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GIS RESOURCES

THE INCREASING ROLE OF UAV'S IN SURVEYING FOR DEVELOPMENT

UAV LIDAR FOR ECOLOGICAL RESTORATION OF WETLANDS

ENHANCING UNMANNED LASER SCANNING SOLUTIONS – THE RIEGL UAV PRODUCT RANGE

TRANSFORMING THE ACCURACY AND PRECISION OF ON-SITE DATA CAPTURE AND TRANSMISSION

Image Credit: YellowScan

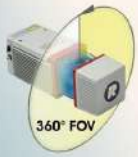
RIEGL's UAV LiDAR SENSORS

for Professional UAV Surveying Missions

ULS

RIEGL miniVUX-1UAV

Very Compact & Lightweight 1.55 kg / 3.4 lbs



- max. operating flight altitude 330 ft AGL
- range up to 250 m
- accuracy 15 mm, precision 10 mm
- suited for measuring snowy and icy terrains

RIEGL miniVUX-1DL „Downward-Looking"

Compact & Lightweight 2.4 kg / 5.3 lbs

- max. operating flight altitude 260 ft AGL
- range up to 200 m
- accuracy 15 mm, precision 10 mm
- suited for corridor mapping

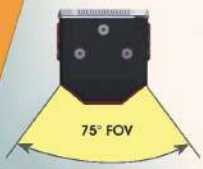
RIEGL VUX-1UAV

Compact & Lightweight 3.5 kg / 7.7 lbs

- max. operating flight altitude 1,150 ft AGL
- range up to 920 m
- accuracy 10 mm, precision 5 mm
- suited for power line, railway track, and pipeline inspection

NEW *RIEGL* VUX-240

Compact & Lightweight 3.8 kg / 8.4 lbs



- max. operating flight altitude 4,600 ft AGL
- range up to 1900 m
- accuracy 20 mm, precision 15 mm
- for using on UAS/UAV/RPAS and helicopters or small manned aeroplanes

Survey-grade LiDAR performance with a size, weight, and cost factor that makes deployment on UAVs practical and economical for commercial applications!

Key Features:

| echo digitization & online waveform processing | multiple target capability | eyesafe laser class 1 | ideally suited for the implementation of emerging surveying solutions by UAS/UAV/RPAS | mechanical and electrical interface for IMU mounting

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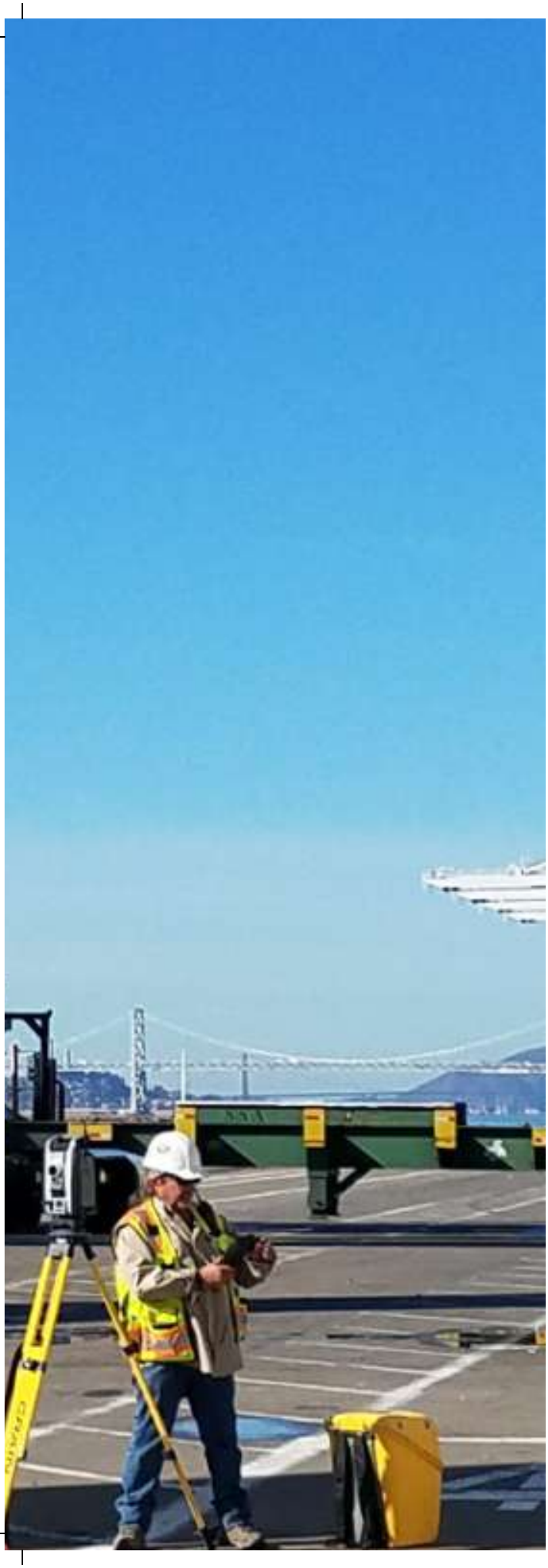


editor's note

Unmanned Aerial Vehicles (UAVs) have arrived as a reliable Geospatial Technology.

The large scale adoption of UAVs in the last decade for Geospatial Data capture has brought about a radical change in the accuracy, speed and timeliness in project delivery in almost every field, ranging from surveys, imaging, surveillance, inspection and many more. The capability, accuracy, resolution, day/night operation and sophistication of this component of Geospatial Technology coupled with processing software, data storage and ease of handling has matured to an extent that it has become the backbone of many survey and GIS operations.

At present the main type of data obtained from the UAV technology is photogrammetry. Though Light Detection And Ranging (lidar) is the newest technology to enter the unmanned aerial vehicle industry, it still needs to be developed further for it to be widely used as another type of data set that can be accepted as an industry standard.

The UAV technology provides high resolution, low-level survey and mapping that provide, amongst others, the following data and information:

- Multispectral Photogrammetric Data
- Geospatial Point Cloud Generation
- Geo-referenced Ortho-Mosaics
- Multispectral Imagery
- NDVI Analysis
- Crop Health and Crop Yield Estimate
- Data from inaccessible areas like fields, densely forested areas, mountainous areas etc

The amount of data collected and derived from UAVs is proving to be a game changer with respect to the high resolution achieved, the speed of data delivery, cost of data capture and the range of products that can be created or derived from the captured data. For possibly the first time, access to the much needed detailed, reliable and repeatable data that does not come at an exorbitant cost, has become easier than ever before. Another great advantage is the near elimination of ground truthing that needs to be done in the field as details can be identified easily in the imagery.

The ability to generate an image from a certain point in space and record that GPS location, and to return to that same location at any time is a unique tool for administrators to obtain change detection of the terrain that will enable them to deliver services, relief and compensation in near real time. It is also an ideal solution for project reporting, as engineers can see their developments grow and expand in a unique way.

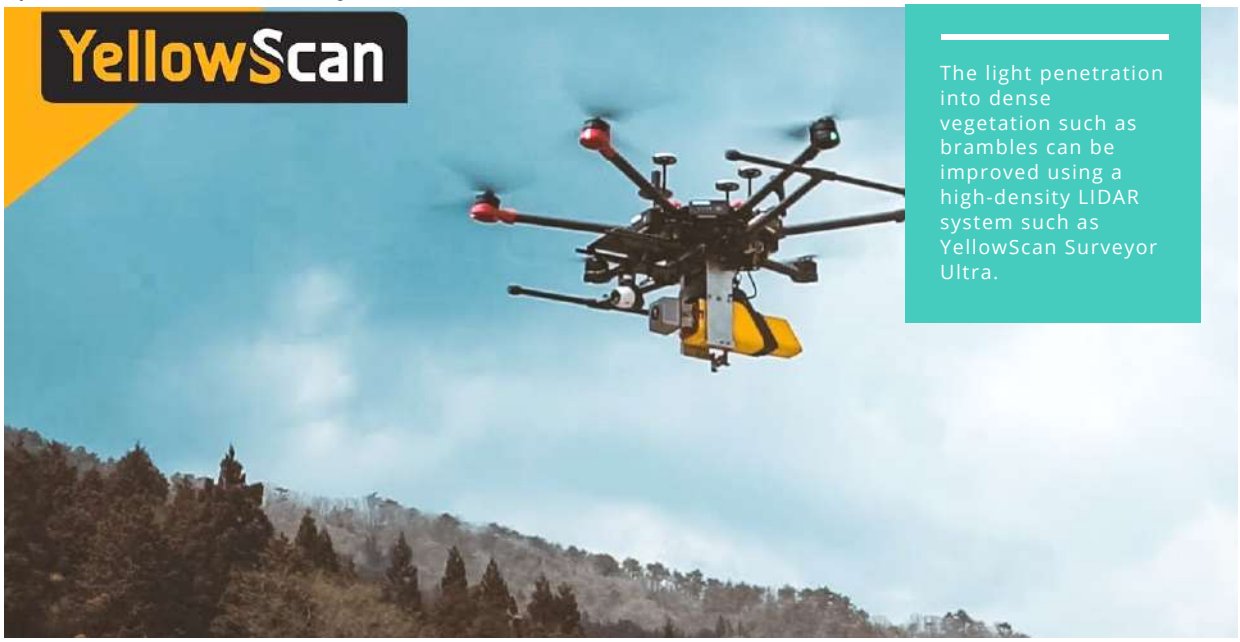
Caution has to be exercised with the use of any data. The same caution has to be exercised when using high resolution data obtained from UAVs. The data still needs to go through strict checking and editing processes to ensure the end user gets reliable and usable data that he so urgently requires.

Ashok Prim
Editor

UAV LiDAR FOR ECOLOGICAL RESTORATION OF WETLANDS

New technologies such as airborne or UAV LiDAR seem to be interesting alternative tools for survey of wetlands topography and hydrology.

by Marie de Boisvilliers and Morgane Selve



The light penetration into dense vegetation such as brambles can be improved using a high-density LIDAR system such as YellowScan Surveyor Ultra.

Wetlands are essential ecosystems which provide heaps of benefits to human societies. Their functionality strongly depends on hydrology and topography of the watershed. However using terrestrial topographical surveys methods may be a challenging task in wetlands. Flooded areas, muddy terrain and low vegetation may slow substantially the movement of the surveyors, while the high vegetation may decrease the reception of GPS receivers. New technologies such as airborne or UAV LiDAR seem to be interesting alternative tools for survey of wetlands topography and hydrology.

Importance of Wetlands and Their Hydrology

Wetlands are ecosystems where water meets land. They are often undervalued and have become globally threatened: since 1900, two thirds of natural wetlands have been destroyed. Their decline and fragmentation can cause the loss of their essential ecological functions, and consequently the loss of all the benefits they provide.

Besides conserving the remaining wetlands, there is a need to help wetlands recover from degradation or fragmentation. Many projects of

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ecological restoration of wetlands have been undertaken in the past decades and lessons have been learnt. In many cases, degraded wetlands have problems that originated with alteration of channel form or physical characteristics, which in turn have led to habitat degradation and loss of biodiversity. Therefore a key principle for successful wetlands restoration is the understanding of the physical terrain structure and natural hydrology.

The Case Study of Mou de Pleure

The bog of Mou de Pleure, located in France, in Franche Comté region, is a case study of wetlands degradation. Since the end of the 19th century, this bog has suffered a wide range of damages. One of the most important was the digging of a ditch in the 1980s for drainage of cultivated lands. This hydrological alteration has led to various negative impacts such as decrease of water storage capacity (which normally contributes in flooding prevention), afforestation and loss of rare local species observed in the past.

The Mou de Pleure is one of the rare peatlands in the region which is located in the plains, and according to ancient studies, it used to be the widest and the most flourishing of all the swamps in the plain of Bresse. Therefore a restoration project has been initiated by the Regional Conservatory for Natural Areas (CEN Franche Comté).

Interests of UAV LiDAR

The restoration project required an accurate digital terrain model (DTM) on the bog and its watershed for studying the hydromorphology. The team of L'Avion Jaune, a French aerial mapping operator based in Montpellier, decided to use a LiDAR scanner on a multirotor platform to conduct the survey.

The study area was around 50 hectares. In the center, the bog takes the form of a dense wooded area of 900 m long by 200 m wide, along the Mou stream. Outside this forested area, the Mou de Pleure is covered by meadows and cultures. The use of unmanned aerial vehicles (UAV), especially multirotor, is typically well-suited for an area of these dimensions. It is too extended to be surveyed cost-effectively by terrestrial techniques, and too small to undertake aerial surveys. Besides, the terrain access for terrestrial surveyors is complicated by the muddy environment and the dense vegetation.

Another stake of this survey was the vegetation cover, as the degradation of the bog has led to a dense afforestation of the riversides. The use of LiDAR scanner is especially relevant in this case, comparing for example to photogrammetry, as the emitted laser pulse can reach through the spaces in the canopy and provide measurement points the terrain.

L'Avion Jaune team chose to operate with the YellowScan Surveyor. The system is an ultra-lightweight standalone mapping system, selfpowered which integrates easily to multiple platform types. With a weight of 1.6kg, it is one of the lightest fully integrated laser scanning systems in the world. The Surveyor includes an onboard computer which manages the three main components: a Velodyne laser scanner, a GNSS and an INS, both from Applanix (APX15). The laser scanner has a 300 kHz frequency, making it optimal for mapping through the vegetation cover. Besides the GNSS-inertial solution provides an accuracy of 5 cm, which fulfils the study requirements.

Figure 1: YellowScan LiDAR Scanner.

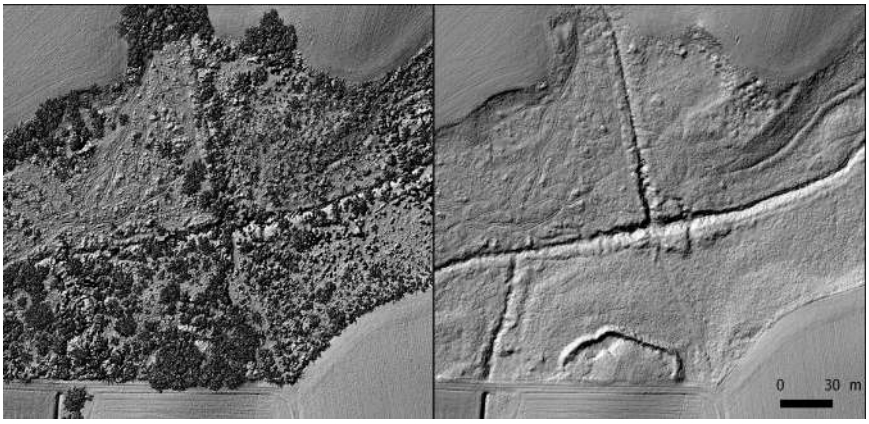

Figure 2: Point Cloud Data (Left) and Digital Elevation Model (Right).

Simple Workflow For Optimal Results

The YellowScan Surveyor system is quick and simple to operate. The fieldwork was completed in one day, including six flights, quality check of the data and picking up of control points. Flights were performed with 5m/s velocity at a 50 m altitude, with a 60 % LiDAR flight line overlap. Four transversal flightlines were added along the wooded area to maximize the point density on the bog.
Back to the office, L'Avion Jaune team ran Post Processed Kinematic (PPK) to the trajectory and generated a georeferenced points cloud with the corrected trajectory. Then, several LiDAR processes were achieved to generate the deliverables, which include noise filtering, flight line matching and classification of the ground. Finally, the point cloud was filtered to keep only ground points, and a DTM was extracted.

The produced point cloud from LiDAR had an average density of 118 pts/m2 over the whole area. Point density reached up to 280 pts/m2 in some areas with crossed overlap. Flooded areas presented a lower point density as infrared light (wavelength : 905 nm) are easily absorbed by water. However the average point density over the bog was satisfactory with 70 pts/m2.
The average density of ground points was of 96 pts/m2 over the whole study area. Under vegetation cover, ground point density ranges from 5 to 25 pts/m2. In some specific cases, the low vegetation consisting of brambles was so dense that the LiDAR beam could not reach the soil, so that some blank areas, fortunately of limited extent, remains in the dataset.

Further processing was completed by a specialised environmental consulting company to analyse hydrology. Contours lines were extracted, and watershed algorithm was applied to map the rivers and the streams. Vertical cross section of the point cloud helped identify the key hydrological elements. The DTM was used to build an hydraulic model and make some flow simulation. Finally, three restoration scenarios have been proposed to restore the Mou de Pleure bog.

Perspectives

Wetlands occur in every country, and under every climate. Environmental studies and restoration actions are undertaken worldwide. UAV LiDAR appears to be an effective tool to characterise hydrology and could be used in other type of wetlands all over the world.

Dealing with flooded areas may limit the point density in some wetlands as water absorbed infrared wavelength. It can be useful to adapt the flight planning to maximize point density, by increasing overlap and/or reducing flight height or speed. A topo-bathymetric LiDAR may also be an interesting tool to overcome this issue.

The light penetration into dense vegetation such as brambles might be improved using a high-density LiDAR system such as YellowScan Surveyor Ultra which includes a laser scanner with a frequency of 600 khz.

This survey was completed with a multirotor UAV which is well-suited for small areas. However a vertical takeoff and landing UAV with a YellowScan Surveyor Ultra could be helpful to survey cost-effectively more extended wetlands areas. This is a well-suited solution for larger areas as you can fly more than 90 minutes and map 700 hectares. As well, the vertical takeoff is a real asset when you need to fly from area that are difficult to access.

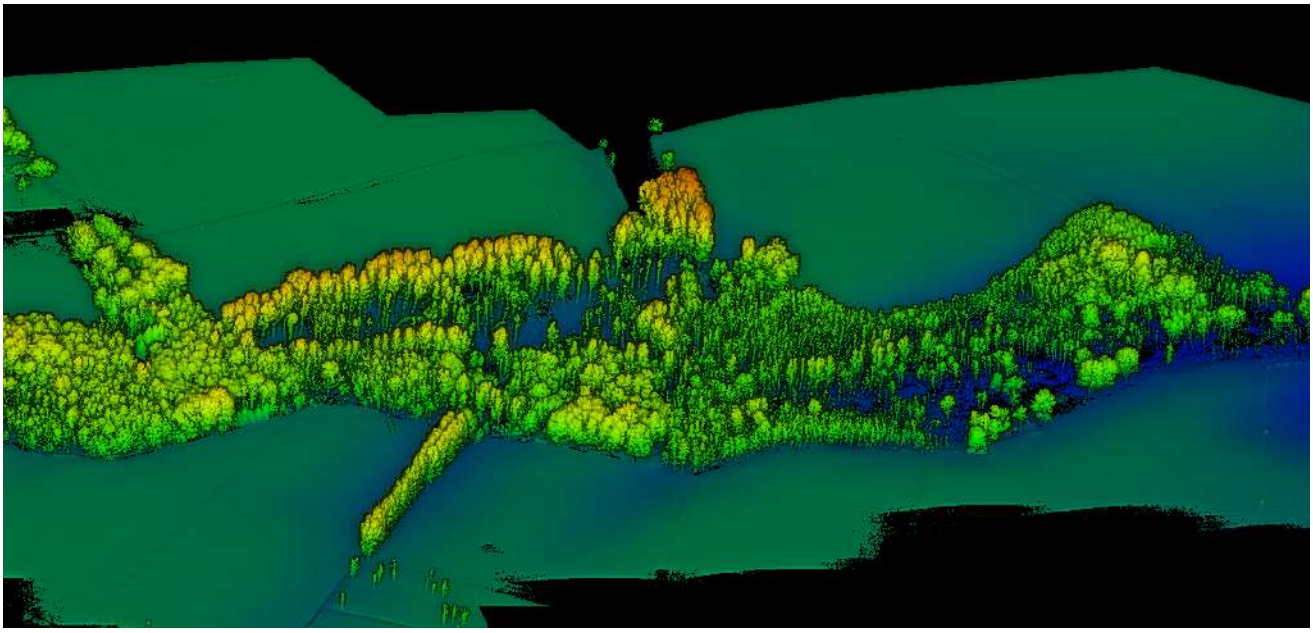

Figure 3: Wetland Restoration Point Cloud.

TRANSFORMING THE ACCURACY AND PRECISION OF ON-SITE DATA CAPTURE AND TRANSMISSION

Wales & West Utilities has worked with AMT-SYBEX and Leica Geosystems to build a mobile solution that uses high-precision GNSS equipment to measure and map the exact coordinates of each new pipe as it is laid.

by AMT-SYBEX, part of Capita plc

Image Courtesy: Leica Geosystems

Wales & West Utilities wanted to find a solution that would take the burden of locating assets away from the user, and provide a precise, unambiguous view of where each pipe is laid.

Britain's gas network has a history dating back to the early 1800s; being the world's oldest network means that its gas mains have been upgraded over time, but many thousands of miles of pipelines are still made from cast iron and other ductile metals. These pipes degrade and may eventually fracture, leading to:

1. Gas leaks that impact the environment
2. Reduce efficiency
3. Increase costs, and
4. Can pose a danger to people and buildings.

Wales & West Utilities, an independent network since 2005, operates 35,000 kilometres of gas distribution pipelines that transport gas to 2.5 million homes and businesses throughout Wales and the southwest of England.

To keep its 7.5 million customers safe and warm with gas connections and a gas supply they can rely on, Wales & West Utilities replaces old

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metal gas mains with new, long-lasting plastic ones across Wales and the southwest of England.

As it upgrades its pipes, the company wants to be sure that those new pipes are easy to find and maintain in the future. Wales & West Utilities has worked with AMT-SYBEX and Leica Geosystems to build a new mobile solution that uses high-precision GNSS equipment to measure and map the exact coordinates of each new pipe as it is laid, as well as capturing important metadata about valves, junctions and other components. Capturing the information digitally has numerous benefits:

- Digital data capture saves time for field engineers and back-office teams
- High-precision GNSS increases the accuracy of asset data and reduces the risk of errors
- Asset data can be transmitted from the field to the office in seconds, not days
- Eliminates paper-based processes, cuts costs and reduces environmental impact
- Future maintenance work should be safer and more efficient due to better location data.

Putting Safety First

Safety is a top priority for Wales & West Utilities. The company invests £1.4 million pounds a week in replacing all old metal gas pipes within 30 metres of buildings with new plastic ones – reducing leakage and improving safety.

Replacing these metal mains with more modern plastic pipes can significantly improve the security and reliability of the network, reducing the risk of leaks and the number of repairs required. For this reason, the Health and Safety Executive has advised all the gas distribution networks to accelerate the replacement of metal main, especially those that are within 30 m of a building.

Wales & West Utilities has taken this advice on board and is already nearly halfway through a 30-year replacement programme. On average, the company replaces more than 400 km of pipe every year.

Anna Perfect, data quality manager at Wales & West Utilities, comments: "It's a huge programme, and it's very important for the business and for the regulator. In addition to capturing the information in the field my team is responsible for validating the data that comes in, keeping our asset repository up to date in our SAP ERP business systems, and producing reports for the regulator about our replacement programme progress."

Part of the effort is to ensure that when the new pipework is laid, the company updates its asset data to keep track of how the pipes, valves and joints fit together, what they are made of, and where to find them. Recording the position of a pipe accurately may seem like a simple task, but it can create complex problems.

Problems with Paper-Based Processes

Simon Barrett, records officer at Wales & West Utilities, explains: "In the past, our measurement engineers would go out on site with a paper map, a clipboard and a measuring wheel, and would draw the new pipes on the map with measurements relating to above-ground points of reference. For example, the pipe might run parallel to a road at a distance of 75 centimetres from the kerbstone.

"But what if a few years after we've laid the pipe, the road is widened and the kerb moved? Then our reference point is no longer accurate, and our crews could easily end up digging in the wrong place. Or what if we're laying a pipe somewhere that doesn't have any convenient reference points nearby, such as the middle of a field?"
After the initial data was captured, the downstream processes were also laborious. The engineers would scale up their field sketches and draw the new pipes on a larger map, which they would post to head office. Then the head office team would review the map and enter the data into the company's central mapping system, Esri.

"We had to wait days for the latest information to arrive from the field, and processing the data was time-consuming for everyone," adds Perfect. "We also used a lot of paper, which was wasteful and impractical. Our measurement engineers need to be able to work outdoors in any conditions, and when it's raining or windy, dealing with paper maps can be a big problem."

Finding A Solution

Wales & West Utilities wanted to find a solution that would take the burden of locating assets away from the user, and provide a precise, unambiguous view of where each

Figure 1. mobile solution that uses high-precision GNSS equipment to measure and map the exact coordinates of each new pipe as it is laid

pipe is laid. It also wanted to digitise the whole workflow and reduce manual effort at every stage.

"For a few years, our leakage teams have been using a mobile solution called Affinity Geofield from AMT-SYBEX, which gives them access to accurate mapping data while they're working on-site - even if they're in a remote area where they don't have a mobile data connection," says Barrett. "When we saw that Geofield could be used for drawing assets too, we saw its potential to help with some of our paperwork issues."

To solve the other half of the problem, the company decided to use Leica Zeno, high-precision GNSS equipment from Leica Geosystems, to locate each pipe's geographical coordinates to an accuracy of centimetres. However, integrating the Zeno GNSS hardware with Geofield would be a first-of-its-kind project.

"One of the biggest challenges was to ensure that the system would still work even if our measurement engineers lost their data connection," explains Barrett. "Normally, the system works by using HxGN SmartNet Real-Time Kinematic GNSS services. The engineer holds a receiver, which takes positional data from a constellation of GNSS satellites. These readings are then compared with the readings taken by nearby base stations, whose precise locations are already known. By comparing the two, you can correct any errors in the readings and achieve incredible accuracy.

"However, if you don't have a mobile data connection to the base station, you can't compare the readings, so you can't do the correction. Since our engineers often work in remote areas where there's little or no mobile phone signal, this was potentially a big problem."

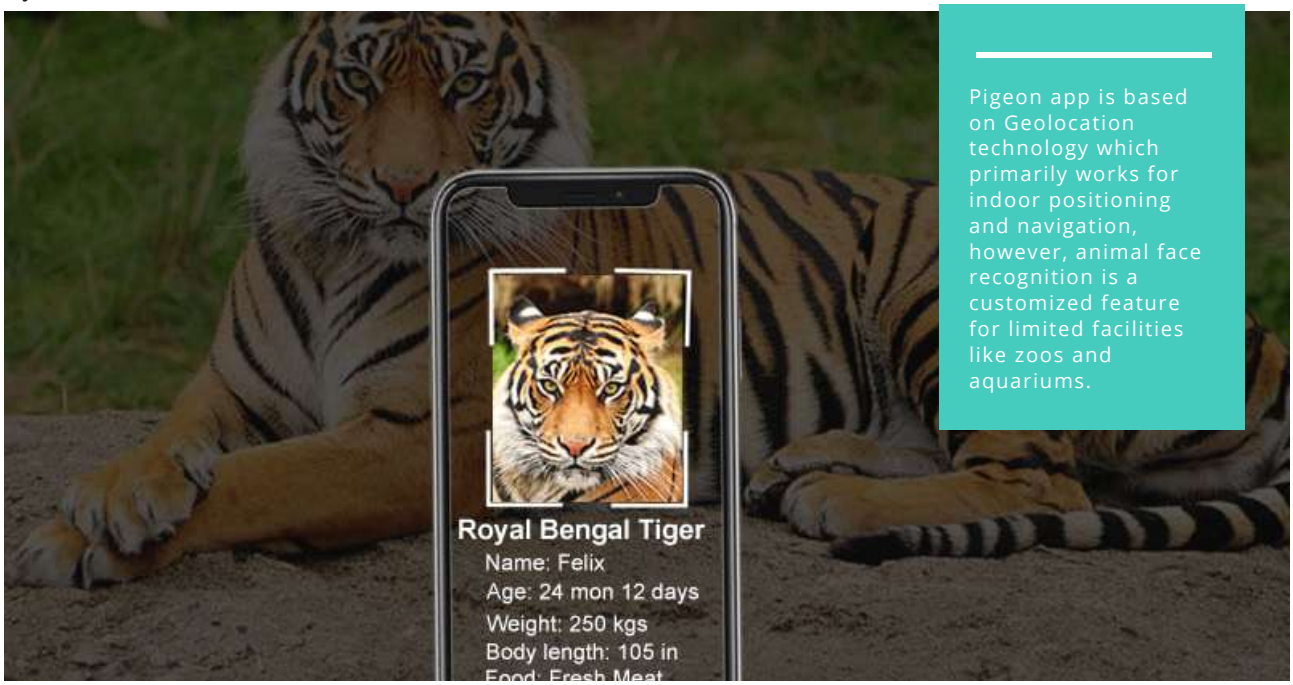
The project team solved this challenge by building a post-processing feature – if Geofield can't find a mobile data connection, it will store all of the uncorrected readings from Zeno equipment locally until the connection is re-established. Once connectivity is restored, it can then process all of the readings in a batch, and provide accurate, corrected geo-positioned data.

Figure 2. High-Precision GNSS Equipment From Leica Geosystems.

IN A FIRST, PIGEON ADDS WORLD'S FIRST ANIMAL FACE RECOGNITION TECH

With innovative animal face recognition technology feature, visitors of aquariums and zoo parks venues will effortlessly be able to extract data on each individual animal which they come across.

by Prasheel Anand



Pigeon app is based on Geolocation technology which primarily works for indoor positioning and navigation, however, animal face recognition is a customized feature for limited facilities like zoos and aquariums.

You must have seen wayfinding technology that helps navigate visitors in large facilities such as zoos, aquariums, shopping malls, etc. But for the first time in the history of Indoor Navigation technology, Pigeon app has integrated animal face recognition technology within the existing list of other features.

How Does it Work?

Navigating in large facilities such as zoos and aquariums is inevitably hectic and, acquiring the awareness of all the species exhibited within those venues is out of reach.

However, the new feature of Pigeon app i.e., Animal Face Recognition will display the complete information of all the animals and species in-detail. All you need to do is to point the screen at the animal from the app interface and the information of that particular creature will be displayed on your mobile screen.

Isn't it something very new and big...?

Submitted By

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Aquariums and zoo parks accommodate a plethora of species (both under-water and on the ground) for visitors but they fail to give enough information about them. Now, with this innovative feature, visitors of both these venues will effortlessly be able to extract data on each individual animal which they come across.

With the existing features of Pigeon work in all situations, animal face recognition will be another feather to its cap, making it more unique and exclusive for large facilities.
Pigeon app is based on Geolocation technology which primarily works for indoor positioning and navigation, however, animal face recognition is a customized feature for limited facilities like zoos and aquariums.

The other numerous features of Pigeon include:

- Proximity Marketing
- Geofencing
- Location Bookmarking
- Indoor Location Tracking

SRISYS Inc, an Ohio based software development company launched this app in 2018 and since then various other features have been integrated based on market trends. Many facilities that are large in areas like convention centers, shopping malls, museums, and theme parks among others have witnessed the magic of this app. The CEO of SRISYS Inc. Vijay Sabbineni says, "Using this app will engage visitors optimally because of the unique features it has and it can even increase footfall as well by enhancing the visitor experience."

She also added saying "only technology can resolve things which seem impossible to solve. However, the management of large venues should think from the visitors' perspective to understand the dynamics of how tough is wayfinding in large facilities like zoos and aquariums."

Pigeon positioning and navigation app is ideal for navigation, wayfinding, gaining instant feedback from the visitors, and proximity marketing and location-based services.

ENHANCING UNMANNED LASER SCANNING SOLUTIONS – THE *RIEGL* UAV PRODUCT RANGE

With a broad line of ultimate survey-grade airborne scanners especially developed for UAV/UAS/RPAS-based applications, *RIEGL* provides first-class technique for this new dynamic topic of the commercial and civil market.

by Philipp Amon

RIEGL miniVUX-1 UAV Integration Kit 600

Laser scanning utilizing high-end unmanned airborne platforms provides the great possibility for data acquisition in hard-to-reach and/or dangerous areas with an excellent cost-to-benefit ratio for a variety of applications.

With a broad line of ultimate survey-grade airborne scanners especially developed for UAV/UAS/RPAS-based applications *RIEGL* provides first-class technique for this new dynamic topic of the commercial and civil market. Laser scanning utilizing high-end unmanned airborne platforms provides the great possibility for data acquisition in hard-to-reach and/or dangerous areas with an excellent cost-to-benefit ratio for a variety of applications in surveying such as corridor mapping, pipeline inspection, mining, forestry, monitoring or archaeology.

Now *RIEGL´s* VUX-Series with a focus on unmanned laser scanning has been expanded. With the *RIEGL* VUX-240, a new airborne LiDAR sensor with less than 3.8 kg of weight and a refined and sophisticated design offering a 75° field of view, is now ready to be integrated on small unmanned aircrafts, especially fixed-wing UAVs. The extremely fast data acquisition rate of up to 1.8 MHz is the perfect base for high point density corridor mapping applications as well. The advanced measurement rate of up to 1,500,000 measurements per second and a fast scan speed of up to 400

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lines per second are the basis for high scan efficiency especially in applications like power line, railway track and pipeline inspection or topography in open-cast mining. Interfaces for IMU/GNSS system integration and up to 4 optional external cameras are further convincing key features of this new scanner. The scanner offers a 1 TB data storage capacity. WLAN enables direct access to the laser scanner, if there is a need to change on configuration settings or to check the system status. Using RIEGL´s unique Waveform-LiDAR technology, the VUX-240 allows echo digitization and online waveform processing. Multi-target resolution is the fundamental element for penetrating even dense foliage.

Figure 1. *RIEGL* VUX-240 UAV LiDAR Sensor.

A second new airborne *RIEGL* laser scanner, the VQ-480-II, is also an appropriate solution for integration in unmanned aircrafts. It captures the user's data with a refined design defining the new standard of performance and user-friendliness. With a pulse repetition rate of up to 2 MHz, an effective measurement rate of up to 1,250,000 measurements per second, and a wide field view of 75°, the instrument is ideally suited for corridor mapping, city modelling and applications in agriculture and forestry with a demand for high point densities. The low weight of only 11kg allows an effortless application onto unmanned UAVs with increased payload capacity, but also small manned aircraft and helicopters. The VQ-480 II is prepared for IMU/GNSS integration, offers interfaces for up to five optional cameras and is equipped with an easily accessible *CFast* removeable data storage card.

Figure 2. *RIEGL* VQ-480II Airborne Laser Scanner System.

Besides these new developments, additionally already proven solutions allow the users to find the right solution for their application in question. The widely used VUX-1UAV is a very lightweight and compact UAV laser scanner fulfilling the requirements of the demanding market of UAS/UAV/RPAS applications concerning measurement performance as well as system integration. Paying attention to specific constraints and flight characteristics of the unmanned aerial systems, the VUX-1UAV can be mounted in any orientation even under limited space and weight conditions. With a modest power consumption, the scanner requires only one single power supply. Having a measurement rate of up to 500,000 measurements per second, a wide field of view of up to 330° and an operating flight altitude of more than 1,000 ft, the instrument can be applied in a variety of endeavours regarding agriculture and forestry, corridor mapping, mining and topography or resource management.

The VUX-1UAV is also the main component of *RIEGL*´s RiCOPTER, the first unmanned aircraft system developed and manufactured by a LiDAR manufacturer. For surveying missions, the RiCOPTER offers a payload capacity of 16 kg. The lightweight carbon fiber main frame, foldable propeller carrier arms and shock absorbing undercarriage enable safe flight, safe landings and handy transportation. Equipped with the *RIEGL* VUX-SYS comprising the VUX-1UAV LiDAR sensor, an IMU/GNSS unit, a control unit and up to two high-resolution cameras a fully integrated airborne surveying platform is ready for take-off.

For UAVs with restricted space or less payload capacity, the *RIEGL* miniVUX-1UAV and the miniVUX-1DL ("Downward-Looking") with a small and sophisticated lightweight design convince as an appropriate solution. With only 1.5 kg weight, the miniVUX-1UAV makes use of *RIEGL*´s Waveform-LiDAR technology and provides a 360° field of view and a measurement rate of up to 100,000 measurements per second. In addition, the scanner´s wavelength is perfectly suited for the measurement of snowy or icy terrains. An easy to remove SD storage card for data acquisition, and/or the option for streaming the scan data via LAN-TCP/IP interface are further key features of the scanner. The miniVUX-1DL with its 2.4 kg is specifically designed for powerline and pipeline surveillance or for infrastructure inspection as in highway or railway monitoring due to the specific wedge prism scanner construction that offers a 46° field of view. The circular scan pattern produces a very high point density with excellent point distribution.

To enhance the miniVUX-1UAV and the miniVUX-1DL even further, the *RIEGL* Integration Kit 600 as an add-on serves as the excellent solution to integrate the instrument with a multi-rotor UAV, e.g. a DJI Matrice M600. The package comes with an appropriate, shock absorbing

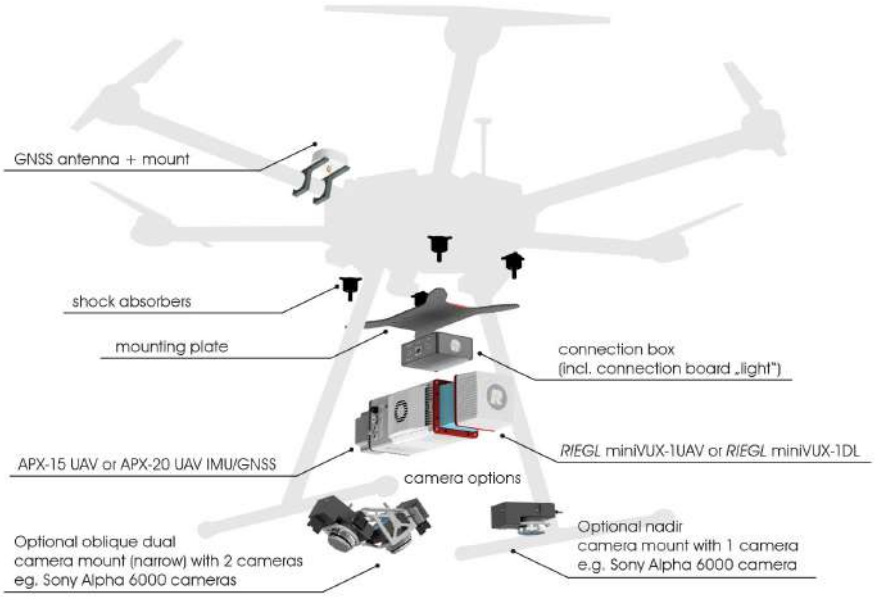

Figure 3. *RIEGL* miniVUX Integration Kit Drawing Setup.

mounting kit, a GNSS antenna with its mount, power supply module integrated in an easy to use interface board, the necessary cabling for a quick and straightforward integration as well as an expansion board for the remote controller to be able to trigger the scanner remotely.

RIEGL is also proudly presenting their brand new solution for combined topo–and hydrographic surveying applications. The VQ-840-G is a lightweight airborne laser scanner which is an efficient and user-friendly instrument for high resolution small to mid-scale coastline and shallow water surveying and is also applicable onto various platforms including UAVs. The VQ-840-G carries out laser range measurements for high resolution surveying of underwater topography with a narrow, visible green laser beam. At this particular wavelength the laser beam penetrates the water in a way that the measurement of submerged targets is possible and offers up to 1.5 Secchi depth water penetration. A measurement rate of up to 200 kHz

Figure 4. *RIEGL* VUX-240 UAV LiDAR Sensor.

and a scanning speed of up to 100 scans per second are the keys for delivering high spatial resolution and a fast acquisition of feature-rich topo-bathymetric surveying data. Straightforward integration is aided by an integrated inertial navigation system. Moreover, supplementary data can be acquired through an optional high-resolution digital camera or an infrared laser channel.

With these instruments in the substantial line-up of *RIEGL´s* unmanned laser scanners and systems, customers will meet the demanding future requirements of their markets perfectly while they can calmly rely on *RIEGL´s* well established technologies.

From the first inquiry, to purchase and integration of the system, as well as training and support, *RIEGL* maintains an out-standing history of reliability and support to their customers. In addition to the headquarters in Austria and the well-established main offices in the USA, Japan and China, now a new office, *RIEGL* Australia, in Melbourne brings all of the technology and developments even closer to the Australian and New Zealand markets.

Figure 5. *RIEGL* VQ-840-G Topo Bathymetric Airborne Scanner.

Find more details on the broad *RIEGL* product range for laser scanning applications in surveying at www.riegl.com.

BRIDGES MONITORING USING GOOGLE EARTH SATELLITE IMAGE OF MAHANADI AND KATHJODI RIVER, ODISHA

Geographic Information System (GIS) and the Global Positioning System (GPS) are the two geospatial technologies that are being used in monitoring of transportation generally.

by Dr. Jajnaseni Rout and Dr. Adikanda Ojha

GIS tools were used to perform the five steps of data acquisition, manipulati on, pre-processing, management and analysis. The data acquisition entailed the use of the GPS receiver to record the coordinates of these roads.

Remote Sensing is highly versatile and can be used in many applications within transportation. Potential uses for Remote Sensing in transportation include planning, environmental impact assessment, hazard and disaster response, infrastructure management, traffic assessment, and homeland security ("Transportation and Remote Sensing," 1999). Transportation is a requirement for every nation regardless of its industrial capacity, political stability, population, size or technological development. The most reliable and widely embraced means of transportation is road. They defined Geospatial technology as an electronic system for capturing, storing, retrieval, analyzing and displaying data related to positions on the earth. The Geographic Information System (GIS) and the Global Positioning System (GPS) are the two geospatial technologies that are being used in monitoring of transportation generally.

The said study was aimed at working out a way of enhancing road monitoring and safety by using geospatial technology. The study was concerned with developing a system that can be adapted to obtain geodetic data of any road. According to it, maps are available to show roads and their connections but they are not comprehensive enough to describe the actual location of any point on these roads.

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This inadequacy was because the maps are not digitized. It is therefore imperative to device a means by which any point on these roads can be located and the accomplishment of this can only be made realistic by the use of geospatial technologies (Akomolafe, et. al. 2009). GIS tools were used to perform the five steps of data acquisition, manipulation, pre-processing, management and analysis. The data acquisition entailed the use of the GPS receiver to record the coordinates of these roads. Remote Sensing imageries showing the roads in the study area were used. Ground truthing was done to verify locations and features. The end result of the study is a system developed for monitoring of roads and planning for possible prompt maintenance. It is a system that can show where there are damages to roads that require repairs or maintenance. Remote sensing and Geographic Information Systems are modern techniques that we need to use for monitoring our roads and to plan for prompt maintenance and are recommended for government agencies and corporate organizations engaged in road design and maintenance. Remote sensing offers many potential advantages including timely information, cost savings, and improved safety and accuracy.

The time series satellite imageries from Figure 1, Figure2 and Figure 3 showing the pre and post intervention of bridges on Rivers. Geospatial technologies such as Remote Sensing and GIS are exciting new tools to transportation decision-makers. As Remote Sensing becomes more accessible, it will accelerate the implementation of this technology in addressing critical transportation issues (Bowen, Vlasek, & Webb, 2003).

Figure 1. Google Earth Satellite Image of the Year 2011 and 2017 of Kathajodi River and the Bridge Connecting Trishulia to CDA, Cuttack.

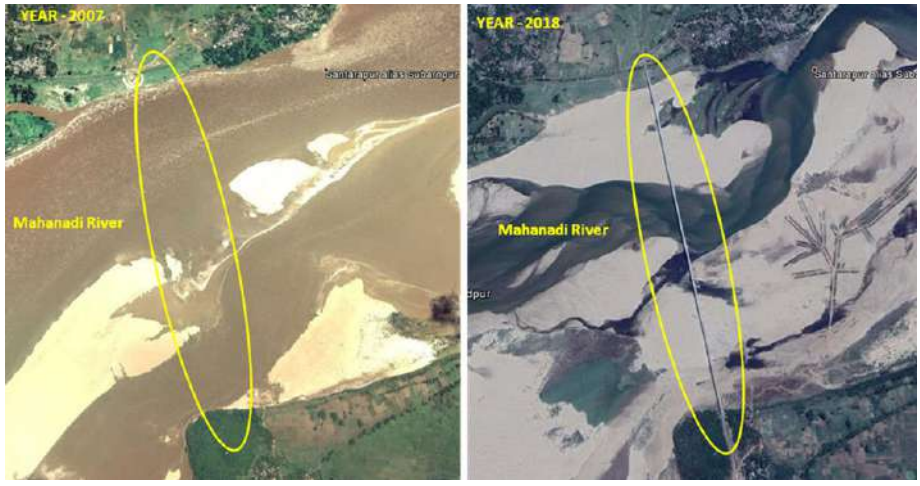

Figure 2. Google Earth Satellite Image of the Year 2007 and 2018 of Mahanadi River in Banki Block of Cuttack and the Bridge Connecting to Southern Side of the Ansupa Lake.

Figure 3. Google Earth Satellite Image of the year 2015 and 2018 of Mahanadi River Near Dhabaleswar Temple, Cuttack.

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