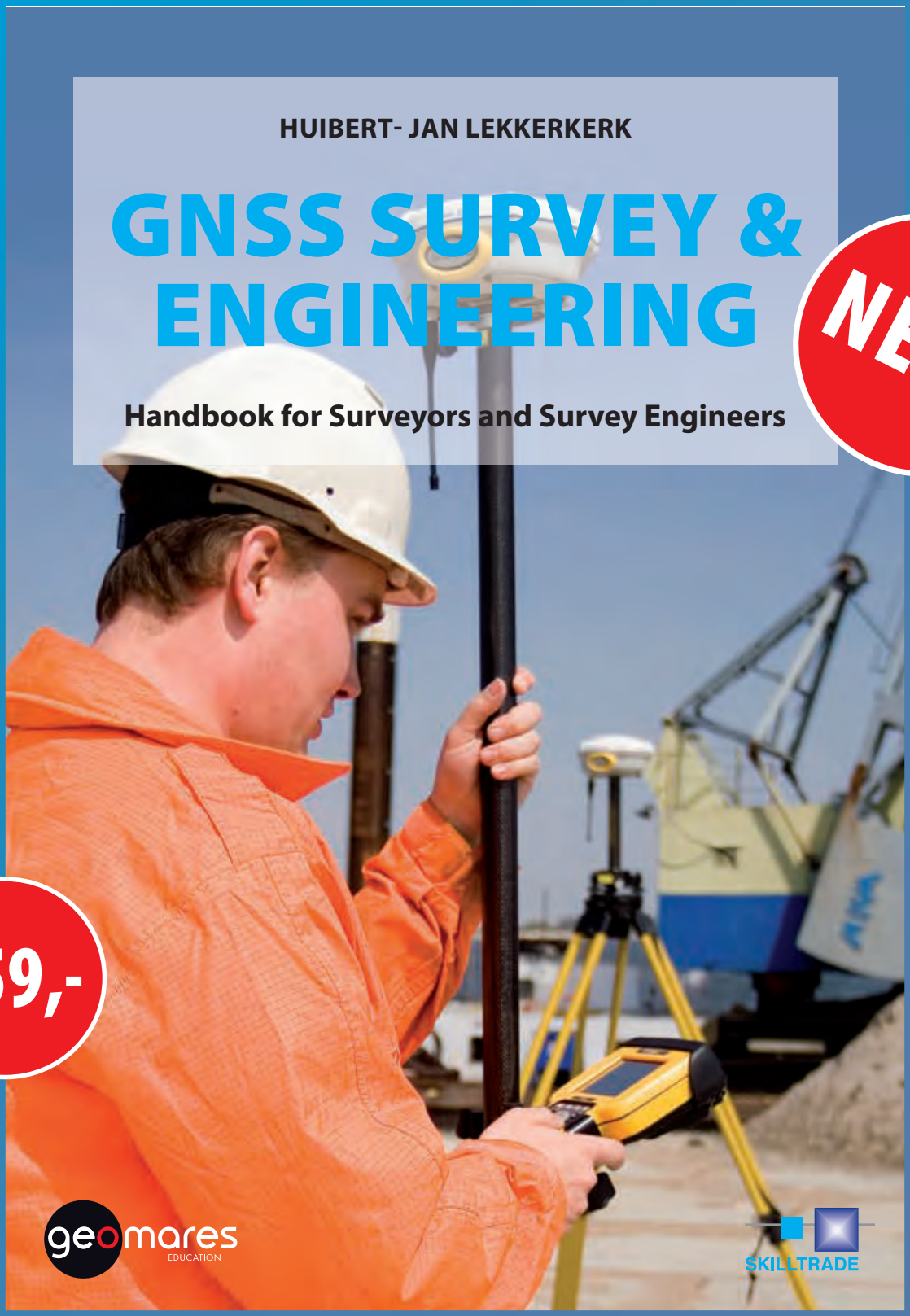
COVER STORY

This March-April issue includes details of mapping and surveying projects carried out with unmanned aerial vehicles (UAVs). Nowadays they are an indispensable part of the geospatial toolkit for many professionals, but in fact they have only gained a firm foothold in the geomatics industry over the past five to ten years. We hope that the articles in this edition of *GIM International* will give you new insights into how UAVs could be used in your survey activities.

GNSS SURVEY & ENGINEERING

Handbook for Surveyors and Survey Engineers



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Work the Way Workforces Work

It was a only small comment during the interview with Ron Bisio, vice president of Trimble Geospatial Systems (see page 14), but it's a remark that struck me as a logical description of how entrepreneurs need to work in our rapidly changing world to cope with the rapidly changing business conditions that lie ahead. He states that, in order to stay relevant, he needs to 'work the way workforces work': "We keep in close contact with customers with the goal of anticipating their needs and developing solutions that help them operate more efficiently, expand their offerings and grow their businesses". That might sound logical, but the reality has been different in the past for lots of companies. Ron Bisio from innovator Trimble shares details of how to do this: "To understand our customer needs, we use a variety of touchpoints, including trusted customer input sessions and intensive beta cycles to help us refine our solutions to best fit the needs of a changing marketplace". Again, it sounds logical, but once again we see lots of companies developing products and solutions without really knowing what their customers want or need. This is made more complex because the requirements for geomatics hardware and software in different application fields are changing every day, and therefore so too are the end users' wants and needs. A company cannot risk a mishit, because our world is so fast paced there's no way for them to catch up again. This puts an enormous strain on companies, and on smaller ones in particular because they often have fewer funds to invest than the big corporates. One cheap, easy and logical step is to talk and above all listen to the customer, although this is often forgotten. After that, you use the input you've obtained from all those conversations with customers to adjust your product to 'the way workforces work'. This is a somewhat more difficult and expensive step but, if it is carried out according to the workforces' wishes, it will probably hit the nail on the head.

Durk Haarsma, director strategy & business development

Looking for New Content!

Have you recently conducted a challenging survey, or are you working with the very latest technology that your fellow geomatics specialists around the world should know about? At *GIM International* we are always looking for enthusiastic mapping and surveying professionals who are willing to share their experiences. Knowledge exchange and lifelong learning are two important pillars of our geomatics media platform, as we strive to serve our readers with a continuous flow of need-to-know (and also nice-to-know!) information. Just some of the ways you could contribute include:

- Blogs
- Columns
- 'How to' articles
- Case studies
- Technical reports

So if you are happy to share your thoughts and ideas about anything that you believe could be relevant for the geomatics community, please let us know! Our content manager Wim van Wegen (wim.van.wegen@geomares.nl) will be glad to team up with you to turn your content into a professional article that meets the standards for publication on our website, in our magazine and/or in our newsletter. We're looking forward to hearing from you!

Mount Erciyes

Back in 2008, when I was doing my degree in European Studies, I spent almost six months as an intern in Turkey. I still cherish many great memories of my time in that lively and dynamic country at the intersection of Europe and the Middle East. I experienced the famous Turkish hospitality first-hand, I drank countless cups of tea and I learned a lot about the culture and the customs of the people. While I was there, I seized the opportunity to travel and explore as much as possible of the captivating country. I recall how I loved the fascinating landscape of Cappadocia, enjoyed the open-minded atmosphere in Eskişehir, and was impressed by Istanbul, but an absolute highlight was Mount Erciyes, situated in central Anatolia. Erciyes Dağı, as the mountain is called in Turkish, is a large stratovolcano that rises up from the Anatolian plateau. The snow-covered mountain is visible from a distance of 50km, and its majestic appearance made a lasting impression on me; it is one of the most breathtaking landscapes I have ever seen in my life. And now, ten years later, I have the honour to include an article in this edition of *GIM International* titled 'UAS Photogrammetry for Mapping Mountains'. This project shows that unmanned airborne systems have great potential for rapidly mapping mountainous areas, and takes us to Mount Erciyes, which was 3D mapped to produce a DSM and an orthoimage. So don't delay – turn to page 24 to read this inspiring story!

Wim van Wegen, content manager

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Best Practices and Inspiring Ideas for Land Administrators

New-era land administration calls for new approaches.

According to Wikipedia, "a cadastre (also spelled cadaster), using a cadastral survey or cadastral map, is a comprehensive register of the real estate or real property's metes-and-bounds of a country". Many countries use the cadastre to define the dimensions and location of land parcels described in legal documentation, which makes it a key source of data in land disputes. A well-functioning cadastre is a fundamental pillar of the economic policy and as such represents an essential ingredient for a country to work on improving its prospects. *GIM International* frequently publishes articles about various methods that can be used to set up such a cadastral system. Check out our selection of articles that may inspire land administration professionals.

▸ **http://bit.ly/2F75nHb**

Wingtra Drone Sets New Benchmark in Photogrammetry

With the launch of the WingtraOne post-processed kinematic (PPK) drone, the Swiss manufacturer of unmanned aerial vehicles (UAVs or 'drones') Wingtra aims to set a new benchmark in large-scale surveying and mapping applications. As the result of Wingtra's collaboration with its industry-leading partners – photogrammetry software provider Pix4D, and the GNSS board and PPK provider Septentrio – WingtraOne PPK is now able to deliver orthomosaic maps and 3D models with an absolute accuracy down to 1cm. With the latest upgrade, the WingtraOne PPK drone can offer something that has never been seen before in drone photogrammetry: broad coverage and high resolution with ultra-precise accuracy. According to Wingtra's CTO Armin Ambühl, the WingtraOne can cover 130ha (320ac), which is equivalent to 240 football fields, in a single one-hour flight and deliver maps at GSDs below 1cm/px with absolute accuracy down to 1cm.

How the Wingtra drone works.

▸ **http://bit.ly/2FfL39H**

CyArk Brings Accurate 3D Immersive Data to Life in Virtual Reality

The replicas can be explored using Oculus-compatible devices.

CyArk and FarBridge have partnered with Oculus to bring photorealistic and fully explorable replicas of some of the world's most amazing monuments in virtual reality. Launching for both Oculus Rift and Samsung Gear VR, MasterWorks transports users to four historic sites on three continents that span over 3,000 years of human history. Users can discover the fate of the ancient capital of Thailand, unravel the mysteries of a pre-Incan temple in the Peruvian Andes, explore the astonishing Native American cliff dwellings of Colorado, and get up close to the monumental stone carvings of Mount Rushmore in South Dakota. The experience provides users with access to sites in far-flung locations across the globe and to parts of these sites that are not open to the general public.

▸ **http://bit.ly/2oKutnZ**

Topcon Acquires ClearEdge3D

Topcon, a world leader in positioning instruments for survey and construction, through its American subsidiary, has acquired all the outstanding shares of ClearEdge3D, a recognised technology leader in the engineering and construction software industry. ClearEdge3D's EdgeWise software speeds as-built modelling workflows by utilising automated feature extraction algorithms and other patented technologies. Its Verity construction verification software compares laser scan point cloud data of recently completed construction work against design or fabrication models, flagging out-of-tolerance or poorly installed elements. Terms for the deal were not announced.

▸ **http://bit.ly/2CSitWR**

ClearEdge3D's EdgeWise software.

GEO Business Expands for 2018

GEO Business, the UK's largest geospatial exhibition and conference, has grown year on year since its inception and the 2018 show looks set to be the most successful event to date, with more exhibition space and a brand-new seminar programme. The event is returning to the Business Design Centre in London, UK, from 22-23 May 2018, and registration is now open. Since the record-breaking 2017 event, which welcomed 2,386 geomatics and geospatial professionals from around the world (a 48% increase since the launch in 2014), stands have been selling fast and for 2018 the exhibition has expanded onto the upper level for the first time. Exhibitors span the entire geospatial industry, showcasing cutting-edge technology and solutions set to mould the future of the industry.

▸ **http://bit.ly/2F9YKny**

The Profession of Surveying: A Changing One?

The surveying profession is in transition.

One noteworthy finding that can be distilled from the recent readers' survey held by *GIM International* is the changing nature of the surveying role. A surveyor's work is shifting away from 'boots on the ground', as increasing automation and the growing influence of robotics require surveyors to increasingly develop their 'soft skills' to survive; they are becoming mediators, advisors and consultants rather than 'just' operators of technology. To cite one of the respondents: "With the enabling technology from robotics and AI, strong standardisation, certification and quality assurance which leverage geomatics as a technology rather than an independent profession, geomatics might become an integral part of services and solutions while it is losing its base as an independent discipline."

▸ **http://bit.ly/2tb1b7G**

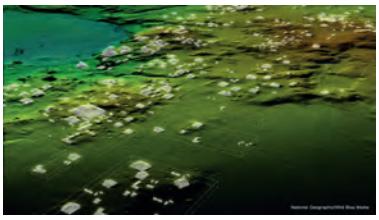
Leica Geosystems Launches Linear-mode Lidar System

Leica Geosystems, an industry leader in measurement technology, has announced the launch of TerrainMapper, its next-generation linear-mode Lidar system. As part of the RealTerrain airborne Lidar mapping solution, the new sensor builds on Leica Geosystems' sensor technology and is supported by the HxMap unified multi-sensor post-processing workflow. TerrainMapper enables users to increase point accuracy and deliver even point density across the swath, and accommodates more efficient flight planning in complex terrains such as those encountered in urban spaces and mountainous areas. The newest sensor increases both acquisition speed and processing productivity, providing efficiency and precision for any project.

Leica TerrainMapper.

▸ **http://bit.ly/2oEx8Azv**

Teledyne Optech Lidar Enables Discovery of Extensive Mayan Ruins



The Titan sensor contributed to a spectacular discovery.

Teledyne Optech's Titan sensor was used by the University of Houston's National Center for Airborne Laser Mapping (NCALM), USA, to reveal extensive Mayan ruins in Guatemala. Lidar technology was able to identify hundreds of previously unknown structures, including raised highways and complex irrigation and terracing systems. After the collapse of the Mayan civilisation, the cities and monuments were quickly covered by thick rainforest, hiding remains of the ancient civilisation from view of conventional airborne observation systems and making surveying on foot very difficult. Flying high above the rainforest, Titan's lasers penetrated the canopy to collect almost a million data points per second from the forest floor, giving archaeologists a 'bare earth' view of the structures underneath. Having rapidly covered 2,100km^2, Titan gathered data revealing extensive ruins concealed below the forest cover, showing that the Mayan urban centres were significantly larger than archaeologists had previously thought.

▸ **http://bit.ly/2CRW4Jg**

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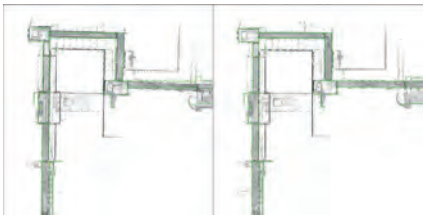
NavVis Launches New Solution for SLAM Precision



NavVis' SLAM technology.

NavVis, a global leader in mobile indoor mapping, visualisation and navigation, has announced new mapping software that significantly improves the accuracy of simultaneous localisation and mapping (SLAM) technology in indoor environments, such as long corridors. The software update will be available for users of the NavVis M3 Trolley and will significantly improve the accuracy of the resulting maps and point clouds. NavVis' mobile mapping system, the M3 Trolley, builds upon SLAM to increase speed and efficiency when scanning buildings. SLAM is a technique originally developed by the robotics industry that is now increasingly being used in surveying and autonomous driving technologies. SLAM solves a core problem that has long plagued robotics engineers by enabling a device to determine its location while simultaneously mapping an unknown environment. This is done by chaining millions of measurements into a trajectory estimate.

▸ **http://bit.ly/2oJ12mh**

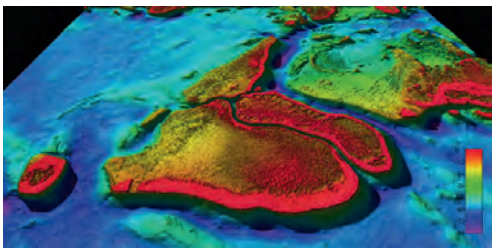
Trimble Releases New MX9 Mobile Mapping System

Trimble MX9.

Trimble has launched the Trimble MX9 mobile mapping solution. The Trimble MX9 combines a vehicle-mounted mobile Lidar system, multi-camera imaging and field software for efficient, precise and high-volume data capture for a broad range of mobile mapping applications such as road surveys, topographic mapping, 3D modelling and asset management. The Trimble MX9 captures dense point cloud data along with 360-degree immersive georeferenced imagery using an industry-leading spherical camera, GNSS/INS technology and dual-head laser scanning sensors. The system's innovative and lightweight design facilitates easy installation and setup on a variety of vehicles. Spatial data can be captured at highway speeds from inside the vehicle for safe operation in transportation corridors. The intuitive, browser-based field software, accessible via most tablets or any notebook, enables operators to quickly establish and conduct data acquisition missions, monitor the system status and assess the quality of the acquired data in real time.

▸ **http://bit.ly/2FdHNMb**

First High-resolution Map of the Great Barrier Reef Released



High-resolution map of the Great Barrier Reef.

1.5 million square kilometres of bathymetric seafloor data have been released to the public by Geoscience Australia under partnership with James Cook University and the Australian Hydrographic Service of the Great Barrier Reef. The project carried out high-resolution bathymetric scans, which were then combined with existing datasets held by the government to create the most comprehensive, detailed models produced to date. The release comes as the federal government announced an AUD60 million investment in protective measures for the Great Barrier Reef, which include measures to shield the reef from polluted water, and investment in the Australian Institute of Marine Science (AIMS) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to develop new ways for the reef to adapt and recover.

▸ **http://bit.ly/2F7NOBE**

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Precise Positioning: The Future of UAV Mapping

The geospatial industry has seen exponential growth in the adoption of unmanned aerial vehicle (UAV or 'drone') solutions in recent years, particularly in surveying and mapping applications. Photogrammetry has recovered from a decline during the analogue era and benefited massively from the light digital sensors on versatile UAVs, with innovative technologies and more integrated, customer-friendly solutions enabling photogrammetry to stay on the radar of industry professionals.

At the turn of the century, the survival of photogrammetry depended on its ability to adapt in the face of more innovative, competing technologies, such as airborne and terrestrial laser scanners (ALS and TLS) and other multi- and hyper-spectral sensors of remote sensing. This need was driven primarily by a growing demand for faster, more efficient and reactive data collection and imaging, with traditional photogrammetric methodologies like analogue cameras on manned aircrafts falling out of favour. This growth in demand has coincided with the rise of UAVs in the geospatial sector, which has played a significant role in changing the future direction of surveying.

Aside from serving as a more cost-effective alternative to manned aerial mapping systems, the precision and efficiency that drones provide has enabled them to become an essential surveying solution. Precise positioning is becoming the standard for UAVs, allowing highly detailed and highly accurate outputs in record time.

Indeed, advances in photogrammetric technologies have enabled this field to complement the rise of drones in the geospatial industry. For instance, there are now photogrammetric cameras that are lightweight and agile enough for use on drones during flights, e.g. the senseFly S.O.D.A. camera which produces detailed, vivid orthomosaics and highly precise digital surface models (DSMs). More complex and higher-quality camera sensors have also enabled a continuum, in terms of ground sampling distance (GSD) and angle of view, ranging from nadir to oblique to horizontal to zenith.

CONTINUED INNOVATION

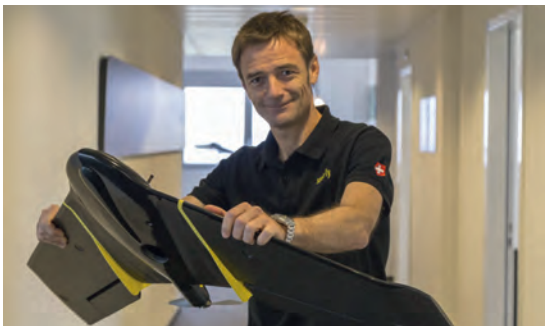
While developments have been crucial in enabling drones to thrive in the geospatial arena, further innovation is required to allow UAV surveying and mapping to continue its upward trajectory. Development of real-time processes is also expected to help streamline drone mapping techniques, further supporting faster image capture, processing and analysis.

With greater awareness of the benefits of drones in commercial applications, including agriculture, mining and humanitarian aid, it is vital that hardware providers continue to innovate. One way in which this can be achieved is through investment in strategic partnerships between hardware and software companies, to enable drones to become integrated, decision-making tools, able to inform project feasibility and operation. With ease of use being more important than ever, such partnerships will also facilitate greater interoperability and more holistic processes, supporting customers from data collection through to analysis and enabling smarter workflows.

MOVING FORWARD

As drone adoption becomes more widespread, safety is inevitably a key consideration for surveying and mapping professionals. Since the first European UTM Day in Geneva in 2017, global attention on unmanned traffic management (UTM) has increased significantly, with greater and safer access to airspace being an important focus for drone providers. At senseFly, we will be working with key stakeholders worldwide to ensure that UAVs are able to integrate more smoothly with manned air traffic, in line with drone regulations across the globe.

Today, the need for more integrated, dynamic UAV surveying and mapping methodologies is greater than ever, while traditional imaging techniques like photogrammetry are increasingly capable of meeting demands for faster, more precise and efficient data collection. Greater interoperability of processing and analysis software with UAV technology looks set to play a key role in ensuring that the geospatial field remains dynamic, while supporting more complete, end-to-end UAV solutions for industry professionals. ◀



ABOUT THE AUTHOR

Francois Gervaix is surveying product manager at senseFly, a provider of professional drone solutions, having joined the company in 2016. A qualified geomatics engineer, Francois has 20 years of experience in photogrammetry with key industry players like Wild/Leica, in academia and drone-based commercial services. He was also president of the Swiss Society of Photogrammetry and Remote Sensing for six years.

GIM INTERNATIONAL INTERVIEWS RON BISIO, TRIMBLE GEOSPATIAL

Taking Advantage of the **Changing Marketplace of Geomatics**

The changing landscape of the mapping and surveying profession brings new challenges, even for a renowned manufacturer of geospatial instruments like Trimble. In view of the growing role of BIM, the rising demand for complete workflow solutions and the challenge of extracting meaningful information out of the immense volumes of point clouds derived from Lidar data acquisition, it is clear that geomatics is in transition. *GIM International* touched base with Ron Bisio, vice president of Trimble Geospatial, to discuss how his company is approaching the new geospatial reality.

Data capture and analysis solutions are increasingly based on software that can also be used by generalists rather than geospatial specialists only. How are you responding to this evolution?

Innovation can fail if it doesn't clearly benefit workflow and take into account all stakeholders. Trimble is always thinking about getting the workflows right and developing solutions with more automation and data processing capabilities that can be easily adopted by customers of all kinds, including non-geospatial professionals. Geospatial software providers play a role in making sure the data is shareable through a cloud solution and uses automation to bring understanding to the desks and devices of the professional, who then delivers it to the customer. For instance, Trimble Clarity, a cloud-based solution, allows anyone to use, analyse and annotate imaging data without specialised software. We really want to make sure technology brings customers into their domain, not the opposite.

Now that software is increasingly bridging the gap between sensor-captured data and the answers organisations are looking for, does this mean that Trimble will focus more on software development and less on hardware development?

Because Trimble has a footprint in both hardware and software, we are uniquely positioned to facilitate the two-way exchange between the physical and digital worlds. We continue to develop hardware to meet market needs for advanced data collection and stakeout, but software is also a key element of most of our solutions. In fact, across Trimble, we have more software developers than hardware ones. Over time, we have redefined our technological focus from hardware-driven point solutions to fully-integrated work process solutions. We haven't lost our passion for hardware innovation, though. As evidenced by the Trimble SX10, our scanning total station that blends traditional point collection with laser scanning and image capture, we continue to focus on meaningful innovation in hardware and software.

Today's customers not only want new solutions, but they also want them in ever-shorter time spans. How do you keep pace with this trend?

We are moving from a phased approach to geospatial data towards more integrated, real-time collection and analysis of the data. With more processing power available in the field, it becomes easier to bring quality control to the data. The expectation of real-time data is growing, so we need sophisticated geospatial solutions that immediately process the data and do more for the user, without them even knowing it. The cloud gives us further power to process data, so data-intensive processes can be conducted in the background, while geospatial professionals can focus on high-value analysis. We anticipate an elevated role for artificial intelligence to extract and interpret information. We also imagine that Lidar data will eventually be extracted from autonomous vehicles to track maintenance of street lamps and road damage and to notify crews of the need for repairs before safety issues occur.

Providing solutions requires close communication with customers. How do you organise feedback to understand their needs and workflows?

To stay relevant, we need to work the way workforces work. We keep in close contact with customers with the goal of anticipating their needs and developing solutions that help them operate more efficiently, expand their offerings and grow their businesses. To understand our customer needs, we use a variety of touchpoints, including trusted customer input sessions and intensive beta cycles to help us refine our solutions to best fit the needs of a changing marketplace.

WE ARE MOVING FROM A PHASED APPROACH TO GEOSPATIAL DATA TOWARDS MORE INTEGRATED, REAL-TIME COLLECTION AND ANALYSIS OF THE DATA

The planning, design, construction and management of buildings is increasingly done through BIM. How do you keep up with this trend?

Building information management (BIM) is, of course, an information-centric process – not a process that begins and ends with the creation of a model. Position accuracy is of crucial importance over the entire construction process, whether that's placing anchor bolts or installing mechanical, electrical and plumbing systems. Survey experts can expand their business by mastering the positioning requirements of various models. But importantly, they can use BIM to understand the end game. The process of construction is increasingly driven by data, which is why our strategy is centred on the concept of 'constructible data'. Over the last several years, Trimble has assembled the most comprehensive set of solutions covering the entire lifecycle of a building project, from feasibility to design and engineering, through construction and ongoing operation. We see many opportunities to improve efficiency and productivity with more thorough utilisation of constructible BIM and a wide range of technologies for building projects.

GNSS technology is a major branch within the geospatial industry. Which major developments do you foresee in GNSS technology and services, and which implications will these developments have on the surveying profession?

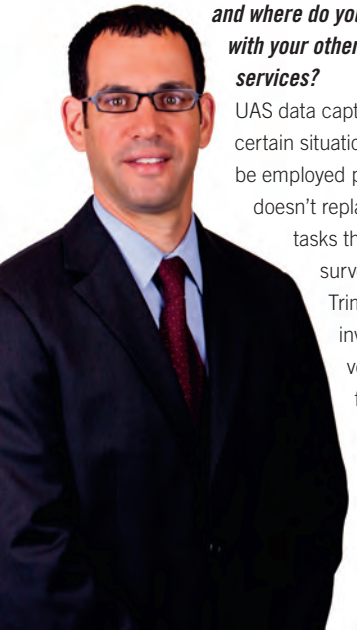
Professional surveying engineers want tools at their disposal that provide them with flexibility

and control so they can perform their work efficiently. For surveying engineers, we not only offer first-class equipment such as our integrated GNSS R10 system with the Trimble Access field software, but we also serve a broader market with solutions such as Trimble Catalyst, our software-defined GNSS receiver for Android devices. With Catalyst, positioning-as-a service provides a flexible option. Not only can you turn the service on only when it's needed, but a variety of service levels also allow users to choose the accuracy that makes the most sense for their application. We think GNSS is a resource that more people need to get their hands on, so we are trying to democratise it by making it easier for more people to use.

Smart cities and smart sensors are attracting considerable attention among policymakers and urban managers. How will these trends affect the geospatial industry?

A city is only as smart as the sum of its parts, so how well those parts work – and work together – is the key. Accurate geospatial data will remain a key element of smart city optimisation. Trimble views its role in smart cities as providing solutions that help build, monitor and measure city functions, whether intelligent transportation systems, smart water or other utilities. Our technology also helps cities understand what improvements are needed and how those improvements are working and making a difference in citizens' lives.

In the last decade, one major revolution has been the rapid rise of unmanned airborne systems (UASs). Which are your expectations about the UAS market worldwide and where do you see synergy with your other products and services?



UAS data capture is valid in certain situations, but it must be employed properly and doesn't replace traditional tasks that require a surveyor. Although Trimble isn't involved in the vehicle market for this sector, we've continued our focus in converting UAS data into reliable, trustworthy information for making business decisions. Primarily targeting the construction sector at this time, Trimble Stratus provides powerful tools for tracking progress against plans, calculating volumes and topographic studies. For geospatial professionals, the Trimble Inpho UASMaster photogrammetric workstation provides a complete photogrammetric workflow. We're also partnering with multiple UAS vehicle vendors to provide users with optimal workflows.

Mobile laser scanning has also advanced rapidly. A major bottleneck, from the user's side, is the extraction of meaningful information from the billions and trillions of points in reasonable time spans. Are you working on software to automate the extraction of objects from point clouds?

We see a future with mobile mapping solutions that merge multiple sensor types into unified data collection and analysis tools. Trimble's innovation will focus on collaborative environments such as Trimble Connect, which unifies data from different hardware and software solutions so multiple stakeholders can work together with disparate tools. Processing those massive datasets does require automation. For this, we continue to incorporate the concept of 'deep learning' into our software, such as eCognition which empowers customers with highly sophisticated pattern recognition and correlation tools. Deep learning employs artificial intelligence to teach the software to automatically identify objects of interest in a scene.

What is behind Trimble Geospatial's 11% revenue growth in Q4 2017?

Our geospatial business continues to benefit from new product introductions, including our recently launched mechanical station product line for emerging markets and continued strong demand for the SX10 scanning total station, as well as increased activity in end markets including oil and gas. We also experienced strong sales of our inertial-based technologies to automotive companies for development of their autonomous technology programmes.

Trimble is involved in many verticals, including agriculture. What kind of geospatial technologies do you expect to be involved in farming over the coming years?

We've seen widespread technological adoption in agriculture, and we anticipate continued growth in this area. Trimble is highly focused on vertical markets and has, for years, developed dedicated franchises to meet emerging market opportunities. In agriculture, we continue to develop 'connected farm' solutions to optimise operations across the agriculture workflow. Our agricultural customers also give us high marks for offering a full spectrum of support for our Trimble Ag Software.

What about the future of the land surveyor? What kind of young professionals is the geospatial business looking for?

The geospatial profession is changing and, not surprisingly, so too is the geospatial professional. Changes in the global workforce require new approaches for surveying organisations to stay nimble. Technology will be a key factor in business continuity. The introduction of younger workers requires improved standardisation and more intuitive workflows. Surveying businesses need to prepare for the shift from data provider to intelligence provider, and they need to migrate to current methods of data extraction and analysis to stay competitive. Luckily, this fits perfectly with the profile of the generation arriving into the workforce now.

Trimble is well known for its acquisition of successful start-ups. Do you have any such plans within Trimble's geospatial division?

Trimble is focused primarily on organic growth, but acquisitions serve to enhance our market position. When we acquire businesses, we do so to gain domain expertise, technology, products or distribution capabilities. The goal is to augment our portfolio and deepen our presence in existing markets or establish a new market. We find success with our acquisitions by effectively integrating them. ◂

ABOUT RON BISIO

Ron Bisio is vice president of Trimble Geospatial and has 25 years of experience in the geospatial technology industry. Bisio joined Trimble in 1996 and held several marketing, sales and general management positions prior to taking over worldwide responsibility for Trimble's Geospatial division. He holds a master of business administration from the University of Denver, a master of regional planning from the University of Massachusetts, and an undergraduate degree in geographic information systems & cartography from Salem State University in Salem, Massachusetts, USA.

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COMPREHENSIVE SURVEYING OF COASTAL TOPOGRAPHY

Monitoring Coastal Erosion with **UAV Lidar**

The French Mediterranean coast is a complex natural environment where geology, climate and the sea interact and continuously reshape the landscape. Coastal erosion and the availability of drinking water are two major coastal management issues that necessitate precise monitoring of the morphological changes to the shoreline. UAV Lidar is being used in this region to produce comprehensive topographic surveys with unprecedented productivity and level of detail, and several Lidar surveys are planned over the next two years. Read on for details of the context, technical setup and results of the very first survey which took place in January 2018.

In the relatively dense settlement around Perpignan, called the Roussillon Plain, agriculture's needs for irrigation combined with large volumes of tourists every summer put pressure on the reserves of drinking water. Meanwhile, seashore infrastructure and climatic changes impact the morphology of the coast, causing erosion that could result in salty seawater percolating into some of the groundwater reserves used for drinking water catchment (Pételet-Giraud, 2013). A regional consortium involving several private companies and public laboratories, led by the French Geological Survey (BRGM), has been set up to thoroughly investigate the availability and possible evolution of groundwater. The project, called DEM'EAUX, is also aimed at implementing and showcasing new survey technologies in this specific context. As a project partner, YellowScan is in charge of providing the oceanographers and geologists with Lidar surveys for the purpose of mapping and change monitoring and as input for sedimentation/erosion models. A pilot project area was selected at the mouth of the River Têt (Figure 1). The Têt has its source in the Pyrenees, and experiences very high flow fluctuations (Bourrin et al., 2008). As a consequence, its estuary experiences dramatic morphological changes, both seasonal and linked with extreme meteorological events such as flooding and storms.

▲ *Figure 1: Survey area: The Têt estuary landscape of the survey area.*

▲ *Figure 2: The UAV equipped with the Lidar system.*

TECHNICAL CHOICES

The BRGM already monitors sections of the shore using photogrammetry, but the benefits of additional Lidar surveying include:
(1) Lidar provides a more accurate digital terrain model (DTM) when vegetation is present, which is the case in some dune areas
(2) Lidar data can be processed faster than UAV photogrammetry and much higher productivity can be achieved, enabling scaling up to large parts of the coastline. The 900m study area can be surveyed by UAV Lidar within minutes
(3) Lidar is expected to produce better reliability than photogrammetry over weakly textured surfaces (although a thorough data comparison still has to be performed to confirm this).

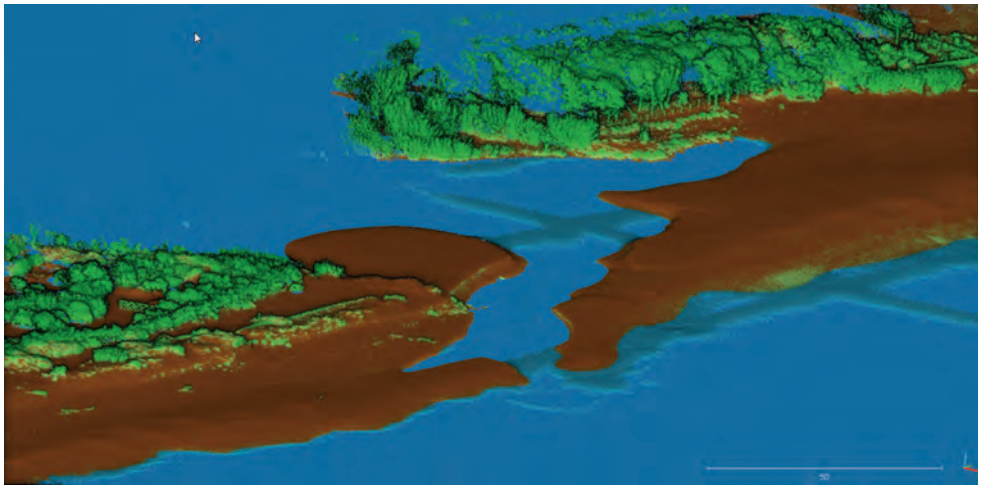
The instrument used for this survey was YellowScan's Surveyor Lidar system, which is based on the Velodyne VLP16 laser scanner. It was selected for its combination of high productivity (300,000 shots/second over a 360°x30° angular range) and fair accuracy and precision (typically better than 5cm when compared to independent measurements on flat hard surfaces). The flights were operated by L'Avion Jaune, an aerial and unmanned aerial vehicle (UAV or 'drone') survey company specialised in natural environment mapping and a sister company of YellowScan.

LIDAR DATA CAN BE PROCESSED FASTER THAN UAV PHOTOGRAMMETRY AND MUCH HIGHER PRODUCTIVITY CAN BE ACHIEVED

The drone used was the OnyxStar FoxC8 HD, a professional octorotor UAV which is part of L'Avion Jaune's fleet (Figure 2).

SURVEY AND DATA PRE-PROCESSING

The survey area encompasses a 900m-long section of the shoreline, from the sea to 100m inland. The survey was performed by Pierre Chaponnière, an application engineer at YellowScan, and John Plaetevoet, a UAV pilot at L'Avion Jaune. Two flights were performed at an altitude of 30m and a ground speed of 5m/s, resulting in a point cloud of 43 million points and a typical density of 400 points/m², which is more than needed for the purpose of erosion/sedimentation monitoring. The swath obtained at 30m height was in excess of 100m. Trajectography information recorded by the Applanix APX15 IMU included in the YellowScan Surveyor Lidar system was



▲ *Figure 3: The classified point cloud. Sea surface echoes are only present underneath the UAV track and in the swash zone. The remaining water surface has been coloured in plain blue.*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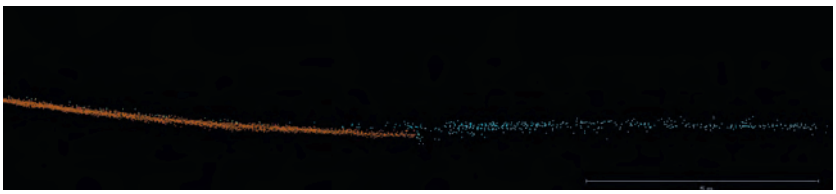
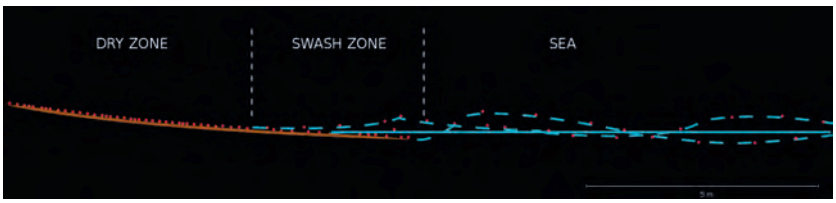


▲ *Figure 4: Vertical cross-section through the point cloud through the swash zone (50cm thick).*



▲ *Figure 5: Corresponding sketch showing the mean sea surface (blue line), the sea surface position at different instants (blue dashed line) and the Lidar measurement points (red dots).*

processed using the Trimble POSPAC In-Fusion single base software. The trajectory resulting from the PPK processing provides an estimated position accuracy of 2cm and an angular accuracy of 0.025° (roll/pitch) and 0.08° (heading). The YellowScan software was used to generate LAS files from post-processed trajectory and Lidar sensor data. Fine line matching and classification were performed with the TerraSolid modules TerraMatch and TerraScan.

POINT CLASSIFICATION AND QUALITY ASSESSMENT

Five classes were defined: ground, water, and three classes of vegetation/objects according to height. Separating land and sea echoes in the swash zone was a challenging task; due to breaking waves on the shore, the altitude of the water surface varies, covering and uncovering the beach. In some places, the instantaneous water surface is far above the mean water surface, so that a crude screening based on altitude is not suitable. In the point could, the waves are seen as patterns similar to low vegetation, and some manual reclassification was needed to extract all the information from the data. The transition from land to sea is characterised by two criteria (Figures 4 and 5): (1) the point density decreases in the water as many laser shots are reflected to other directions by the sea surface, and (2) the vertical thickness of the point cloud increases due to the vertical movement of the water surface with waves. In some cases it was possible to follow the terrain below the mean sea surface, when the ground was uncovered by a wave trough during the scan.

A land and bathymetric survey was also performed on the same day as the Lidar survey. The land survey data provided by Yann Balouin (BRGM) and measured using an RTK GNSS receiver was used for validation.

A straight comparison between the points collected during the land survey and the Lidar DTM displays an average error (bias) of 4.0 m and a standard deviation of 9.5cm in Z, which is significantly larger than the 2.5 to 5.0cm usually observed with the same device in tests on hard, well-defined surfaces like roads or concrete. The main reason for this relatively high figure has been identified as the specific sampling strategy of the land survey; it was focused on the land-sea interface, where ground point classification is the most difficult, as well as on the sharp break in the slope of the beach (visible in Figure 1), where interpolation from the point cloud to a DTM is expected to produce the worst results. In view of the fact that the soft sand on the beach is far from a hard reference surface – a mere footstep will create a 5cm indentation – the resulting accuracy can be considered as a good outcome in very demanding test conditions.

CONCLUSIONS AND NEXT STEPS

This first survey has confirmed the suitability of UAV Lidar for the purpose of comprehensively surveying the coastal topography in a context of morphological changes. The point density in this survey is actually excessive and can be reduced significantly without any loss of information. Today, the main limitations to productivity while surveying with UAV Lidar are the restrictions on UAV flights beyond line of sight. With the current setup and present regulations, a team can reasonably survey up to 10km of coastline per day in favourable conditions, outside urban or restricted areas. With a fixed-wing UAV and the relevant permits from the civil aviation authority, provided the safety of the flight and reliability of the UAV can be ensured, more than 100km would be technically achievable. YellowScan Lidar systems have already been tested successfully in several fixed-wing UAVs and will soon be implemented in operational surveys.

For the DEM'EAUX project, the surveying team is awaiting the day after the next winter storm to start a new survey and quantify the changes in the topography. This flexibility of mobilisation is one of the major benefits of UAV operations. A series of surveys over a two-year period are expected to bring new insights into the dynamics of the river estuary.

ACKNOWLEDGEMENTS

Thanks are due to the development team of the open-source software CloudCompare used for data visualisation and analysis in this project (www.cloudcompare.org). Project partners BRGM and CEFREM contributed valuable data and context information. YellowScan and L'Avion Jaune teams provided practical help and advice. This survey was conducted within the DEM'EAUX project, which is supported by the Région Occitanie-Pyrénées-Méditerranée and funded by the European Regional Development Fund. ◀

REFERENCES

Bourrin, F., Friend, P.L., Amos, C.L., Manca, E., Ulses, C., Palanques, A., Durrieu de Madron, X. and Thompson, C.E.L. (2008). Sediment dispersal from a typical Mediterranean flood: The Têt River, Gulf of Lions. *Continental Shelf Research*, 28(15): 1,895-1,910.

Pételet-Giraud E., Négrel Ph., Guerrot C., Aunay B., Dörfliger N. (2013): Origins and processes of salinization of a Plio-Quaternary coastal Mediterranean multilayer aquifer: the Roussillon Basin case study, Water Rock Interaction [WRI14], *Procedia Earth and Planetary Science* (7), 681-684.

ABOUT THE AUTHOR

Michel Assenbaum was educated as an engineer and holds a PhD in physical oceanography from Toulouse University, France. Alongside his role as president of YellowScan, he pursues research activities in the fields of remote sensing and Lidar surveying.
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CONNECTING CALIFORNIA'S MEGA-REGIONS

UAV Technology in Action to Survey High-speed Rail Corridor

In 2029, the US state of California will see the opening of the first high-speed rail system in the country. The project, commissioned by the California High-Speed Rail Authority, will connect San Francisco and the Los Angeles basin – the state's so-called 'mega-regions' – allowing customers travelling the route to reach their destination in under three hours with speeds exceeding 200 miles (322km) per hour.

Californian transportation engineering firm JL Paterson & Associates (JLP, now Jacobs Engineering Group) was enlisted by the authority in early 2015 to perform the engineering design work for the Los Angeles to Anaheim corridor. The challenge facing former vice president at JLP, Marc Cañas, and his colleagues, however, was that no surveying data existed for this route prior to the project's inception. This meant that, before work could commence, it was necessary to survey the entire area: a 30 mile (48km) long by 1,500 feet (457m) wide active railroad corridor, which sees up to 100 trains a day pass through it.

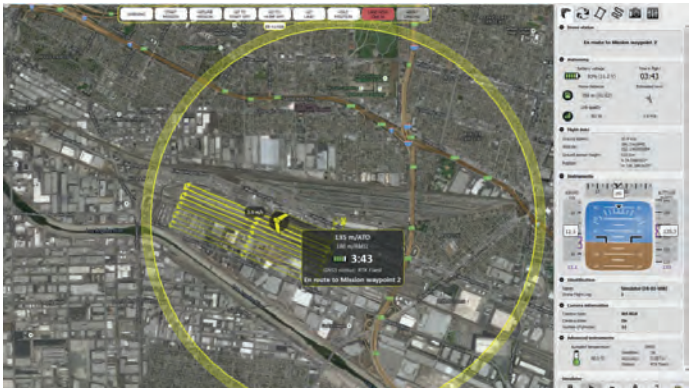
CHOOSING THE RIGHT TOOLS

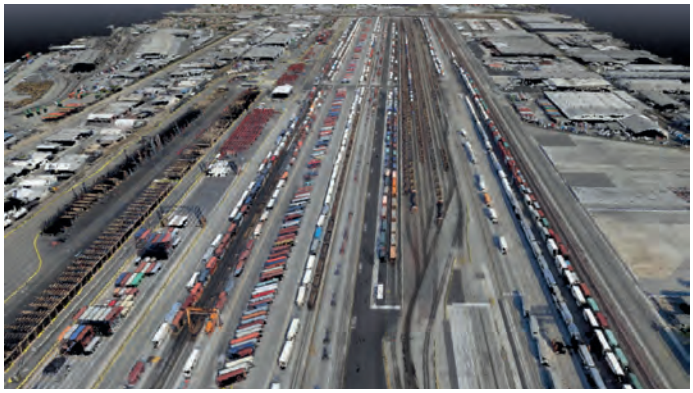
With a significant area to map and a tight timeline to work to, it was vital for the team at JLP to collect the data they needed accurately, quickly and with minimal disruption to the corridor's day-to-day operations. Traditional surveying options, such as aerial mapping via a manned flight and ground-based surveying, were considered in the early stages; however, these were not able to meet the stringent time or flexibility requirements. Ground-based surveying techniques required lengthy permits to access the site and would have experienced continuous disruption due to train traffic. Alternatively, while a manned aerial flight over the area would have avoided the necessity for disruption, it would have taken eight to ten weeks to collect and process the data. The team also required a more in-depth, three-dimensional data model to best inform project logistics and guide decision-making, leading them to conclude that unmanned aerial vehicle (UAV) technology would be the best solution.

Having previously used senseFly eBee drones on small-scale projects, Cañas and his colleagues opted to use the senseFly eBee RTK, a survey-grade mapping drone. Designed to capture both aerial photography and mapping data, the eBee RTK can create highly accurate 3D models in real time and was chosen for its professional, survey-grade quality and portability. Using this technology, the team could be on site and flying within a matter of minutes, without the need for complicated launching systems or disruption to rail processes and operations. The software's geofencing feature, available via the pre-installed eMotion software, was also an important factor in the decision, as it helps to enhance the safety of the vehicle during flight by enabling flight planning in advance.

OVERCOMING OBSTACLES

While familiar with drone technology, JLP's experience of UAV technology on a large scale for surveying was limited. In addition, stringent Federal Aviation Authority (FAA) regulations meant that, although JLP owned two eBee RTKs when the project was carried out, the team was only able to fly one aircraft at a time to collect data. The result of this was that, in the early stages of the project, a significant amount of trial and error was required to identify any factors





that might interfere with data collection and to enable the team to integrate the software as seamlessly as possible into workflow and operations.

Based on these trials, JLP then created a series of 1,500 foot (457m) by 5,200 foot (1,585m) flight polygon areas with overlapping areas of approximately 300 feet (91m), which formed the basis for ground control points (GCPs). While GCPs are not typically required with an RTK drone, the nature of the project environment meant that the RTK network was unreliable and ran the risk of dropping out in certain areas. As well as helping to refine the execution of their missions, the initial trials also showed that the chosen approach would fit JLP's corridor objective and optimise time out in the field.

The team at JLP also had to take into consideration the challenge posed by FAA regulations on maximum elevation levels, which specify that UAV flight elevation cannot exceed 400 feet (122m) above take-off altitude (ATO). To overcome this and obtain high-quality orthomosaic aerial imagery, JLP used the eMotion software to set a 3.6cm (1.4in) per pixel ground resolution. The eMotion program was also used to incorporate elevation data, which helped to ensure that all flights remained at the same altitude above the ground and provided consistent, reliable data.

Perhaps the biggest challenge of all for JLP, however, was that the area surrounding the Californian rail corridor was heavily urbanised, which meant that the team's initial ground planning did not always transfer well in practice. For instance, when identifying take-off and landing sites, what looked like a suitable location in the office was often, in reality, obstructed by overhead wires or street lights, or even by buildings that were not yet visible on the satellite imagery. It was, as a result, necessary to adapt to the environment, and the final GCPs were painted in the surrounding streets approximately two weeks before the commencement of the project.

MARC CAÑAS, FORMER VICE PRESIDENT OF NATIONAL FREIGHT RAIL AT JL PATERSON & ASSOCIATES (JLP, NOW JACOBS ENGINEERING GROUP):

"Since the completion of the California high-speed rail mapping project, JLP has put its senseFly eBee RTKs to work in a further 15 projects, including construction monitoring and engineering. These operations have hugely benefited from having access to large amounts of in-depth, accurate data in the early stages – in some instances helping to prove the financial viability of a project. It is clear that UAV technology has the potential to transform the way that surveying data is used and collected and can be an excellent tool to revolutionise the efficiency and effectiveness of business operations and workflow. While the project was a learning curve for myself and my team, our initial investment, both in terms of financial ROI and training time for our employees, has been worth it many times over."

ON THE RIGHT TRACK

With all 82 GCPs finalised, the team at JLP was able to pave the way for the beginning of the data collection process. To map the 30-mile corridor – an area of 61 square miles (158km2) – JLP deployed three of its staff to the site to fly a total of 41 flights. With an average flight time of 28 minutes and average flight altitude of 200 feet (61m), 11,800 images were captured. These were downloaded and processed in a matter of hours by three other members of the JLP team using Pix4Dmapper Pro software – all in the comfort of the JLP office.

By using the senseFly eBee RTK, JLP was able to pull together highly accurate, professional-quality surveying data of the Los Angeles to Anaheim corridor of the California high-speed railroad in less than one month – a job that would have taken more than 18 weeks with traditional surveying techniques and cost twice as much if using a manned aircraft. The team collected ortho-rectified images at 1.5 inches (3.8cm) per pixel – twice the resolution of even the best manned aerial product – and was able to achieve accuracy of one to two inches (2.5 to 5cm) for both vertical and horizontal.

RAPID 3D MAPPING OF MOUNT ERCIYES, CENTRAL TURKEY

UAS Photogrammetry for **Mapping Mountains**

High mountains are attractive places for outdoor sports. However, sometimes they change from recreational areas into hazardous ones. All year round, falling rocks and landslides endanger hikers and mountaineers and may cause casualties. To avoid mountaineers setting foot on tracks that are prone to landslides or where they may get crushed by rockfalls, high-quality maps of recent data are needed. In this article, the authors show that unmanned airborne systems have great potential for rapidly mapping mountainous areas.

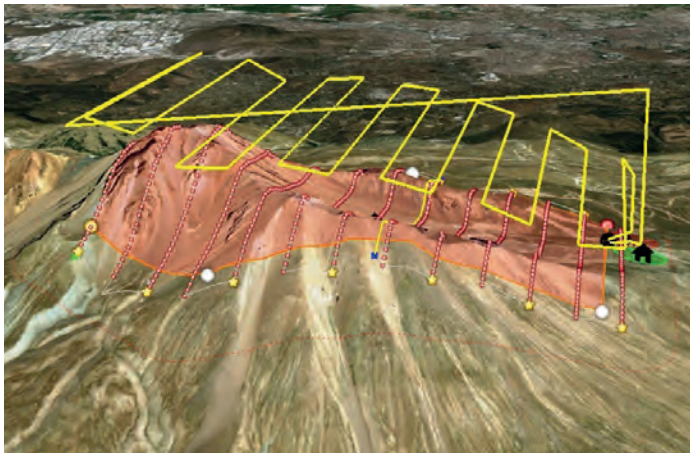
Hikers and mountaineers following mountain tracks may get injured by falling rocks or shifting slopes, and first responders may subsequently become victims when attempting to rescue them. To reduce risks, information on the condition of the tracks is crucial, especially in the shape of high-quality 3D maps of recent data. Several techniques can be exploited to carry out 3D mapping of mountains on a regular basis. Conducting field surveys is one such approach. Field surveys are reliable but time consuming, costly and – when the terrain is inaccessible, such as in areas with extreme variations in altitude – difficult to execute. Satellite images and manned aerial photogrammetry do not require access on foot, but the spatial resolution of the images is often too low while the acquisition costs are usually high. This raises the question of the suitability of unmanned airborne systems (UASs) as an alternative for mapping inaccessible mountains. A pilot study executed in Central Turkey demonstrates that UASs are able to rapidly produce high-resolution digital surface models (DSMs) and orthoimages of steep-sloped mountains.

TO TEST THE EFFICIENCY UNDER HEAVY TIME CONSTRAINTS, THE AREA HAD TO BE CAPTURED WITHIN ONE FLIGHT ONLY

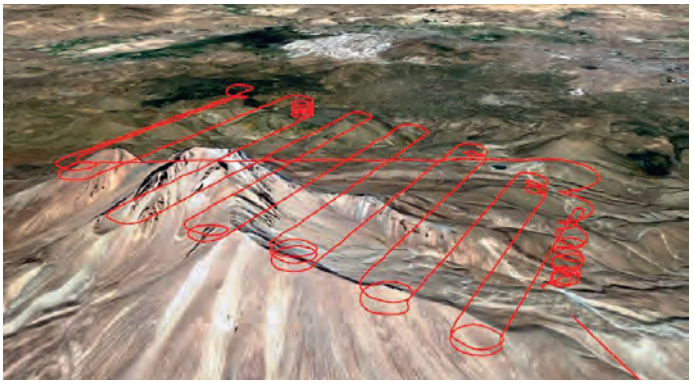
MOUNT ERCIYES

The survey aimed to create a DSM and an orthoimage of Mount Erciyes located in Central Turkey, 15km south of Kayseri. At the foot of the mountain, at a height of 2,150 metres, is a winter sports resort. At its peak, the summit of Mount Erciyes is 3,917 metres above sea level. The survey team was accompanied by a professional mountaineer and Prof Dr Erkan Beşdok, head of the Geomatics Engineering department of Erciyes University. After inspecting the map, Çoban Ini, a camp area located at the north east of the summit at a height of 2,858 metres (Figure 1), was chosen as a suitable launch and landing site for the UAS. Built by the

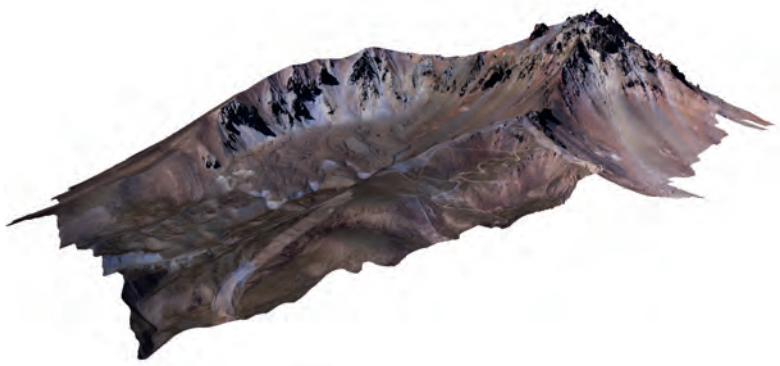
▲ *Figure 1: Çoban Ini, the base station for the survey.*



▲ *Figure 2: UAS mission plan for Mount Erciyes.*



▲ *Figure 3: UAS flight trajectory.*



▲ *Figure 4: Mission results.*

Turkish firm ATLAS Unmanned Systems, the fixed-wing aircraft has a span width of 1.2m and a weight of 2.3kg, and it can stay in the air for 70 minutes.

CONSTRAINTS

To demonstrate the feasibility of the use of a UAS for mountain mapping, several constraints were set for the aerial survey. To test the efficiency of UAS technology under heavy time constraints, the area had to be captured within one flight only. Repeated launching and landing would take up too much time if a casualty had occurred and a rescue team were preparing for their life-saving operations under critical time constraints. The launch site was also selected because of time constraints; the winter sports resort is just a 30-minute car ride from the launch site.

The region has very steep slopes and the height ranges from 2,858m at the launch site to 3,917m at the peak of Mount Erciyes. The flying altitude of the UAS varied from 3,337m to 4,231m. To obtain a constant ground sampling distance (GSD) of 7cm, the flight trajectory was defined in 3D enabling the aircraft to maintain a fixed height above the ground. After launch, the UAS first climbed to the peak height of the survey and then descended gradually. The flight time was nearly 50 minutes, the average speed was 88km/h and the distance flown was 64.5km.

SURVEY AND PRODUCTS

The survey was conducted in mid-September 2017. The UAS was fitted with a Sony a6000 camera. Equipped with a Sony E 20mm f/2.8 lens, the image size of the camera is 23.50 x 15.60mm and its effective resolution is 6,000 x 4,000 pixels. To obtain the GSD of 7cm, the average flying height was set to 350 metres. 13 north-south parallel lines with a mean length of 3km were flown, with along-track and across-track overlaps of 80% and 30%, respectively. Capturing images at predefined positions instead of using time intervals guarantees the minimum number of images when there is a headwind or aft wind, and also reduces the processing time. The images were therefore taken at coordinates which were determined by the ATLAS Mission Planner (Figure 2). Figure 3 shows the trajectory. The area covered was approximately 1,359 hectares, resulting in 569 images. The images tagged with exterior orientation parameters, consisting of the three angles defining image plane pose and the 3D position of the projection centre during exposure, were processed with Pix4DMapper software running on a PC with an Intel i5 processor and 12GB RAM. The software generated a DSM and orthoimage (Figure 4). This 3D mapping exercise was executed within 24 hours including travel times, flight planning, carrying out the flight and creation of the DSM/orthoimage.

THE FLIGHT TRAJECTORY WAS DEFINED IN 3D ENABLING THE AIRCRAFT TO MAINTAIN A FIXED HEIGHT ABOVE THE GROUND

CONCLUDING REMARKS

This pilot project has shown that UAS photogrammetry is a feasible alternative for high-altitude mapping with the advantages of low cost, short mission time, high resolution and flexibility. The low cost and modest time requirements for surveying and processing pave the way for regular UAS surveys of high-altitude areas. Such UAS surveys make it possible to track the surface changes and to keep the 3D maps of the region up to date, which is important for hikers and mountaineers as well as for first responders in case of a rescue mission. The UAS used in this pilot can also be deployed to survey snowfall/glaciers to track climate change, and to make inventories of avalanches, landslides and debris flows. ◀

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VENTURING INTO DISASTER ZONES

Proving the Rescue Potential of **Multi-sensor UAVs**

When disaster strikes, the courage and experience of rescue task forces is put to the test. They face heading into the unknown every time they enter a terrain during a rescue mission. Efforts to implement the latest technological tools, such as UAVs, to support their work are aimed at providing safer working conditions for rescue teams and speeding up search activities to improve the efficiency of the entire rescue mission.

Specially equipped unmanned aerial vehicles (UAVs or 'drones') have in the past been proposed for firefighting, for search missions, for delivery of rescue kits, and many other impressive tasks. UAV reconnaissance is considered a very powerful way of overcoming the potentially dangerous lack of information in affected areas. There are high expectations of the use of drones for this type of work, and for obvious reasons: they can go where it would be too hazardous or even impossible for manned aircraft to go. This is one of the major arguments for UAV utilisation.

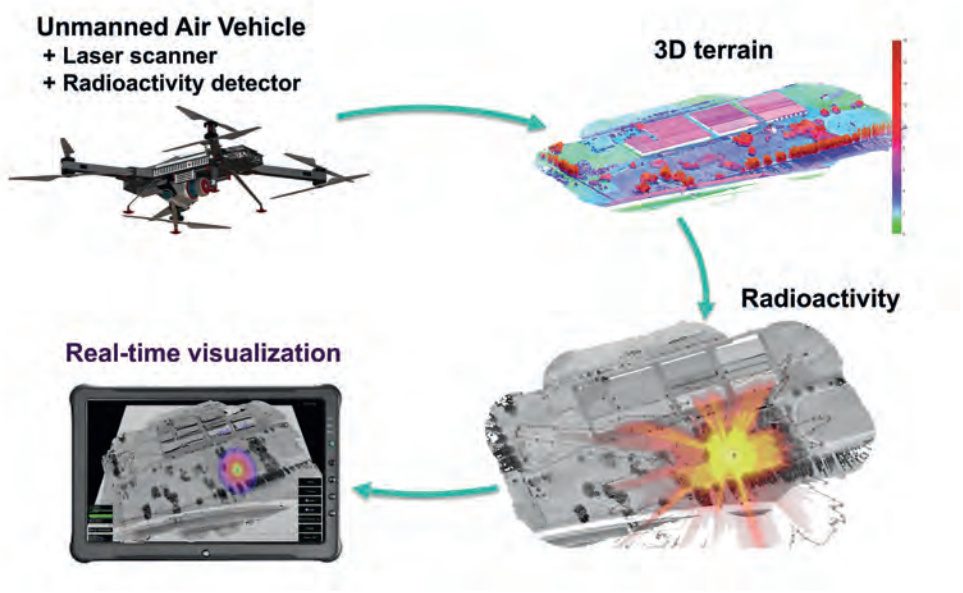
SIMULATION OF A CONTAMINATED LANDSCAPE

An experiment was carried out within the framework of the Austrian research project called 'SecuRescue'. The following emergency scenario was imagined for a test setup: a disaster, caused by natural forces or technical failure, hits an urbanised and partly industrial area. The immediate effect is complete destruction of the topographic array caused by collapsed buildings, making existing maps useless. The test focused on how to provide essential access information to first responders as quickly as possible, and ideally in real time. Furthermore, sources of hazard – which could include things like contamination by toxic gas leakage, risk of fire or explosion – were to be identified. In this test scenario, nuclear radiation was the simulated danger.

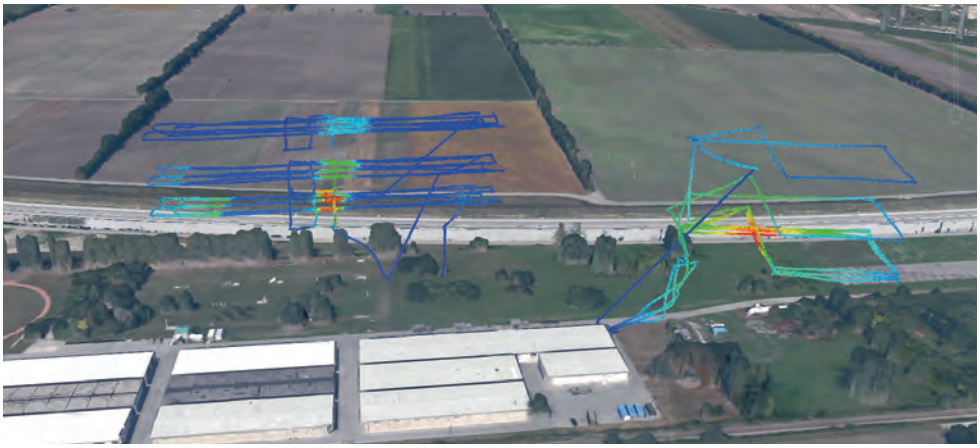
The scenario included as many factors as possible in order to adequately reflect the complexity of such a situation. Emergency forces are familiar with such scenarios, in which everything can be expected and nothing can be ruled out. Creating a scenario such as this also helped to explain in an experimental way which technical solutions might be proposed to confront it: what kind of information is crucial, how it is to be obtained and communicated to the rescue team, and how a UAV can be safely employed in these conditions. Performance criteria and methodological considerations had to be taken into account when choosing the sensor system configuration, as well as the UAV that served as the carrier platform.

LIDAR FOR RELIABILITY AND PRECISION

The RIEGL VUX-1UAV Lidar system was used for acquiring the precisely updated topographic information. The VUX-1UAV is



▲ *Figure 1: Concept of the 'SecuRescue' Austrian research project.*



▲ *Figure 2: UAV trajectory coloured by radiation intensity.*

a survey-grade laser scanner with a rotating mirror, a 330° field of view and a rate of up to 500,000 measurements per second. It is a very lightweight and compact laser scanner, meeting the challenges of UAV survey requirements in terms of both measurement performance and system integration. In normal circumstances, the measurement data of the VUX-1UAV is stored on an internal SSD drive and processed offline after data acquisition. With the associated post-processing toolchain, a measurement accuracy of 10mm is achieved.

According to Dr Martin Pfennigbauer, CTO and director of research at RIEGL, the specific challenge of the application lies in the fact that information is conventionally accessed and analysed from Lidar data during post-processing. However, time is of the essence in rescue missions; first responders need immediate information in order to safely access the terrain. So while reliable and precise data acquisition is well within the proven capacity of state-of-the-art Lidar surveying, it is tricky to select from the enormous amount of data only that part of the information which would be relevant for orientation and localisation purposes and to subsequently transmit it in real time.

GNSS FOR REAL-TIME PROCESSING

Therefore, the real-time data processing approach relied on a completely different processing method. Raw laser scanning data was immediately processed and fused with the real-time trajectory generated by the GNSS/IMU system. The GNSS system had no access to any kind of correction signal, resulting in an absolute height error of up to 2m. The described approach achieved a net rate of 50,000 acquired and real-time-processed measurements per second, requiring a bandwidth of roughly 10Mbit/s for the radio communication link to the ground station.

GAMMA RADIATION SENSOR

A gamma radiation sensor was used to analyse the potential nuclear contamination. The weight of the commercially available gamma radiation probe was significantly reduced by using a customised lightweight housing with a volume of 420ml. Radiation measurement is based on a plastic scintillator with a photomultiplier attached. Gamma and beta radiation hitting the crystal is displayed as pulses, which are detected and converted to counts per seconds (CPS) by an internal processor. The high voltage needed for this measurement principle is created within the gamma radiation probe in a specially shielded housing. The current CPS is continuously provided every 250ms over a serial communication port. This measurement rate enables high-resolution acquisition of the local radiation pattern. In the test scenario, the same flight pattern was executed at different heights to support a precise localisation of the

▲ *Figure 3: In-flight testing of transponder integration at local airfield during operation hours.*

▲ *Figure 4: RiCOPTER-M with call sign 'OE-VUX' is visible on onboard instruments and flight radar web page.*

gamma radiation source, in this case caesium and cobalt radiation sources.

The complete sensor payload consisting of the laser scanning system and radiation sensor was integrated on the RIEGL RiCOPTER-M, a 35kg electrical octocopter with 10kg maximum sensor payload. The high-performance UAV (flight time of up to 30 minutes with full payload) has been especially designed for operation in particularly sensitive areas. It can optionally be equipped with LED projectors for night-time search missions, as well as an infrared camera or other sensors. For the present test setup, flights were carried out in daylight and under fair meteorological conditions.

HELPING WITHOUT HINDERING

As the RiCOPTER-M must be safely operable even above populated areas, it is resilient to all main signal failures. To achieve this, two completely independent flight controllers with separate power supply and dedicated sensory hardware (i.e. GNSS, gyroscope, accelerometer and compass) are integrated. The sophisticated design permits operation with the utmost reliability. Nevertheless, while expectations for UAV use in disaster management are high, there is still some concern that they could present a disturbance – if not a threat – to rescue teams, especially with regards to how to coordinate them with manned search & rescue helicopters.

For this reason the RiCOPTER-M was operated with an ADS-B/Mode S transponder from Sagetech, in coordination with air traffic management. The integration of this transponder on the UAV presented certain challenges; it had to be thoroughly tested to rule out any interference between the transponder and the UAV remote control, onboard electronics and sensor payload. This could be attained by installing the transponder antenna at a sufficient distance from the UAV electronics and antennas. Besides these precautions, the design and material of the UAV may influence the necessity for adapting the installation. In the case of the RiCOPTER-M, carbon fibre for the aircraft fuselage and aluminium for electronics housings has proven a favourable material combination in supporting interference-free integration. The resulting emission range achieved by this setup is 30km.

Airspace rules clearly dictate that manned aircraft take priority at all times, so a UAV's flight path has to be chosen accordingly. In addition to receiving priority in the air, it could be reassuring for pilots to have any UAV in their vicinity clearly displayed on their screen and to also have the possibility to rely on Air Traffic Management warnings or separation.

NEXT STEPS

This test focused not only the results but also on the overall workflow. The potential of the information contained in the acquired data is undisputable, but there is always room for improvement. Just some of the ideas for the follow-up test are to include additional sensors on the multi-sensor-platform to achieve even more information output at a time, and to enhance quality of the trajectory by upstreaming GNSS real-time correction data over a wireless data link. Concerning the UAV carrier, expanding operational limitations towards conditions that might easily be expected for 'after-the-storm' areas, e.g. fire, smoke or dust, will require further testing. Of course, an authorised, appropriate test field must be available to fly in such conditions. These and future tests will further prove the potential and usefulness of UAVs for disaster management and rescue task forces. ◀

ABOUT THE AUTHORS

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THE IMPORTANCE OF WORKING WITH THE RIGHT EQUIPMENT

Five Challenges When Selecting Drones for Mapping

Every mapping project is unique; even within the same industry, each project will have its own distinct challenges. Selecting the right equipment is therefore key to getting the job done. Unmanned aerial vehicles (UAVs or 'drones') have emerged as a solution for many mapping and surveying projects. This article elaborates on five important challenges that should be considered when finding out which type of drone is the best fit. Examples are given to illustrate how these five challenges could play out in practice based on a recent project aimed at mapping Silhouette Island in the Seychelles.

Silhouette Island is the third-largest island in the Seychelles, located in the Indian Ocean. The interior region of Silhouette is a national park, with a biodiversity that is one of the richest in the entire Indian Ocean. It is also home to several critically endangered plants and animals. In order to keep track of the different species on the island and gain insights into the unique ecosystem, an up-to-date map is an essential tool. However, the most recent map of the island was made by a manned flight back in the 1970s.

The island covers more than 2,100ha and is known for its rough terrain with scenic yet dramatic mountain peaks, five of which are above 500m (1,640ft) in elevation. At 751m (2,464ft) Mont Dauban has the highest peak, and there are only a handful of days a year on which it can be mapped because it is almost always covered in clouds; the constant wind blows hot and humid air from sea level to the peak, cooling down the air and causing the water to condense. The level of detail of satellite imagery is insufficient, and aircraft fitted with high-resolution surveying equipment are often too expensive to operate in such remote locations, which explains why the most recent map is almost half a century old. In order to create an up-to-date map, TFC International selected the Dutch hybrid drone Marlyn that was able to meet all the challenges mentioned in this article.

THREE TYPES OF UAVS

Traditionally, a UAV could be one of two categories: the multicopter or the fixed wing.

▲ *One of the three possible take-off and landing locations on Silhouette Island.*

Nowadays, a new type has become available: the hybrid drone. The multicopter has flight characteristics that are best compared to a helicopter and often has four or more rotors. Fixed-wing drones have comparable characteristics to conventional aeroplanes, and can fly fast and long. Finally, the hybrid drone is a cross-over between a multicopter and a fixed wing, having the vertical take-off and landing capabilities of helicopters and the efficient cruising of conventional aeroplanes. However, only correctly engineered and designed hybrids offer good performance, stability and safety during all phases of flight.

CHALLENGE 1: TAKE-OFF AND LANDING

To start, it is necessary to find a suitable location from which to launch and recover the drone. Since multicopters and hybrids can take off like helicopters, they only need a small location for this manoeuvre, making them very flexible to deploy. When using fixed-wing drones, finding a suitable location can prove challenging since they need a large, flat, open space to land – and even then, their 'belly landings' regularly result in damage to the airframe. If the project does not have large, open, grassy fields, the drone will need to be capable of taking off and landing vertically, i.e. a multicopter or hybrid drone should be used.

In the Seychelles project, most parts of the island that are flat enough to deploy a UAV are covered with trees; even the relatively small beaches have overhanging palm trees. As a result, only three small take-off locations of approximately 20x20m (65x65ft) were found, and it was essential to perform pinpoint take-offs and landings.

FIXED-WING AND HYBRID DRONES CAN FLY FASTER, LONGER AND WITH A SUPERIOR RANGE, MAKING THEM EFFICIENT AND EFFECTIVE IN ANY MAPPING PROJECT

CHALLENGE 2: SIZE AND LAYOUT OF THE AREA

The second thing to consider is the area that needs to be mapped. The size of the area has a direct correlation with the time it takes to cover the area and therefore with the operational costs. The rotating propellers of multicopters consume a lot of energy to stay airborne, which is why multicopters intrinsically have a short endurance and are therefore only effective for very small mapping projects. In contrast, fixed-wing and hybrid drones use the aerodynamic shape of their wings to stay airborne. This enables them to fly faster, longer and with a superior range, making them efficient and effective in any mapping project, large or small. In general, drones with wings can map up to ten times faster than multicopters or helicopters.

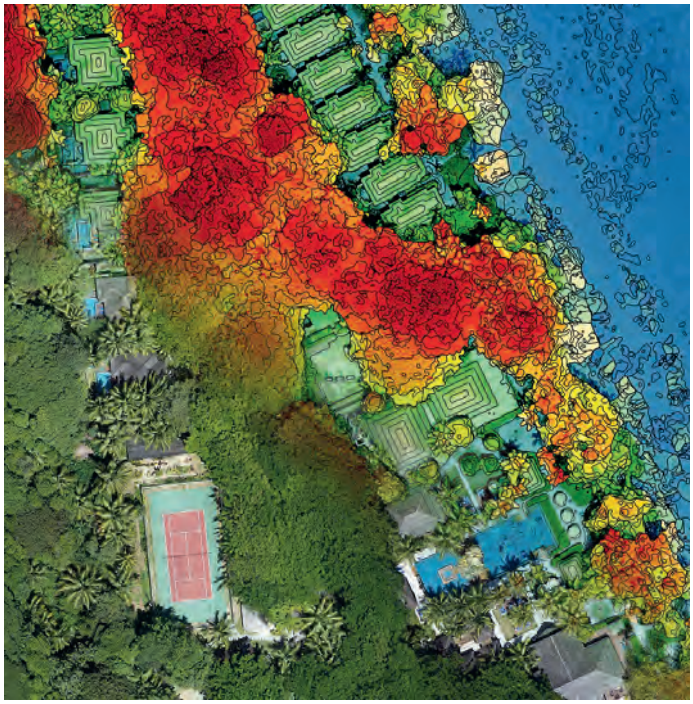
In the case of Silhouette Island, multicopters would not even have been able to map the island from the three possible take-off locations due their limited range and the mountain peaks present. If the project entails mapping a large area or overcoming high mountain tops, a fixed-wing or hybrid drone would be the best option.

CHALLENGE 3: ACCESSIBILITY OF THE PROJECT AREA

A large number of projects have partially or totally inaccessible areas, perhaps due to heavy and dangerous machinery on location, unstable/swampy ground or impenetrable regions such as on the vegetation-rich Silhouette Island. For these kinds of projects, it is a challenge to guarantee a high relative and absolute accuracy, since it will also be impossible to use ground control points (GCPs) in such locations. The solution to this problem is to use a drone that is equipped with a post-processed kinematic (PPK) module. Similar to real-time kinematics (RTK), this module generates geotags of the photos at a far higher precision. The increased accuracy of the geotags also significantly increases the accuracy of the resulting model so that few, if any, ground control points need to be measured for the entire project.

▲ *Marlyn UAV takes off at Silhouette Island.*

▲ *Orthophoto generated from data captured by the Marlyn drone during a mapping mission on Silhouette Island.*



▲ *Digital surface model (DSM) as an overlay on the orthophoto of Silhouette Island.*

The vegetation and steep slopes present on Silhouette Island mean that it is impossible to cover the whole island on foot, so laying out GCPs is not feasible. A drone equipped with a PPK module was crucial for this project.

CHALLENGE 4: TRANSPORTING THE MAPPING EQUIPMENT TO THE LOCATION

To maximise its full potential as a mapping tool a UAV must be used as frequently as possible for different or recurring projects, and hence moving the drone from one location to another should be as easy as possible. Depending on the project, this could mean that the system must be suitable for shipping as air freight, fit easily in a small car and be easy to carry around in the field. The best option is to use a hard transport case that can withstand air freight and which is also engineered to fit in a small car. A system such as a backpack can be used for on-site portability.

For the Seychelles project, the system needed to be transported in a small car and carried around on the beach and through the jungle on Silhouette Island. A backpack was used in order to achieve a high degree of freedom to move the system around.

CHALLENGE 5: WIND RESISTANCE

To achieve on-time delivery of a project it must be possible to deploy the drone as much as possible, and wind resistance is the most important influencer of drone deployability. A system with a higher wind resistance can be deployed more frequently, increasing the ability to finish the project on time. Multicopters have good wind resistance when taking off, because their four propellers ensure a steady take-off and landing in windy conditions. However, the low cruising speed of multicopters is a deal-breaker, since flying into the wind detracts from performance and reduces their endurance even further. UAVs with built-in wings have higher cruising speeds, enabling them to fly against the wind. Note that traditional fixed-wing drones have to launch and land into the wind, which can lead to problems when there are obstacles in that direction. The solution is a hybrid drone with high wind resistance throughout the entire flight, from take-off, during cruising and during landing. Hybrid drones with at least four propellers have high wind resistance and stability during take-off and landing, just like multicopters, and, due to their built-in wings and high cruising speed, they also have high wind resistance during cruising.

On Silhouette Island there is a constant wind and there are obstacles all around the take-off and landing location. The only way to successfully complete the project was to deploy a hybrid drone with high wind resistance during all phases of the flight.

HYBRID DRONES WITH AT LEAST FOUR PROPELLERS HAVE HIGH WIND RESISTANCE AND STABILITY DURING TAKE-OFF AND LANDING, JUST LIKE MULTICOPTERS

CONCLUSION

If you have a challenging project or are planning to use drones in the near future, be sure to consider which type of drone is the best fit for your situation. ◀

ABOUT THE AUTHOR

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HOW GEOMATICS SMOOTHS OUT INEFFICIENCIES

Resurfacing Roads or Runways

One of the runways needed to be resurfaced at Frankfurt Airport in Germany. For an airport, that means serious disruption on many fronts. Frankfurt Airport was therefore interested in cooperating with Topcon to develop a system that would speed up the whole process. The resulting surveying and machine control solution automates most of the data collection, data feeds and measurements – including the as-built data – involved in resurfacing projects. The technology substantially reduces the downtime involved in road or runway renovation activities.

▲ *Automated variable-depth milling allows for mill-to-fill optimisation and a smooth surface for the paver to follow. The project at Frankfurt Airport required six milling machines and the associated material-moving trucks to work in parallel.*

▲ *With a 14cm milling depth, it was essential that 3D machine control was carried out.*

The world population is expected to rise from 7.5 billion today to 9.7 billion by 2050. In view of this population increase and the exponential growth in the number of vehicles, as well as a lack of historic investment in existing and new road networks, there are significant reasons to improve infrastructure across the globe. Therefore, the infrastructure construction industry is under pressure to find innovative, cost-effective ways of working, to limit the amount of time roads are closed, to improve safety for road workers and to make road networks more efficient. Resurfacing is an effective solution for maintaining existing roads, but traditional methods can be both expensive and time-consuming. All of the above considerations hold true for airport runways too: the more passengers and freight an airport handles, the more intensively its runways are used and the more maintenance is needed.

One of the biggest time drains on projects is that roads or runways have to be closed for surveys to be carried out. Current data collection methods involve a surveying team measuring a point around every 15 metres, which does not produce a high data density. Additionally, having such a low point density makes it difficult to smooth out the cross slope and main axis slope. Technology to support automation of mass data collection is key to speeding up these processes, which is why Frankfurt Airport and Topcon teamed up for the renovation of Runway West.

AUTOMATED SURFACING

Just as with roads, in the case of airport runways it is essential that renovation work can be completed quickly and efficiently, causing as little air traffic disruption as possible. As Europe's third largest airport, Frankfurt Airport manages over 60 million passengers per year, 50% of which depart from Runway West which was in need of resurfacing. With the airstrip being in such high demand, closing it for maintenance presented an operational challenge. Any work therefore needed to be carried out quickly, without errors. Moreover, due to the high level of on-site security, every person, every truck and all materials had to go through 'customs' each time they entered or left the job site.

THE RESURFACING WORK CAN START ON THE SAME DAY THAT THE MOBILE MAPPING SCANS ARE PERFORMED

The project required six milling machines and the associated material-moving trucks to work in parallel at the same time on different parts of the project. This created high traffic on the site and made it impossible to manage machine control via optical instruments. Additionally, the project had to be carried out in just 120 hours; this limited time window would not allow time to set up and move the optical instruments according to the progress of the milling workflow.

AT EVERY POSITION, THE MACHINE CONTROLS WITH MILLIMETRE ACCURACY

With all this in mind, Frankfurt Airport and Topcon developed a system called SmoothRide, encompassing seven steps: surface scanning, planning of new design, milling, control scan of surface changes, paving, compaction, and control scan of the as-built situation. The first stage involves mobile mapping using vehicles that scan at speeds of up to 80km/h, delivering an accurate depiction of the entire runway surface at normal highway speeds. Data is collected every 20cm in the initial survey and therefore provides high-density, accurate data. This process ensures all imperfections in the old runway surface are recorded. The data is utilised in the paving and compacting process to vary the levels of the asphalt required in order to create an evenly flat surface. Control at the project site enables the results to be implemented in real time, meaning that the paving and/or milling can be carried out on the same day that the scans are performed.

UTILISING THE SAME JOB FILES

The next step is to create a design that meets the necessary specifications. Topcon's Magnet Office software enables the millions of data points to be managed and optimised. Following this, a transfer is carried out into the 'Resurfacing' module, which has features to meet the smoothness and cross slope

requirements while adhering to any minimum or maximum thickness specified for the project. The design is then sent directly to the machines.

While traditional surveying methods use 2D machine control, the SmoothRide solution is equipped with 3D machine control. The milling machine's position is determined by GPS and the height difference for milling is measured by sonic sensors and internal machine sensors. This means that the machine controls the milling depth at every position with millimetre accuracy. Furthermore, automated variable depth milling enables milling to be carried out to precisely the specified depth, allowing for mill-to-fill optimisation and a smooth surface for the paver to follow. By managing material usage, a uniform thickness of paving is achieved, improving accuracy and allowing the job to be completed in one go, thus saving time and reducing cost overrun. With a 14cm milling depth at Frankfurt Airport, it was essential that 3D machine control was carried out. The 3D model allowed accurate measurements to be transferred to a screen in the cabs of the milling machines as guidance for drivers about the exact amount of material to remove. Providing drivers with this level of detail removed the potential for human error and helped to ensure a smooth surface.

After the paver has spread out the asphalt, the compactor compacts the final layer. This is important to optimise the quality and lifetime of the final surface. Utilisation of the same job files generated by the milling and paving machines means that operators know exactly when and where to compact, aided by advanced heat sensors. This prevents over-compacting and therefore increases the efficiency of the process. Whilst compaction processes are active, rollers collect as-built data on the built surface and additional measurements are not required. Essentially, this technology allows for a continuous representation of reality.

RESULT

The Frankfurt Airport project to resurface 45,000m^2 of runway was completed in just five days. Traditional work processes would have taken three weeks longer and would have cost 20% more. The runway is also ultra-smooth, which is not only more comfortable for crews and passengers, but also reduces wear and tear on aircraft, increasing the useful life and reducing repair costs. Topcon now uses SmoothRide successfully in renovation processes within all relevant key infrastructure projects, whether for runways or roads. ◂

TRADITIONAL WORK PROCESSES WOULD HAVE TAKEN THREE WEEKS LONGER AND WOULD HAVE COST 20% MORE

▲ *Utilisation of the same job files generated from the milling and paving machines means that operators know exactly when and where to compact. During compaction, rollers collect as-built data on the built surface, so additional measurements are not required.*

ABOUT THE AUTHOR

Ulrich Hermanski is vice president of construction business for Topcon Positioning Europe. His responsibilities include managing the distribution for all machine control products through both after-market and OEM channels in Europe, the Middle East and Africa. By providing support across surveying, civil engineering, machine operation and building information modelling, Topcon enables construction industry professionals to manage the entire workflow of their projects more effectively. Topcon was founded in 1932, and since then has established itself as a global affiliated company including 86 subsidiaries spanning 27 countries. Topcon operates across two segments: the Positioning business and the Eye Care business. Topcon Positioning has long-standing relationships with companies including Bentley, Autodesk and Intel.

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Embracing Our Smart World Where the Continents Connect: Enhancing the Geospatial Maturity of Societies

Surveyors need reliable, evidence-based, open and/or low-cost data, which is overall described as a 'spatially enabled' society. However, under prevailing circumstances, we must make a transition from a 'spatially enabled' to 'spatially mature' society for decision-making. This transition requires massive creation and consumption of data (either structured or not), extended use of affordable smart devices, increasingly high downloading speeds, the Internet of Things, cognitive computing for all to improve human decision-making, provision of personalised information and the 'Internet of Me'. It is a well-known fact that location information has changed people's perceptions. We cannot measure or monitor sustainability and growth without the intelligent use of evidence-based geospatial data. Technology helps us 'uncover' the missing information and reduce inequalities. Therefore, we have to increase our skills as professionals, whether we measure, position, map, locate, appraise and value, estimate and cost, plan, construct, develop or manage the land, the seas and/or any man-made structures.

Considering the abovementioned issues, the theme of FIG Congress 2018 indeed fits very well with the definition of 'geospatial maturity' of our society as a part of moving 'towards spatial maturity'. Hence, the theme of the FIG Congress, which is 'Embracing our smart world where the continents connect: enhancing the geospatial maturity of societies' finds its meaning in the 'geospatial transformation of the world'.

The FIG Congress 2018 takes place where two continents connect: Istanbul. From 6-11 May 2018, professionals from all over the world will gather there to learn, discuss, exchange, network and be inspired. The four plenary sessions will elaborate on the overall theme:

1. Urban development
2. Modern technology usage for our profession
3. Rural development
4. Spatially enabled societies

Furthermore, over 100 technical sessions will go into detail on these and many other themes.

More information
www.fig.net/fig2018

The GSDI Mission

Participants at 'NSDI: Towards a data society'.

At GSDI, we continue to encourage international cooperation that stimulates the implementation and development of national, regional and local spatial data infrastructures. A good example of the international cooperation that we encourage can be seen from our member EuroGeographics' support for the international 'NSDI: Towards a data society' conference, which was organised by the State Service of Ukraine for Geodesy, Cartography and Cadastre and the Japan International Cooperation Agency (JICA). Around 200 delegates from Ukrainian public authorities, universities and private GIS developers who participated heard from EuroGeographics' members from Belarus, Croatia, Finland, Germany, Norway, Moldova, Latvia, Poland, Romania, Slovenia and Sweden who shared their knowledge and experience of developing NSDIs.

It is also pleasing to report that work to translate the GSDI SDI Cookbook version 2012 into the Mongolian language, funded through our Small Grants programme, was recently completed. The finished work, all 205 pages of it, was delivered to the Agency for Land Administration and Management, Geodesy and Cartography.

The work was led by the Mongolian Geospatial Association, a non-government and non-profit organisation founded in July 2014 to provide and share knowledge, experience and cutting edge technology information among Mongolian surveyors, remote sensing and GIS professionals and users, and to support government organisations. We wish them all well in the implementation of SDI in Mongolia.

With the 'Bridging the Geospatial Digital Divide' strategic partnership between the World Bank and UN-GGIM to stimulate the development of national and sub-national spatial data infrastructures gaining momentum, the GSDI mission to advance geoinformation best practices, knowledge sharing and capacity building for the improved sharing and application of geographic information is a step closer to achievement.

The future looks bright for spatial data infrastructures!

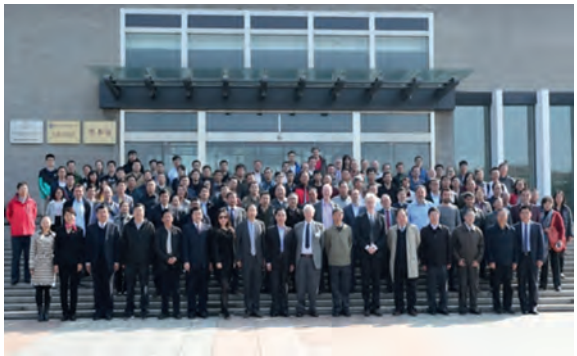
More information
http://gsdiassociation.org/index.php/publications.html

ICAG-2017 and Workshop on Absolute Gravimetry

In 2015 the National Institute of Metrology (NIM), China, was officially appointed by the Consultative Committee on Mass and Related Quantities (CCM) and the International Association of Geodesy (IAG) to be the pilot laboratory for hosting the 10th International Comparison of Absolute Gravimeters (ICAG-2017). Since 2009 this comparison has been a key comparison activity of the CCM. The measurement campaign took place at the Changping Campus of NIM, close to Beijing, from 16 October to 20 November 2017. It brought together more than 30 absolute gravimeters from 14 countries – China, USA, France, Germany, Japan, Korea, Switzerland, Austria, Finland, Czech Republic, Turkey, Luxembourg, Saudi Arabia and Thailand – to participate in an international comparison. Six atom gravimeters from China and many FG5(X) absolute gravimeters participated. This was the first time an ICAG has been held outside Europe.

In addition, an Absolute Gravimetry workshop was organised with 19 expert speakers from many international institutes. The topics of the workshop included new developments for the measurement of gravity, global, regional and national gravity networks, gravity measurement applications, and the importance of gravity measurements in the redefinition of the kilogram. The workshop was opened with a talk on 'Absolute Gravity' by Prof James E. Faller from the US National Institute of Standards and Technology.

More information
www.unggrf.org and http://ggim.un.org/UN_GGIM_wg1.html



Attendees of the Absolute Gravimetry workshop.

Young Award Winners: the ICA Scholarship Programme

One of the roles of international learned societies that endeavour to direct their discipline at a global level, is to support young scientists and encourage them to engage with the community, notably at events and conferences. ICA offers scholarships to young scientists and professionals from ICA member nations who wish to actively participate in the International Cartographic Conferences (ICCs) and all other ICA events.

A large number of applications to the ICA scholarships fund sought support for participation in ICC2017 in Washington DC. The resultant awards (some for nominal amounts) were given to a wide range of nationalities, offering presentations across the full range of cartographic subjects: Amber Bosse (USA) on cartographic aesthetics; Yvette Bevis (South Africa) on 3D visualising of uncertainty; Sébastein Biniek (France) on designing typefaces; Jorge Chen (USA) on coordinate reference systems for 3D point cloud data; Michele Denner (South Africa) on referencing of historical aerial photography; Song Gao (USA) on interpreting geographic features on maps; Katrin Glinka (Germany) on mental map modelling with georeferenced

2017 ICA scholarship recipients: (from left) Glinka, Pánek, Pászto, Said, Bosse, Shah, Pitura, Oluwafemi, Gao, Lucchesi, Glisovic, Biniek, Bevis, Denner, Keler, Advis, Stirnemann, Chen (missing: Liu). Photography: László Zentai

personal activity data; Jelena Glisovic (Serbia) on military mapping; Andreas Keler (Germany) on visualisation of traffic bottlenecks; Lanfa Liu (China/Germany) on feature learning for soil mapping; Annita Lucchesi (USA) on mapping genocide in native America; Olawale Oluwafemi (Nigeria) on the impact of gold mining on the landscape; Jiří Pánek (Czech Republic) on crowdsourced mapping and participatory planning support; Vit Pászto (Czech Republic) on using geo-games in geography field courses; Mateusz Pitura (Poland) on the Mars Exploration Zone Map; Shahmy Said (Malaysia/Great Britain) on the diversity of bus mapping systems; and Syed Attique Shah (Turkey) on using social media data to enhance disaster management. Two further scholarships allowed for participation in pre-ICC2017 Commission workshops: Javiera Advis (Chile/Germany) on virtual and real experiences of cities; and Julia Mia Stirnemann (Switzerland) on the emotional response to map projections.

ICA was delighted to welcome them all to Washington DC, where they actively engaged with the ICC 2017 formal programme. We look forward to following their subsequent careers in cartography with interest.

More information
www.icaci.org
www.un.org/sustainabledevelopment/sustainable-development-goals/

Towards Photogrammetry 2020

The TC II Mid-term Symposium will be held in Riva del Garda (Italy) from 3-7 June 2018. The symposium will feature an initial day of tutorials, four days with plenary and parallel sessions and an exhibition of the most important business players in the photogrammetric domain. The themes of the symposium reflect TC II scientific activities. More information can be found at http://www.isprs.org/tc2-symposium2018/.

There will be four invited speakers covering all aspects of the photogrammetric and geospatial fields: Jantien Stoter (3D Geoinformation group, Delft University of Technology, The Netherlands) on 'Designing, developing and implementing better systems to model 3D cities, buildings and landscapes'; Davide Scaramuzza (Robotics and Perception group, University of Zurich, Switzerland) on 'Autonomous, Agile, Vision-controlled Drones: from Active to Event Vision'; André Streilein (Swisstopo, Switzerland) on 'National mapping agencies in a changing period'; and Camillo Ressl (Department of Geodesy and Geoinformation, Photogrammetry group, Technical University Vienna, Austria) on 'Investigating Dense Image Matching'.

The event will provide ample opportunities for scientific exchange and discussion based on two types of submissions: full papers and extended abstracts. It is being organised by FBK Trento in collaboration with the Association for Real-time Imaging and Dynamic Analysis (ARIDA), the Japanese Society of Photogrammetry and Remote Sensing (JSPRS) and the Italian Society of Photogrammetry and Topography (SIFET).

The venue of the event is the beautiful town of Riva del Garda on Lake Garda, the largest lake in Italy. The mild climate of Riva del Garda favours a typically Mediterranean vegetation with lemon trees, olive trees, laurels and palm trees: a true Mediterranean island at the foot of the Dolomites. The centre of Riva del Garda offers fascinating works of art and architecture, bearing witness to the area's ancient history and a past rich in art and culture.

On behalf of the symposium organising committee, we are looking forward to seeing you in Riva in June 2018.

Fabio Remondino

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

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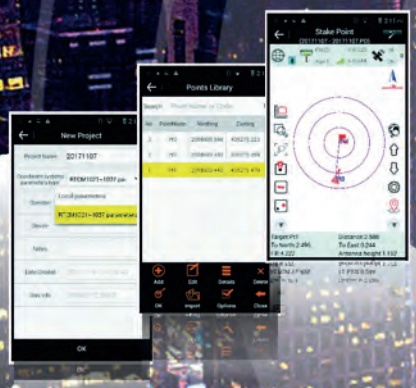

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