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GIS RESOURCES

UAV MAPPING FOR LAND RECORD MODERNIZATION

REAL-TIME NETWORK RTK TECHNOLOGY FOR LAND RECORDS MODERNISATION FOR RAJASTHAN

THE USE OF UAVS FOR LAND PARCEL MAPPING

UAV TECHNOLOGY TO MAP LARGE AREAS FOR THE PURPOSE OF LAND TITLING

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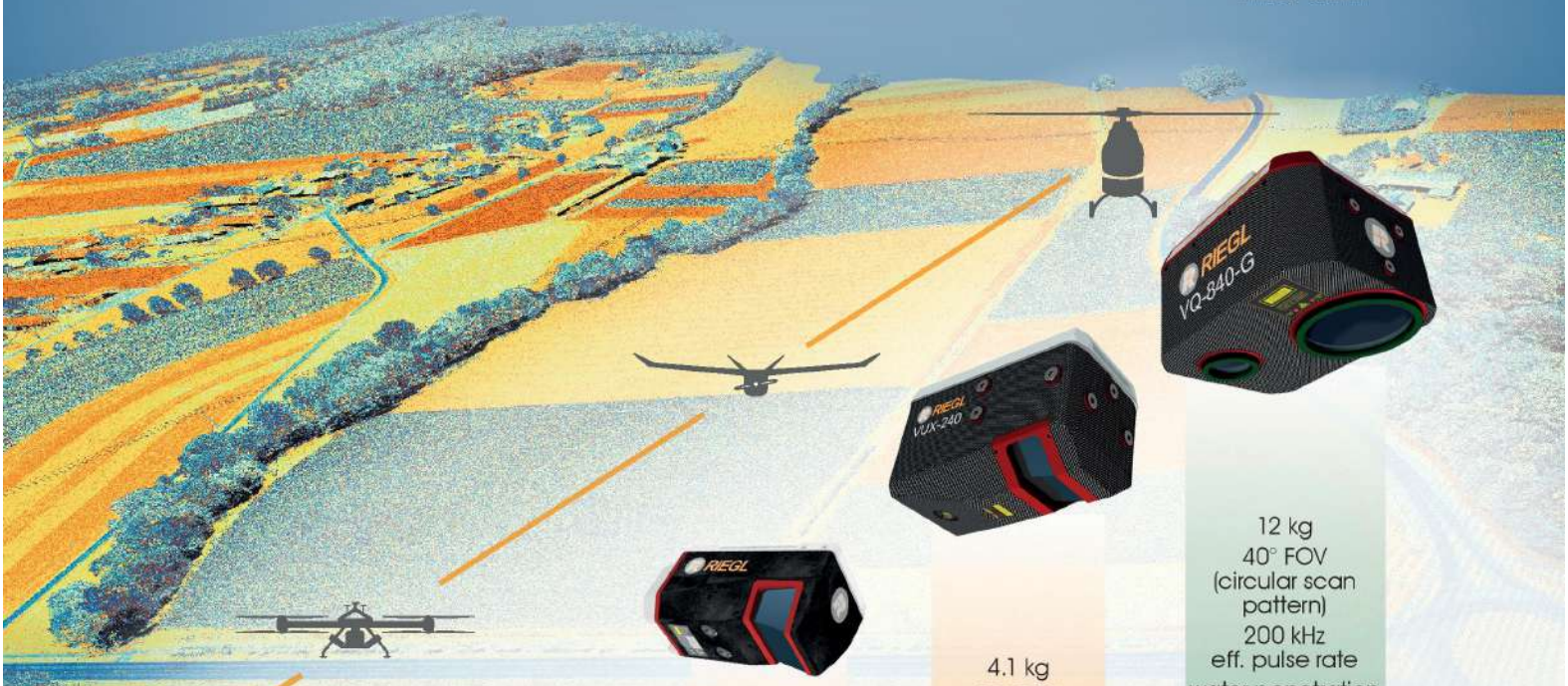

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editor's note

The demand for land has increased exponentially in recent times. It seems everybody wants a piece of land. The agriculture and farming sector are based on the availability of arable land, Government wants land as it can sell it to generate vital revenue to fund several developmental and social obligations, the Industrial sector and Mining sector depend on the land and lately the real estate and housing sector are the latest groups who need land and their need is limitless. Hence, Land is now a vital resource for Agriculture, Dams, and Canals, Road network, Flora and Fauna, Industry (SEZs), Mining, other development activities, and their dependant livelihood.

Managing land has become an important activity for the Government. Since Cadastre is a State subject, it is primarily the responsibility of the State to modernize its revenue records. Currently, revenue records are mostly analog, decades old, and in different stages of decay.

The **Government of India** launched The Digital **India Land Record Modernization** Programme (DILRMP), previously known as the National **Land Record Modernization** Programme (NLRMP), in 2008 with the purpose to digitize and **modernize land records** and develop a centralized **land record** management system. The programme is far from complete after so many years and it has been extended up to 2020-21 at a total cost of Rs. 950 crores.

Land is a limited resource. With no clear land titling system as yet, there is increased pressure on its ownership and use. In India, a large percentage of available land is used for Agriculture. However, the increased population has lead to a decrease in the size of individual land holding, causing inefficiencies in economies of agricultural produce. Ownership disputes clog the courts for years locking land that was needed for other use. Improper and unauthorized diversion of land use adversely affects flora and fauna, the environment, and maybe the food chain as well as the use of community land holdings. And life & livelihood is adversely affected.

High-end Geospatial Technologies must be used to measure and fix the corners of an Individual land parcel with a high degree of accuracy in order to prevent uncertainties in the area of the individual landholding. This will ensure a high degree of measure when individual land holdings are aggregated to obtain village areas and higher-order administrative domains.

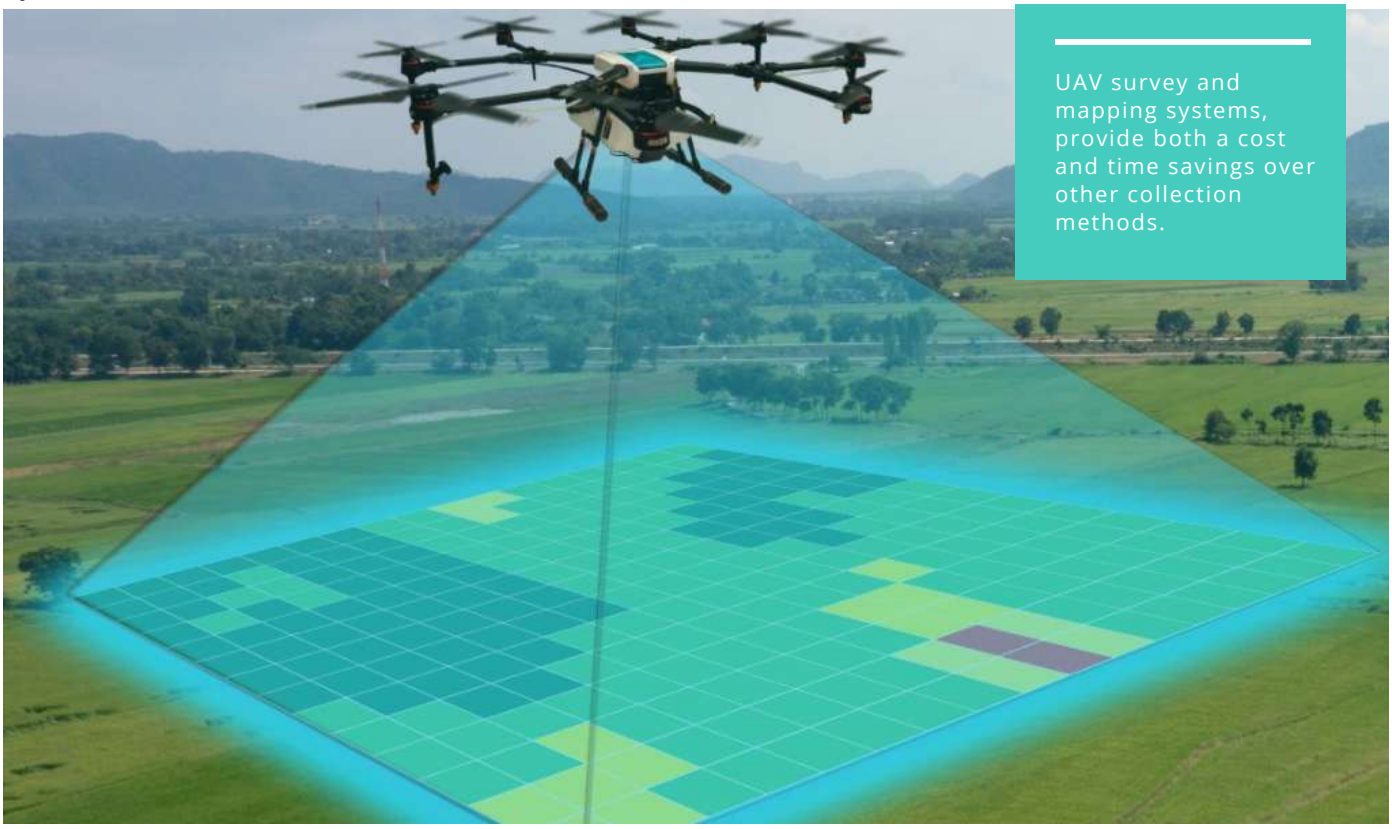
States must move rapidly towards using sophisticated Geospatial Technologies that use high-resolution imaging technologies and software that puts land parcels in a framework to rapidly prepare a comprehensive Land Records Management System that will keep the Land Records updated in all aspects for immediate and future use.

Ashok Prim
Editor

THE USE OF UAVS FOR LAND PARCEL MAPPING

UAVs for Parcel Mapping are providing a much-needed complimentary option to more traditional methods from both manned airborne and satellite mapping platforms.

by Brad Schmidt



UAV survey and mapping systems, provide both a cost and time savings over other collection methods.

Remote sensing has long been a valuable tool for mapping everything from agriculture plots, to forest cover, to land use and parcel mapping and much, much, more. Today, remote sensing technologies are playing and ever increasing role in capturing survey grade data for a variety of applications including for parcel mapping purposes. This is no more evident than with the UAV survey and mapping industry.

Methods of Data Collection

Traditionally, survey and mapping companies have employed a variety of methods to collect this information, the most common being a traditional land survey approach where a survey team uses a Total Station among other equipment such as static GNSS to accurately capture land parcel information. For larger areas, manned airborne surveys have become the standard methodology, where high quality metric cameras and scanners are used to collect imagery in support of survey and mapping projects, including parcel mapping. For municipal parcel mapping, these surveys tend to cover an entire urban area to a resolution

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of several centimeters.

Mapping from satellite imagery has also emerged as a key methodology for the mapping of larger parcel fabrics, such as with agricultural land or forest plots. Imaging satellites provide a much wider field of view when compared to manned aerial imagery and have much higher temporal resolutions, some with daily revisits over the same area of the globe. The quality of satellite imagery has improved dramatically since the launch of the first imaging satellite in 1972 (approx. 80m pixels) to today, where commercial imaging satellites can provide pixel resolutions of approximately 30 cm, such as that available from Digital Globe.

The Emergence of Land Parcel Mapping from UAVs

There is now yet another tool available to survey and mapping organization for the capture of land parcel data and that is the use of UAV imagery for parcel mapping. Over the past 5 years and more the survey and mapping industry has witnessed a revolution in data collection from UAV platforms. Unlike manned aircraft surveys, or mapping from satellite imagery, UAVs can fly at a much lower altitude, making the generation of precise and accurate survey grade data, much more efficient and cost effective and virtually independent of atmospheric conditions such as cloud cover.

The growth of survey and mapping within the commercial UAV space is being driven by a variety of factors, first and foremost is the fact that UAV platforms have been shown capable of generating high-quality survey grade data that meets the requirements for large-scale parcel mapping.In addition, established players as well as new start-ups are manufacturing UAV platforms designed specifically for survey and mapping purposes (e.g. see Microdrones or SmartDrone). Another factor is the constant improvement in sensor payloads. Many types of sensor systems have been re-purposed to meet the Size, Weight and Power (SWaP) restrictions typically found with UAVs, while other are now being deployed specifically for UAV platforms, such as the range of LiDAR/RGB camera systems available from GeoCue Group. Improved data capture and processing techniques are also helping to drive the value of the image data collected from UAV platform.

Considerations for UAV Parcel Mapping

When configuring or choosing a system for UAV parcel mapping, several elements must be considered, including the selection and use of a UAV platform, the sensor payload deployed, a data augmentation solution, and the data processing methods and techniques designed to achieve the parcel survey accuracy required.

Key components for UAV Parcel Survey:

1) UAV Survey and Mapping Platforms for Parcel Mapping:

UAV platforms typically fall into one of four categories:

- Multi Rotor UAVs
- Fixed Wing UAVs
- Single Rotor Platforms – (i.e. helicopter)
- Fixed Wing Hybrid Platforms

In today's UAV survey and mapping world, the first two types of UAVs are most commonly deployed for survey and parcel mapping work. The multi-rotor platform is best deployed for those parcel mapping mission that are constrained to relatively small project areas (i.e. within Visual Line of Sight). Fixed Wing platforms provide better coverage for larger area collects and Beyond Visual Line of Sight (BVLOS) mapping missions (where permitted by regulations), as they can typically fly faster and cover more area for the same flight time.

2) Payload Considerations:

Selecting a sensor payload for parcel mapping can be a daunting task given the variety of UAV compatible sensors now available. Typically though, either a high-resolution RGB camera, or multispectral sensor or LiDAR, or a combination thereof will be selected for parcel mapping purposes, depending on how the data will be used. In selecting a sensor package, the objective is to work with payloads that will generate the data required, thus it is important to first define the requirements for the parcel mapping project and then select the sensor system that will best support the required deliverables.

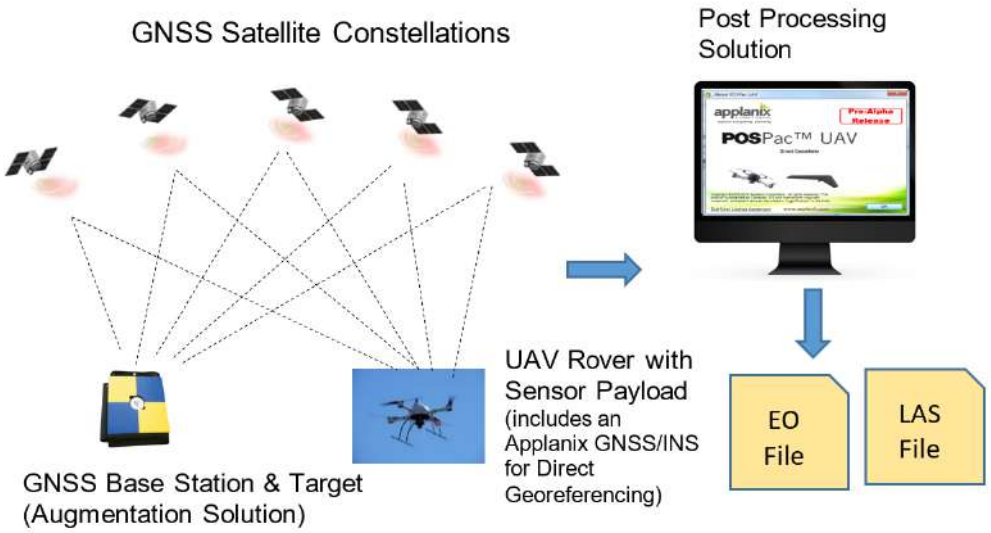


Figure 1: UAV Systems for Parcel Mapping.

3) Augmentation Solutions:

Another key component for a UAV parcel mapping system, is the incorporation of a GNSS data correction solution needed to improve the accuracy of the raw GNSS observables. UAV survey and mapping companies have typically used RTK GNSS receivers (single base station) for this, which allows for the Rover GNSS data to be corrected to survey grade quality. An example of this is Trimble's Smart GNSS Antenna Target (See Figured 2). The GNSS receiver and ground target combination, can also be used as a check point to confirm the accuracy of the data collect.

Another correction methodology is the use of Virtual Reference Stations. An example of this is Continuous Operating Reference Stations (CORS). The data from the CORS can be used for single base station processing or processed in a network solution to produce a moving Virtual Reference Station or VRS that enables high accuracy carrier phase differential GNSS positioning anywhere within the network (the Applanix POSPac SmartBase module is an example of such a solution). The advantage of this approach is that no GNSS reference station hardware is required; however it can take up to 24 hours for the CORS data to be available for data processing, which delays the generation of final mapping results.

An alternative technique to establishing a physical reference station or using an existing network of CORS for differential GNSS processing is 'Precise Point Positioning' (PPP). Instead of differencing the rover observables from the reference station observables and cancelling out atmospheric and satellite errors, an advanced model for every aspect of the GNSS error chain is developed and parameterized. The Trimble CenterPoint PP-RTX technology combines the methodology of PPP with advanced ambiguity resolution technology to produce centimeter-level positional accuracies anywhere on the globe.

Figure 2: Simple Base Station and Target for Data Corrections.

Data & Data Collection and Processing

The principle product required for parcel mapping is the orthoimage, which can be generated through photogrammetry using a classic aerial triangulation (AT) process and Ground Control Points (GCP's) for georeferencing, or using the more efficient process referred to as 'Direct Georeferencing'.

With AT the UAV will capture a large number of overlapping images, often with an 80% side-lap and an 80% end-lap. This overlap is required such that the same point on the ground is visible in multiple images and from different vantage points, which provides perspective similar to the depth perception the human brain processes via information from both eyes. By using automatic pixel matching methods, and identifying pre-surveyed GCP's in the imagery, the position and orientation (Exterior Orientation or EO) of each photo can be computed using a least squares adjustment (the AT process). Once the EO is computed, orthoimages can be produced and mosaicked to form large image blocks for parcel mapping. The drawback of this method is that a large number of matched pixels and ground control

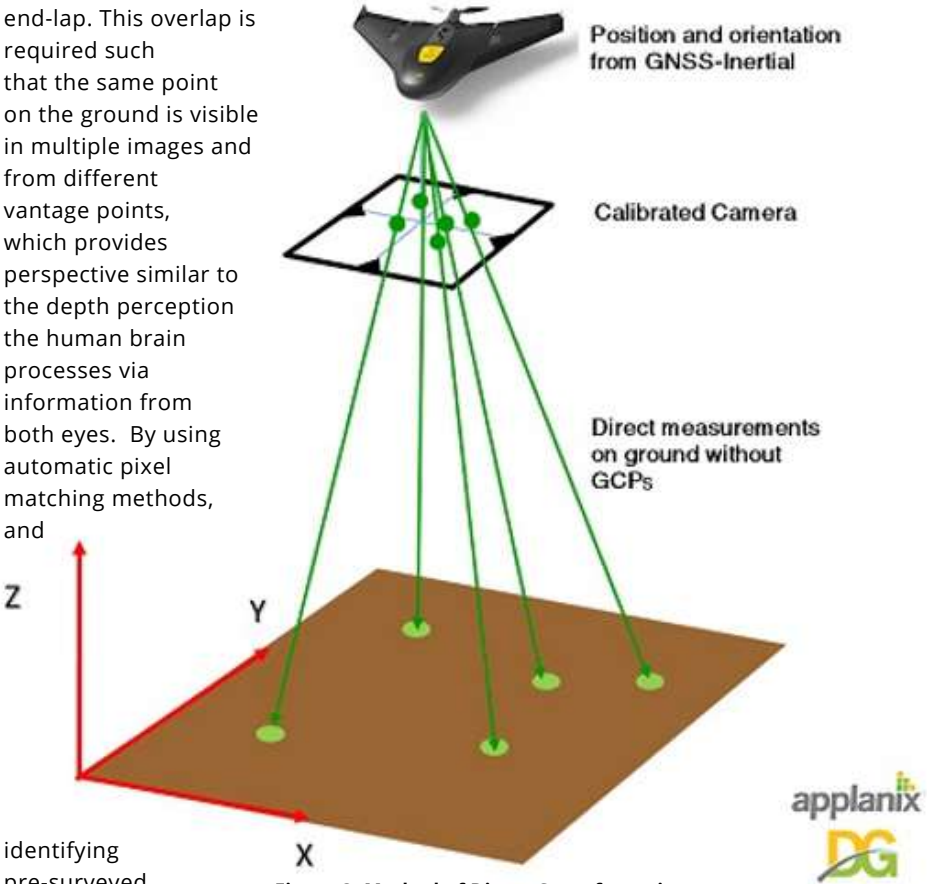


Figure 3: Method of Direct Georeferencing.

points (GCPs) are required to achieve the desired cm level accuracy, and a significant collection overlap for the imagery is needed, each adding time and cost to the data collection and data processing requirement.

An alternate and superior approach for photogrammetric georeferencing is the use of Direct Georeferencing (DG). The DG method (see Figure 3) bypasses AT to compute the EO for each image by measuring the position and orientation of an imaging payload directly. This is done to a very high degree of accuracy and precision using survey grade, multi-frequency, multi-constellation Differential GNSS tightly integrated with calibrated inertial sensors. A DG system for UAV's is comprised of a GNSS receiver with a calibrated inertial measurement unit (IMU) – (See Figure 4), along with a survey grade differential correct system (single base station) or virtual reference system and post-processing software. The post-processing software either runs on a desktop or in the Cloud as-as-Service and generates the EO for each image at the time of exposure using the GNSS data, the inertial data, and the augmentation data. Post-processing always produces the highest level of accuracy and fidelity for Direct Georeferencing.

The key benefit of using DG instead of AT is productivity. Aerial Triangulation is a labour intensive and time consuming process due to the requirement to collect a network of GCP's and match these up with corresponding features in the imagery. The Direct Georeferencing approach eliminates the need for dense GCP's and significantly reduces the need for a tight network for flight lines as exhibited in Figure 5 below. This means projects can be completed faster and with a lower cost.

Figure 4: Integrated GNSS/INS for Precision Survey and Mapping.

Observations and Concluding Comments

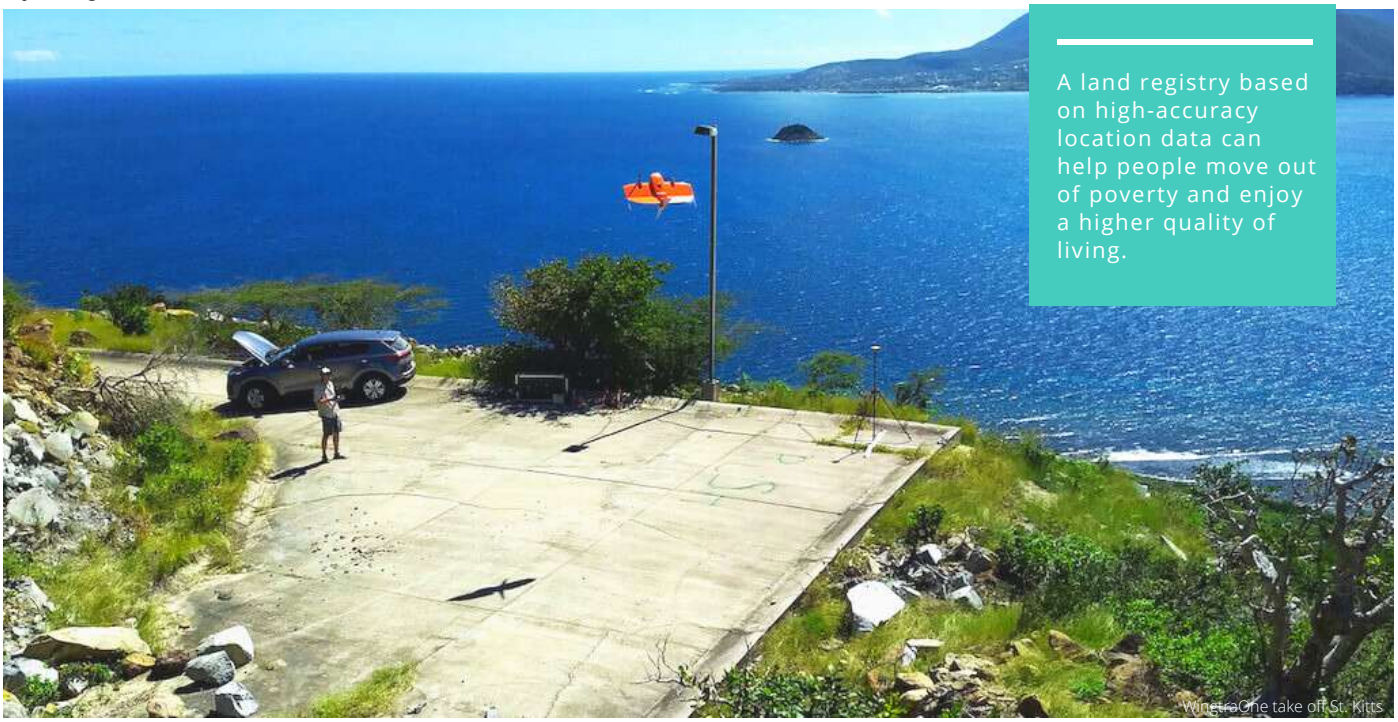
It should be noted that it is often not a choice between using satellite imagery, or manned, or unmanned imagery for parcel mapping, as these data sets will often complement each other depending on accuracy and resolution requirements. Essentially, the challenge is to select the right tool for the job at hand. Large area collects should continue to be serviced through either satellite imagery or manned aerial survey depending on the precision and accuracy required, while small localized data collects are best served with quality UAV survey and mapping systems, which provide both a cost and time savings over other collection methods.

Figure 5: Image coverage require without DG vs with DG.

UAV TECHNOLOGY TO MAP LARGE AREAS FOR THE PURPOSE OF LAND TITLING

Survey firm Medici Land Governance uses WingtraOne technology to map large areas for the purpose of land titling.

by Wingtra



WingtraOne take off St. Kitts

A land registry based on high-accuracy location data can help people move out of poverty and enjoy a higher quality of living.

Around seventy percent of the world's property is unregistered, causing land insecurity and poverty. Creating a system to document and formalize land ownership is the only way to ensure that the land is developed sustainably into the future. Medici Land Governance works in partnership with governments at the national, state and city level to provide low-cost and innovative land-titling solutions that help people secure property rights.

White and a team of three other specialists recently mapped the island of St. Kitts, which is one of two Caribbean islands making up the nation-state of the Federation of St. Kitts and Nevis. The island measures around 168 km2 (65 mi2), and the team mapped 104 km2 (40 mi2) of it with WingtraOne in just 28 days / 65 hours of flight time—overcoming volcanic terrain and windy conditions.

Drone Data, Poverty Alleviation and Environmental Protection

Drone mapping instead of hiring costly airplane surveys is opening opportunities to make more high-accuracy maps of more of the world. In particular, WingtraOne's ability to capture large amounts of high-accuracy data in short periods of time across challenging terrain makes it a cost-effective tool in the push to document land rights.

About Author

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A land registry based on high-accuracy location data can help people move out of poverty and enjoy a higher quality of living. First of all, owned property can be taxed in order to fund and expand utilities and services. Drone data can back up the exact area parameters of properties. Environmental conditions improve as well, because if people have proof that they own land, they're more likely to make sustainable developments and increase investments in land.

"The sense of owning one's property and having accurate, tamper-proof records of that ownership is invaluable. It provides financial, social and psychological security," White said. "It's also really important in terms of having a sense of 'home' and a sense of place during international crises like this pandemic."

"Land titling improves socio-economic status and impacts the social determinants of health. Medici Land Governance is a cutting-edge company that offers land registry systems at a lower cost. And WingtraOne now plays a major role in making this possible."

- Ben White
GIS Engineer at Medici Land Governance

Cutting Costs and Overcoming Challenges to Map a Volcanic Island

For its first projects, Medici gathered location data from manned aircraft surveys plus ground-level data collection to capture fine details of the places they were contracted to cover, White explained. Besides the cost being much more, the knowledge gained by this method was limited as well as the quality of the data.

"With drones, I budgeted 70,000 dollars, which was 150,000 dollars less than for manned aircraft data capture," White said. "And you also have to figure the in-house knowledge gained with a drone. For me to be an airplane pilot, I need a commercial license in the US, which is so much more investment. We are a startup. We're on the ground to help people, and it's a lot more feasible with the drone."

In addition to high cost, airplanes presented safety concerns and issues with cloud cover, since all of Medici's images must be cloud-free. Satellite data wasn't sufficient either, White said. Fixed-wing drones could get the data they needed, so they invested in an eBee. But in a place like St. Kitts, they realized they would also need VTOL.

Figure 1: White, left, and Nick Kiraly, right, along with two other team members from Medici Land Governance surveyed St. Kitts efficiently and at high quality with WingtraOne.

"What we found is that St. Kitts is very windy. It's also heavily forested and steep because it's a volcanic island. So I identified places where I could land with the eBee—playing fields, stadiums, parks. We mapped around 15-20 km2 (5-7 mi2) with it."

"We needed 60 meters (196 feet) for an eBee belly landing, or 35 (115 ft) if the landing was steep. Sometimes I only had less than 10 meters to land, so we needed a VTOL, and we liked Wingtra's approach: focused on surveying and mapping down to 1 cm (0.4 in) accuracy."

- Ben White
  GIS Engineer at Medici Land Governance

In addition to capturing high-accuracy data efficiently, White and the small Medici team needed a user-friendly solution to map such a large area in a short time. They also needed it to be dependable.

"The safety checks with WingtraOne are great, White said. "They aren't overwhelming, and are just enough to ensure you are flying safe. Across most of St. Kitts, we didn't have internet in the field, so it was really nice to be able to download those base maps and the elevation profile into WingtraPilot."

White said he's also impressed by the easy and transparent data processing

Why Wingtra?

Save time: Up to 80% faster surveying operations - Drones speed up the labor-intensive collection of geospatial data in the field. With its autonomy and long range capability, the WingtraOne mapping drone goes further by increasing mapping efficiency up to 80% compared to various mapping methods, including many other drones.

Minimizing time in the field - In one flight, WingtraOne can map almost 2x more than a conventional fixed-wing drone and approximately 10 to 14x more than multicopter drones. This is mainly due to its 42MP Sony camera. With this high resolution, the WingtraOne can fly higher than drones with 20MP cameras while ensuring the same or better GSD, thus covering a larger mapping area.

Traditional survey

5 h

WingtraOne

1 h

80% faster survey means that a one-hour surveying job with the WingtraOne equals up to five hours with traditional survey methods.

Cover up to

14 x

more than a with multicopter in one flight

Cover up to

2 x

more than standard fixed-wing drones in one flight

Down to 1 cm (0.4 in) drone survey accuracy - Equipped with the 42 MP full-frame Sony RX1R II camera and a multi-frequency PPK GNSS receiver, the WingtraOne surveying drone delivers best-in-class absolute horizontal accuracy, down to 1 cm and vertical accuracy down to 2 cm.

Figure 2: WingtraOne can map a 130 ha (320 ac) quarry in an hour's flight. The resolution of the final map allows you to zoom in and see a coin lying on the ground. And what is best is that it's possible to know the exact coordinates of the coin down to an absolute accuracy of 1 cm (0.4 in).

in WingtraHub and Wingtra's extensive knowledge base, featuring quick image and text modules with support insight on any procedure or troubleshooting that can come up in the field. All of this lined up with the company's goal to keep overhead lean and knowledge transfer robust among team members.

Figure 3: Orthomosaic of St. Kitts from WingtraOne Data.

Mapping St. Kitts: Method Comparison

Manned aircraft survey	Classical fixed-wing survey	WingtraOne survey
		
220,000 USD for data only; i.e., no team knowledge transfer. Plus, cloud coverage would render data unusable.	Limited functionality due to massive take-off and landing area needed to belly-land.	70,000 USD includes knowledge transfer to entire team for future projects.

DRONE SURVEYING AND MAPPING OLD QUARRIES WITH NEW TOOLS FOR NEW USE

Landfill sites are important to monitor, but it's expensive. Sky Grid uses Pix4Dsurvey and Pix4Dcloud Advanced to be cost and time-efficient.

by Pix4D

The point cloud was incredibly detailed and clear, and the grid creation was automatic, leaving no room for human error from manually creating the grid.

The clear point cloud of the Sky Grid site.

Quarries present a huge challenge for industry: when in use, they are filled with large equipment moving tons of material back and forth, which is a concern for health and safety regulations. This has made worse when the quarry is no longer in use or transitions to focus on a different part of the site, as it leaves an immense pit in the ground that people or animals can fall into. In the UK, one solution for this is for empty quarries to be repurposed as a landfill. Waste is dumped into the hole, providing a space for the refuse to be stored and giving some function and regulation to the space.

However, carefully monitoring these sites is important to the owners of the quarries. Whether reports for government or environmental agencies, or for analyzing the capacity of the pit, quarry owners need to know exactly what is going on with their quarry-turned-landfill. This was the challenge for a British quarrying company, where the cost of inspecting the landfill surface every few months was costing tens of thousands of pounds. Properly surveying the progress in each cell is mandatory for quarry owners despite the expense. This is where Sky Grid came in.

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Construction and Drone Surveying

Sky Grid, a specialized surveying company partnered with warehouse and logistics construction company Glencar Construction, was hired to survey the quarry. This assignment is well within the capabilities of Sky Grid, who are used to surveying buildings sites and other closely monitored locations, such as large earthworks projects.

The scale of the project was huge: Sky Grid had to survey 327 acres as accurately as possible. They achieved this by using Pix4Dcloud Advanced and Pix4Dsurvey. By using an integrated SIM tied into the Leica Smartnet network through the controller on a DJI Phantom 4 RTK, Sky Grid's operative did not need GCPs to improve the accuracy of their results due to this innovative solution. This use of technology and Sky Grid's expertise meant the process of surveying the site was extremely efficient. After only 90 minutes on site, Sky Grid had collected all of the images and data needed. Surprising the client with the speed of their data collection, Sky Grid's operative headed back to the office to start processing the data immediately.

Project Details

Project location	UK
Area surveyed	327 acres
Flight time	32 minutes at 120m
Hardware	Phantom 4 RTK
Software	Pix4Dcloud Advanced & Pix4Dsurvey
Total number of images	828 images
Outputs	Orthomosaic, DSM, contour lines, quality report

**This project was completed in July, 2020.*

Challenges in Aerial Surveying Quarries

Naturally, there are often challenges when working in the field. There were several obstacles to overcome for Sky Grid. The first was the sheer size of the site: 320 acres to be covered by one drone which needed to be within sight of the pilot. It took two flights for the DJI Phantom 4 RTK to complete the flight plan. Not only that but the location had a busy airspace, which meant that as the pilot, Sky Grid's operative had to register the flight with nearby aviation authorities. Respecting air space regulations is vital for planning a drone flight, as breaking those rules can result in a large fine and cause disruption to local airspace users and authorities.

Registering Sky Grid's flight was especially important as the photos were taken at a height of 120 meters to capture the size of the site, which is higher than may be expected of drone flights. This adherence to important rules also meant following regulations about being within the line of sight of the drone. Sky Grid's team drove to a different point on the site for the second part of the mission to ensure they could always see the drone as it completed the flight plan.

Boosting Efficiency with Accurate Quarry Mapping

Despite the range of challenges Sky Grid faced with this project, they

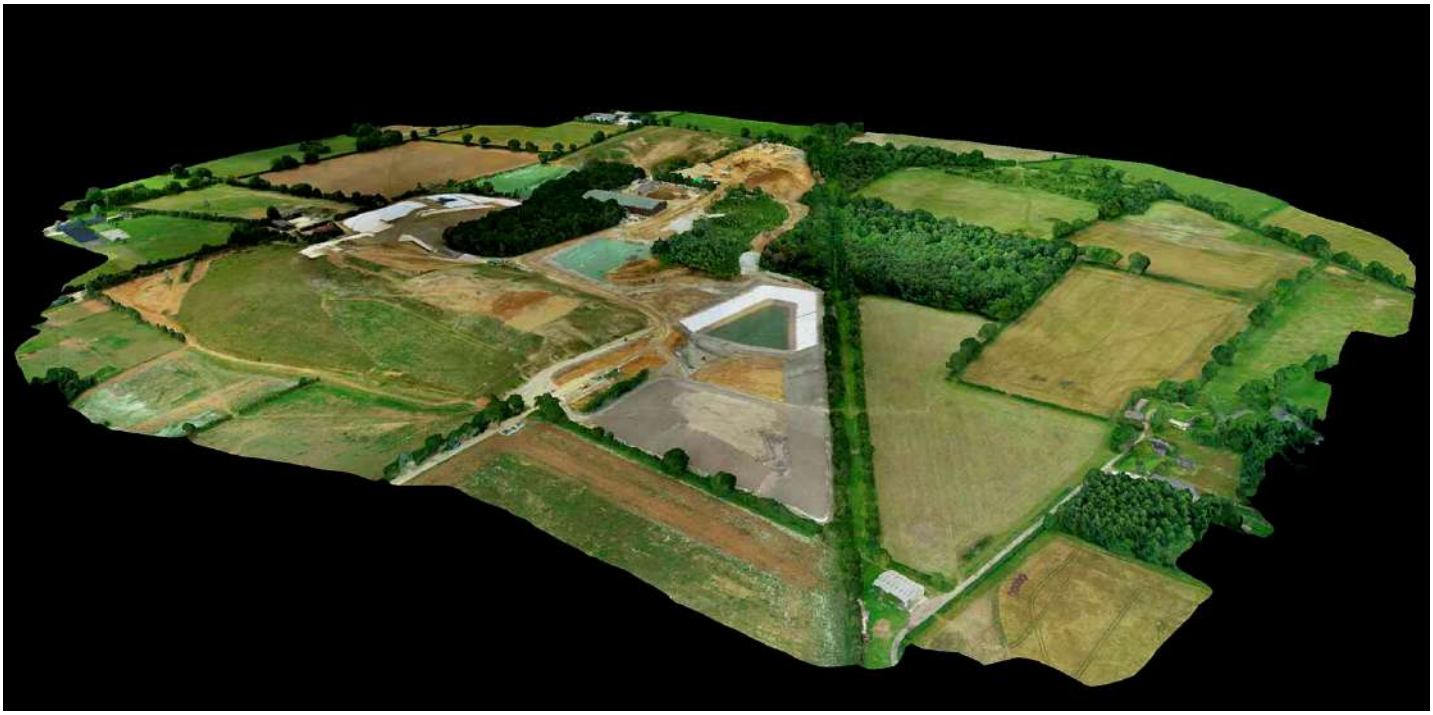


Figure 1: Digital twin of the surveyed quarry landfill.

completed the assignment successfully. Uploading the images to Pix4Dcloud Advanced, the processing stage of this workflow was rapid, completed on Pix4D servers within 5 hours. This dataset was then imported to Pix4Dsurvey. The point cloud was incredibly detailed and clear, and the grid creation was automatic, leaving no room for human error from manually creating the grid. Not only were the results clear but they were also accurately georeferenced. Harnessing the outputs of Pix4Dcloud Advanced with Pix4Dsurvey, Sky Grid quickly separated the ground and non-ground parts of the point cloud and created a grid of points with just 500 millimeters spacing across the terrain. This gave Sky Grid a dense set of points that could be imported into CAD software, which Sky Grid used to create a contour map that they delivered, along with the produced a detailed orthomosaic, DSM, and QA report, to the client.

In addition to this, Sky Grid provided a digital twin of the site for Sky Grid's client to explore and analyze.

Powerhouse Combination of Surveying and Cloud Photogrammetry

Tracking the stockpiles of cells at the quarry using Pix4Dsurvey is highly accurate and efficient. Using Pix4Dcloud Advanced and Pix4Dsurvey, Sky Grid can return to the same site on a monthly basis to provide updates for the owners and it will still work out cheaper for the clients, rather than paying contractors to do the work every 3 months. Sky Grid summarized their results in a pdf report including the outputs of Pix4Dsurvey, which was easy for the site owners to use for breaking down the complexities of the dataset. Combined with the overlay comparison feature available on Pix4Dcloud Advanced, the changes to the landfill site can be easily identified, which is incredibly valuable in the evolving shape and use of the site.

Sky Grid took advantage of the variety of functions in Pix4D software which meant the team could show their client exactly what Sky Grid's findings were and represent the site as never seen before.

"I use this software as it is the easiest to use with the best features - Pix4Dsurvey is efficient and the sharing and comparison features on Pix4Dcloud Advanced simplify everything"

- Andy Green
  Sky Grid Owner

Read about Pix4Dcloud at - *https://www.pix4d.com/product/pix4dcloud*

Read about Pix4Dsurvey at - *https://www.pix4d.com/product/pix4dsurvey*

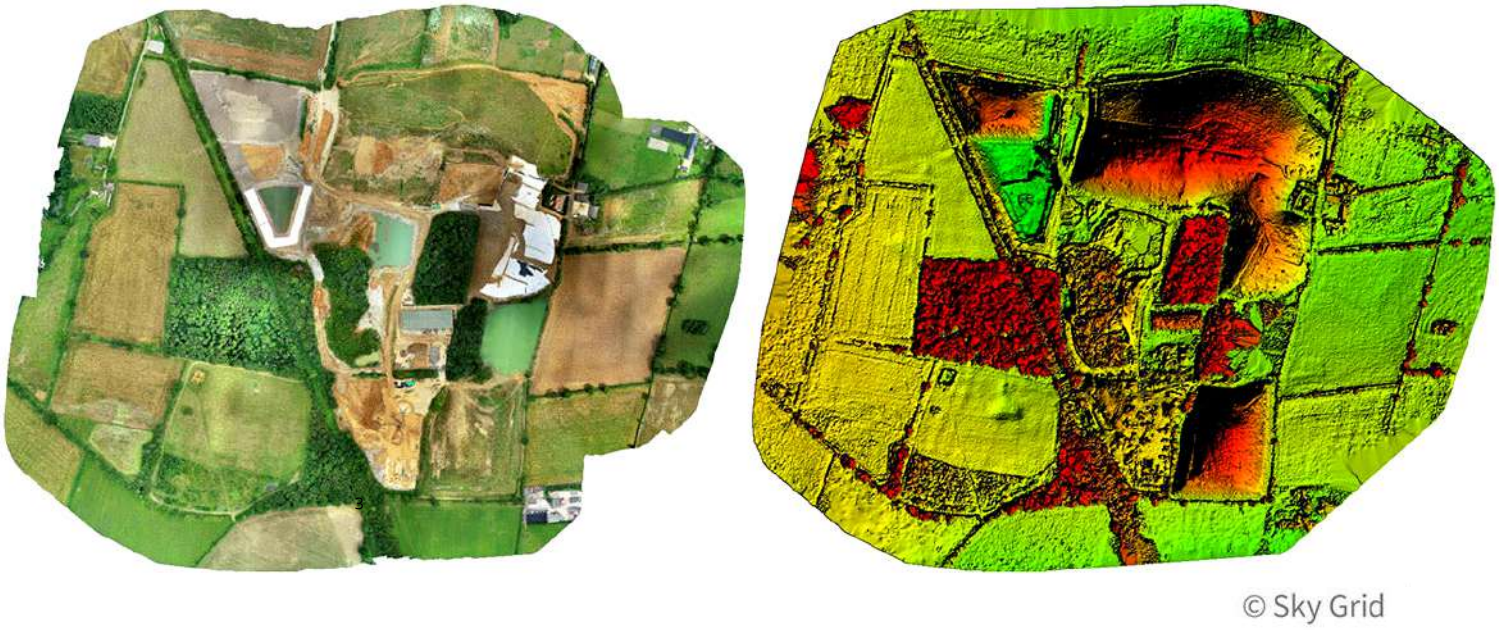
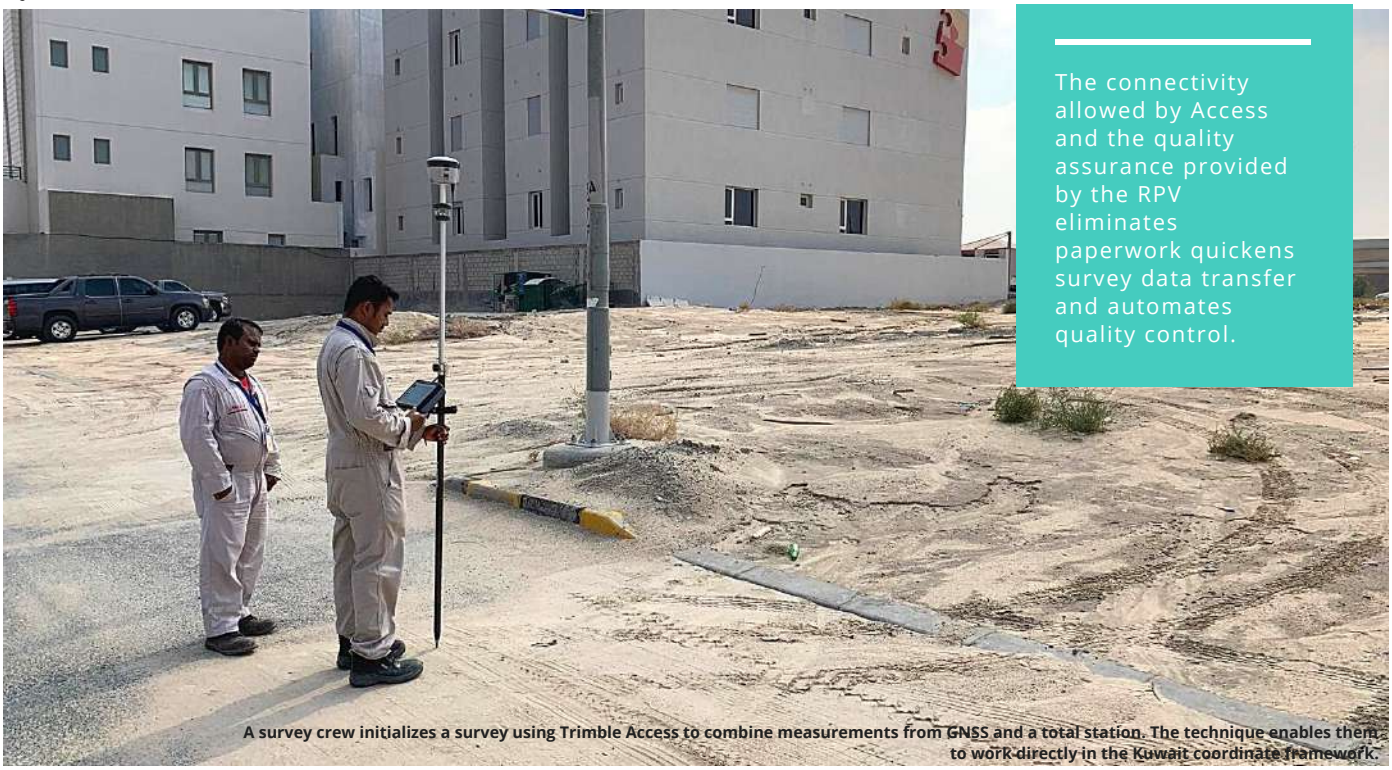


Figure 2: Comparing the Sky Grid 3D model with the Orthomosaic.

ESTABLISHING LAND BOUNDARIES IN THE MIDDLE EAST

How Kuwait reduces property encroachments using geospatial technology.

by John Stenmark



A survey crew initializes a survey using Trimble Access to combine measurements from GNSS and a total station. The technique enables them to work directly in the Kuwait coordinate framework.

The connectivity allowed by Access and the quality assurance provided by the RPV eliminates paperwork quickens survey data transfer and automates quality control.

Kuwait's land management department, Kuwait Municipality (KM), is always one step ahead when it comes to efficiency. The department requires all landowners to have their boundaries surveyed and marked before development, which has been critical, especially with its rapid growth and buildings seemingly shooting up overnight, to stay one step ahead of landowners, KM needs to ensure site improvements remain within their defined territory. Thanks to a new integrated software solution, this lengthy process of boundary work has been expedited.

Boundary Simplification

As surveyors know, performing a boundary survey is seldom as easy as setting monuments at the corners and walking away. In the high-development areas of Kuwait, existing buildings tend to complicate boundary work in two ways: by obstructing GNSS reception during stakeout of an adjoining parcel and more seriously by encroaching boundary lines.

Encroaching features delay new development and can have costly consequences for parties on both sides of the property line. "Often there are parcels attached to buildings from one, two or three sides," says, Ahmed Elesawy of Vision International, a software solution company, "KM wants to check if the

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neighbors have violations [encroachments]."
"KM requested Vision International to develop a system that would enable them to locate and mark parcel coordinates with an accuracy of better than 3cm," says Elesawy. The new paperless system employs several software solutions, including Trimble Access, which facilitates the data transfer between the field and the main offices.

Figure 1: Surveyors and municipal officials mark an encroachment. By combining precise measurements with cadastral data they can quickly identify any problems.

Integrated Software Solution

Access works with an application called the Remote Parcel Validator (RPV), which performs quality control checks in real time. The RPV evaluates several factors to ensure the survey work is done properly and then either approves or rejects the boundary survey based on municipality standards.

Items evaluated by the RPV include the functioning status of the equipment, the accuracy of the boundary coordinates as located by the surveyor and the quality of the GNSS network. If the stakeout coordinates are outside of tolerance or the GNSS constellation is poor, the RPV will freeze the transaction and allow the supervisor to intercede remotely.

Alternately, if the RPV determines the job was well done, it prompts the parcel release form, which the surveyor and client then sign digitally on the data collector. Access then delivers the form instantly to the main office for final approval. Once a 15-day process, the boundary survey and parcel handover can now be performed in a single afternoon.

Ensuring Accuracy

The KM surveyors rely on the Kuwait real-time GNSS network to perform their survey work. Should buildings or other features obstruct the horizon and interfere with GNSS reception, a surveyor will setup a Trimble S5 robotic total station. With a prism and GNSS receiver mounted on a single pole, simultaneous optical and GNSS measurements are taken in three different open areas. This establishes the position of the S5 on the control network through the resection routine in Access. This is followed by a conventional stakeout of the parcel corners.

When a KM surveyor arrives on site and finds encroachments, he postpones the parcel stakeout and instead measures the encroaching features, which might include fences, driveways, or buildings. This data is sent by Access to the main office for review, where the boundary is often adjusted and the parcel corners set at another time. Any encroaching features need to be reviewed by management just as they were traditionally. Any errors are delivered in real-time so adjustments can be made quickly.

The connectivity allowed by Access and the quality assurance provided by the RPV eliminates paperwork quickens survey data transfer and automates quality control. This combination of software solutions will create more accurate and efficient boundary surveys for Kuwait.

Figure 2: (Left) Trimble S5 Total Station and (Right) Trimble R10 GNSS Receiver

Figure 3: Trimble Access software enables surveyors to combine GNSS and total station data for resection, stakeout and in-field computations.

REAL-TIME NETWORK RTK TECHNOLOGY FOR LAND RECORDS MODERNISATION FOR RAJASTHAN

With the implementation of new technology, a new era will be ushered regarding the knowledge and delineation of boundaries, whether they are the individual parcel or the collective types of administrative boundaries.

by Ashok Prim

The Digital India LRMP (DILRMP) programme launched in the State of Rajasthan in January 2016.

A need was felt for a better management of land records with a view to minimize scope of land/property disputes, enhance transparency in the land records maintenance system, and facilitate moving towards guaranteed conclusive titles to immovable properties in the country. Towards this end the Govt of India launched the NLRMP programme in 2008. The major components of the programme are computerization of all land records including mutations, digitization of maps and integration of textual and spatial data, survey/re-survey and updation of all survey and settlement records including creation of original cadastral records wherever necessary, computerization of registration and its integration with the land records maintenance system, development of core Geospatial Information System (GIS) and capacity building.

On the same lines as the NLRMP, the Govt of Rajasthan launched the Digital India Land Records Management Programme (DILRMP) in January 2016 to fulfil these aims with its operations on Survey/Re-Survey and updation of Survey and Settlement Records.

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The Rajasthan Survey-Resurvey Operations - Method & Scope

The objectives of the NLRMP Project as stated in the document 'The National Land Records Modernization Programme (NLRMP) Guidelines, Technical Manuals and MIS, 2008-09', prepared by the Department of Land Resources, Ministry of Rural Development, Government of India, was the creation of a spatial database of land parcels and integrating the database with the Record of Rights (RoRs).

Three methods of survey/re-survey were suggested in the above document, from which, the Govt of Rajasthan has chosen the third method for creating the spatial database. The method of survey/re-survey adopted by the Govt of Rajasthan has been stated in the Bidding document 'Establishment of Ground Control, Network, Conducting Survey/Resurvey and Updation of the Survey & Settlement (Records), Operations in Rajasthan'. In para *5.2.2* of the document under *'Schedule II- Preparation of up-to-date GIS compatible Land Parcel Maps for districts of Rajasthan through hybrid method using High Resolution Stereo Image of satellite (HRSI), Differential GPS and, Electronic Total Survey Station (ETS) in GIS environment, including various attributes/metadata'* the hybrid model has been selected as the method of survey/re-survey.

The survey/re-survey operations are to be conducted in the entire state. Controls points were established and HRSI imageries were acquired for 11 districts in the initial phase. After generation of ortho-images creation of Khasra map is being done. Acquisition of imageries for the remaining 22 districts is in process.

The Hybrid Model of Survey/Resurvey

The Digital India LRMP (DILRMP) programme launched in the State of Rajasthan in January 2016, uses 40 cm resolution Quickbird Stereo Satellite Imagery obtained from Digital Globe as the base HRSI.

After processing the satellite imagery, the 'ground truthing' of all parcel boundary corner points and edges are done using DGPS and Electronic Total Station (ETS).

The 'ground truthing' term essentially means that the coordinates of each parcel corner and edge that are not visible/unclear in the satellite imagery or those whose identity cannot be deduced from the satellite imagery are measured by DGPS techniques. Where the DGPS technique cannot be used to measure the coordinates of parcel corners and/or edges, such as parcel corner points under tree cover, then the ETS technique is used to measure the coordinates of parcel corners and/or edges.

Further, para *5.2.2.8* on *'2D features capturing with respect to ortho rectified images'* states that 'features those are not visible or unclear shall be captured using ground methods (DGPS and/or ETS) and later integrated with the digitized data'.

Para *5.2.2.14* and *5.2.2.18* of the bidding document on *'Grounds Survey Methods to be adopted' and 'Collection and recording of additional map data from the field'*, respectively, strive to emphasize the above.

Consistency of the Hybrid Model of Survey/Resurvey

The different levels of accuracies of coordinates of parcel corner and edges obtained from satellite imageries and from DGPS/ ETS will create inconsistencies in linear and area measurements. The Higher accuracy of DGPS/ ETS coordinate data when used with the much lower accuracy coordinate data obtained from satellite imageries will lead to inconsistencies in side lengths and area of parcels.

The acceptable accuracy has been given in para 5.2.2.2 of the bidding document. The para states the general accuracy requirements.

The accuracies of coordinates obtained from the screen readout of satellite imageries are acceptable to within 40cm of the coordinates obtained from DGPS/ETS techniques. Whereas the accuracies of the coordinates of points/features that cannot be identified on the satellite imagery, obtained using DGPS/ETS techniques, are accurate to about 2 – 5 cm.

For the same parcel the two levels of accuracies are inconsistent and will contribute to the propagation of errors in the whole database.

Scope for Achieving Higher Accuracy

It is seen that there is a requirement for improving the consistency of the data being generated. Alongwith improving the consistency of the data, there is also a need to enhance and improve the accuracy of data.

Para *5.2.2.13* of the bidding document states the need for *'Enhancement to the data by Ground Survey'* wherein higher accuracy levels are required to be achieved. The para states – 'Ground survey using ETS and DGPS enabled smart stations (or equivalent or better) shall be conducted for the following objectives:

- Capture the features, which are not visible in the satellite images
- Achieve the required accuracy levels in the data by enhancing it by ground survey.

Type of Area	Target Scale	Maximum on Ground Error on Linear Distance
Agricultural Land	1:4,000	+/- 40cm
Abadi Land in Village Area	1:1,000	+/- 20cm

On the other hand para *1.2.v.m* of the NLRMP document in *Chapter-4* on *'Choice of Software and Standards'* states the accuracy standards of survey as: horizontal accuracy of 20 cm for rural areas, 10 cm for urban areas, or better.

In both the above norms there is an inherent need to obtain 'better' accuracy standards as well as to 'achieve the required accuracy levels in the data'.

In 2008 when the NLRMP was being prepared the technology in use was the ETS & DGPS technology. These technologies on their own are advanced technologies which are still very much in use. However technology has evolved since then and newer technologies, based on the earlier technologies, come with much better capabilities and accuracies whilst making the data consistent at the same time.

With the use of advanced technology it is possible to aspire for better levels of accuracies in parcel coordinates to make it compatible with the ground reality and to fulfil the requirements of the parcel owner.

The CORS Technology – Real Time Positioning

The GPS Continuously Operating Reference Station (CORS), a term adopted by the National Geodetic Survey, an office of the United States Department of Commerce's National Oceanic and Atmospheric Administration (NOAA), is a sophisticated and advanced GPS based technology that first requires the precise determination of a position on the surface of the earth and then the continuous monitoring of that precise position for the purpose of Geo-scientific studies that include determining the shape of the earth, determining the effect of the earth – moon gravitation on the shape and rotation of the earth, determining the movement of the earth's crust, defining a Spatial reference System and so on.

The GPS receiver is the heart of a CORS configuration. In order to support a wide realm of activities, the receiver must be a high quality geodetic unit capable of tracking and recording all components of the GPS signal. Rapid advances in GPS technology have enabled the GPS technology to become more robust and versatile. The applications derived from a network of CORS has found use in the determination of precise position on a 24x7 real time basis for civilian use that has been shown to save time and cost of execution of developmental projects.

Real Time Network RTK – Achieving the Required Accuracy Levels in Survey/Resurvey Operations

The evolution of Real Time Network RTK is a giant leap from the DGPS technology mentioned in the NLRMP & the DILRMP documents.

High accuracy Real-Time Kinematic (RTK) Positioning with Global Navigation Satellite System (GNSS) is one of today's most widely used precision surveying techniques. This infrastructure is already operational in government and private agencies in many countries and for which there is increasing demand. Earlier, the use of Real-Time Kinematic (RTK) Positioning was restricted by the effects of the ionosphere and troposphere, which create systematic errors in the raw data over long baselines. In practice, it means that the distance between a rover (mobile) receiver and its reference station has to be quite short in order to work efficiently. The precision of RTK decreases as the baseline length increases.

Real Time Network RTK (RTN) surveying has been developed to extend this base-to-rover range limitation.

The concept and technology of Virtual Reference Station (VRS) is one of the methods that RTN can be applied wherein the systematic errors (due to Ionosphere & Troposphere) in the reference station data are either reduced or eliminated. This not only allows a user to increase the distance at which the rover receiver is located from the reference, it also increases the reliability of the system and reduces the RTK initialization time. The concept can be used not only to set-up new GNSS networks, but also to improve the performance of old, established GNSS networks.

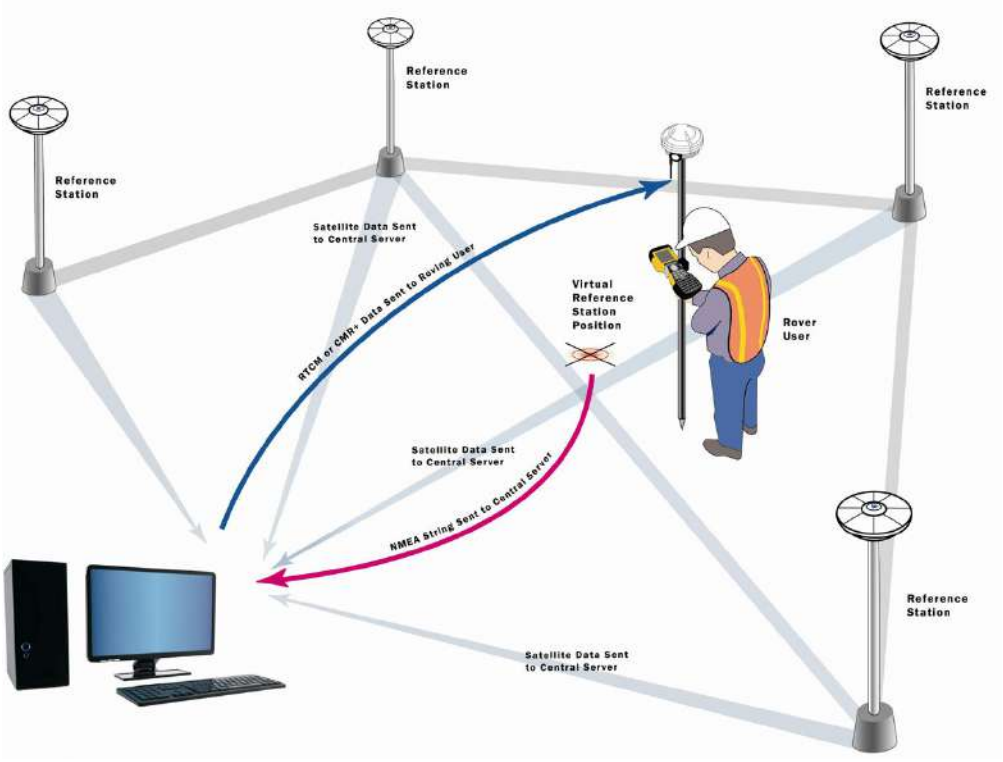

Figure 1: Real-Time Network (RTN) Surveying; Image Courtesy of Trimble.

The "Virtual Reference Station" principle is based on having a network of GNSS reference stations continuously connected via data communication link to a control centre. A computer at the control centre continuously gathers the information from all receivers, and creates a living database of Regional Area Corrections.

These are used to create a Virtual Reference Station, situated only a few meters away from the location of rover together with the raw data, which would have come from rover. The rover interprets and uses the data just as if it has come from real reference station. The resulting performance improvement of RTK is dramatic.

With "Virtual Reference Station Concept", it is possible to perform highly improved RTK positioning within the entire station network.

The expected horizontal position accuracy is 1 – 2 dm when distances between actual reference stations are within 300km and 1 - 2 cm when distances between actual reference stations are approximately 50-70 km.

Please note that the optimum distance between the reference stations depends on the geographic location of the network, i.e. areas with higher ionospheric activity (TEC) might require a denser network. Fortunately, India comes under moderate ionospheric activity.

With the availability of better GNSS satellite configuration and more signals, the determination of precise positioning has become more robust.

Advantages of the Real Time Network RTK System

i. No user base station is necessary as is required in the DGPS setup. The user needs only half the equipment to produce RT work (or, conversely, one can double productivity). Additionally, there is no lost time setting up and breaking down the base station equipment and radio.
ii. No start and end points are necessary as is required in the ETS setup. So no time is lost in providing start and end control points.
iii. Half the manpower is required as compared to the DGPS system and one fourth the manpower as compared to the ETS system.
iv. There is considerable reduction in cost and time in the execution of the project.
v. The first order ppm (part per million) error is eliminated (or drastically reduced) because ionospheric, tropospheric and orbital errors are interpolated to the site of the rover. This enables centimetre level positioning at extended ranges over 10 kilometres from a reference station.
vi. The network can be aligned with the National Reference Frame with high accuracy. The users will then be collecting positional data that will fit together seamlessly across the Real Time Network coverage. This is important to all users of geospatial data, such as GIS professionals who by using good RT practices may deal with such regional issues as emergency management and security issues.
vii. Different formats and accuracies are readily available. GIS data, environmental resource data, mapping grade data, etc. can be collected with 30 to 60 centimetre accuracy while surveyors and engineers can access the network with upto 2 centimetre level accuracy. RTCM, CMR+ and other binary formats can be user selected.
viii. The RTN can be quality checked and monitored in relation to the National Reference Frame using utilities such as OPUS from NGS and TEQC from UNAVCO.

Design of the Real Time Network RTK System

As the name suggests, a real time network would require a network of base stations continuously receiving and sending data. The data from the base stations is continuously being sent to and received from a Master Control Centre (MCC) over mobile networks or the internet.

i. Base station network

One element that is most readily associated with planning and design of a Real Time Network RTK is the base station spacing and geometry. As with any network of sensors or emitters; to cover as broad an area with as evenly and with as few nodes as possible, an array of stations in a pattern forming equilateral triangles is best. While an RTN is not simply "solving triangles" as is mistakenly assumed by looking at a map of an RTN, a pattern of equilateral triangles does also provide an optimal geometry for certain types of network modelling and for post-processing services and users.

Spacing is a fundamental cost variable. There are many factors governing optimal spacing (per your RTN goals for performance/risks).

Even the most well planned theoretical spacing will be subject to site-specific considerations. The regular equilateral triangle pattern will in reality be unlikely to achieve. Finding suitable sites near your desired locations can be challenging. It is not always a direct trade-off between compromised site conditions and optimal geometry as there are many options to mitigate for less than optimal site conditions (see construction) as well as some flexibility in geometry (perhaps through slightly closer spacing).

ii. Suitable base station site

A brief summary of site conditions that may directly influence options for spacing:

- The quality of data that is sent and received from the site
- Availability of real-time communications
- Availability of reliable power
- Secure site availability

For the Rajasthan Real Time Network RTK an extremely important factor for the location of a site is the availability of infrastructure at or near the site. With the largest area to cover in the network and places which are remote and isolated, two realities force the consideration of the network spacing and geometry. First the availability of Raj Swan Point of Presence (PoPs) sites that house the required infrastructure and second the availability of Survey of India GCP control points (stable stations) that can be used where PoP sites are either not situated or not considered as suitable sites for setting up a CORS Base Station. It is of great significance that any dilution to the achievable accuracies, caused due to the location of a particular site, will be counter-productive to the capability of the technology.

iii. Infrastructure

The availability of infrastructure, reliable and continuous Electrical supply and communication modes, are an integral part of the design of the system. Without them the system would simply not work. Hence availability of reliable and continuous is mandatory. Where power supply is either irregular or not available, solar power is a popular means of providing power supply. Back-up generator supplied power can also be considered as a means of supplying power. Each of these methods has its own set of challenges to be overcome.

Communication of data can be done over mobile networks and the internet. However the will be situations where one or the other or both will not be available in remote locations of Rajasthan. Augmentation of communication will have to be done. This can be done over time with resources generated from this technology.

iv. The Master Control Centre (MCC)

The Master Control Centre (MCC) is the nerve centre of the system. The MCC harbours the software that generates the corrections to be supplied to the rover. It is also the centre from where the entire operations of the system are managed

A redundant/second MCC also needs to be located in case of an outage in the main MCC. It is important that the most qualified manpower is deployed for the highly specific operations of the MCC.

The MCC also stores all the data generated in this system. Hence a data storage system and a backup system need to be put in place along with all security precautions.

A preliminary Real Time Network RTK Base station setup is shown in the figure annexed with this document.

Seema Gyan

With the implementation of this technology, a new era will be ushered regarding the knowledge and delineation of boundaries, whether they are the individual parcel or the collective types of administrative boundaries. The old analogue methodologies which made the process of boundary delineation difficult to generate, maintain and update will be replaced by precise digital technologies which will not only make the process of boundary delineation easy to generate, maintain and update but will also be possible to disseminate the information to the user as well as otherwise be used in ever increasing formats and scenarios.

A parcel boundary is uniquely demarcated by its corners and edges. It also has a unique area. It is now possible that the unique character of a parcel can be derived and maintained.

The precision with which this technology can generate position data will make the parcel data unique for nearly all times to come i.e. until another revolutionary technology arrives to redefine the whole system of position data generation. In the near and distant future, RTN will be the mainstay of precision and consistent data generation of parcel boundaries.

The Future

The RTN system, its functions and its deliverables can be given a name and a new autonomous entity can be created. Say for example 'Rajasthan Position Data Services Inc (RPDSI)'. The RPDSI can be made autonomous. For the initial three years Govt (Settlement Office) can fund the enterprise. After three years RPDSI will generate its own funds to pay for its manpower, maintenance, augmentation, research etc. Till such time the office of the Settlement Commissioner will manage this entity.

It can create its own library where students can come to learn and do research on Geospatial Technologies with special emphasis on Geo-scientific research.

It can set up an advisory service where position data is needed it times of emergency and disasters. Many other technologies can be integrated such as real time tracking for high speed road and rail vehicles.

References

The National Land Records Modernization Programme (NLRMP) Guidelines, Technical Manuals and MIS, 2008-09. https://dolr.gov.in/sites/default/files/Guidelines%20%20NLRMP%2017.4.2009.pdf

Establishment of Ground Control, Network, Conducting Survey/Resurvey and Updation of the Survey & Settlement (Records), Operations in Rajasthan. https://bit.ly/2PkxvAh

BUSINESS

December 16, 2020 - March 15, 2021

Space Flight Laboratory (SFL) Announces Successful Launch of 12 Satellites on SpaceX Ride-Sharing Mission

Space Flight Laboratory (SFL), a developer of complete microspace missions, has announced the launch and successful deployment of 12 satellites on January 24, 2021. The SpaceX Falcon 9 ride-sharing mission carried three different SFL-designed microspace platforms into orbit for three separate commercial constellations. SFL is a unique microspace provider that offers a complete suite of nano, micro- and small satellites – including high-performance, low-cost CubeSats – that satisfy the needs of a broad range of mission types from 3 to 500 kilograms.

Capella Space Now Offers the Highest Resolution SAR Imagery Commercially Available

SF-based small satellite startup Capella Space is now exclusively offering the most cutting-edge synthetic aperture radar (SAR) imagery available on the commercial market. The company has now made available 50cm x 50cm "Spot" imagery — much higher resolution than the previous 1m x 25cm images that were the best available. SAR imagery offers advantages versus other types of satellite-based observation, because it can operate regardless of cloud cover, air visibility, lighting (whether it's day or night) and more.

TCarta Leverages AI Technology and ICESat-2 Data to Create Global Satellite Derived Bathymetry Product

TCarta Marine, a global provider of hydrospatial solutions, has introduced a Global Satellite Derived Bathymetry (G-SDB) product line developed with a new seafloor depth measurement technique that leverages Machine Learning and NASA ICESat-2 laser data. The first G-SDB offering covers the entire Red Sea – available now – with additional data sets rolled out through the end of this year.

LiveEO Performs Satellite-Based Vegetation Risk Analysis of Entire U.S. Electric Transmission Grid

For the first time in history, vegetation encroachment risk to the entire publicly available U.S. transmission grid has been analyzed from space by the Berlin-based start-up LiveEO. The goal of this large-scale analysis was to demonstrate LiveEO's market-leading analytic capabilities to a North American audience. In total, over 15,000 public satellite images were used to evaluate risk to 574,000 miles of electricity lines. (Details about the analysis can be found at www.live-eo.com/us-power-transmission-grid-analysis)

Microsoft Announces the General Availability of Geospatial Features in Power Apps

Microsoft has announced the general availability of geospatial features in Power Apps, which include both the Address Input and the Interactive Map Component. Geospatial features empower app makers to introduce location-based capabilities into their apps to visualize and update geospatial data using tools they are already familiar with. Geospatial components, powered by Azure Maps services, can now be added with the ease of drag-and-drop and with low code development.

CATALYST Announces Cost-Effective, Fully Scalable Processing of Earth Observation Imagery on the Cloud

CATALYST, a PCI Geomatics brand, has introduced CATALYST Microservices, a library of geospatial workflows and algorithms optimized to process Earth image data on the cloud at scale. Applicable to more than 70 aerial and satellite sensors, CATALYST products integrate powerful image analysis, photogrammetric and radiometric processing, and information extraction capabilities for professionals. CATALYST Microservices makes low-latency, high-refresh image processing a reality. By leveraging public cloud services, Microservices can process thousands of images covering large geographic areas in a fraction of the time on the cloud service.

Scientists Calculate Juneau Icefield Melting with 2D, 3D Glacier Models

The Juneau Icefield Research Program (JIRP) calculates that thinning of Alaska's Taku Glacier has increased from an average rate of a half meter to two meters per year over the past two decades. Annual mapping by JIRP reveals the glacier's thickness has increased and decreased from one year to the next, likely due to snow accumulation variability, but the overall current trend shows an annual net loss of ice. JIRP monitors the complex kinematics and mass balance of the Juneau Icefield – that is, they study annual changes to ice velocity, snow accumulation, and surface melting – to estimate if the glacier is advancing or retreating over time.

TCarta Awarded NOAA Grant to Enhance Satellite Derived Bathymetry Technology in Alaskan Waters

TCarta Marine, a global provider of space-based hydrospatial solutions, has been awarded a Small Business Innovation Research (SBIR) Phase II grant from the National Oceanic and Atmospheric Administration (NOAA). The research focuses on enhancing Satellite Derived Bathymetry technology for application in the coastal waters of Alaska.

Extensis Offers GeoViewer Pro All-in-One Geospatial Data Viewer at No Charge

Extensis®, a leading provider of digital asset management solutions, has announced its GeoViewer Pro for Desktop application will now be offered at no charge. GeoViewer Pro is a standalone GIS image viewer for compressed MrSID files, raster imagery, LiDAR point clouds, and vector layers. GeoViewer Pro was developed by LizardTech, now Extensis, as a paid multi-feature upgrade to the free GeoViewer application. It allows end users to view satellite, aerial and drone image files, as well as LiDAR data and GIS vectors. Moreover, it is a free way to view MrSID, JPEG 2000, NITF, LAS, and LAZ files created with the popular GeoExpress software.

Bentley Systems Enters into ~ $1.05 Billion Agreement to Acquire Seequent, Global Leader in 3D Modeling Software for the Geosciences

Bentley Systems, Incorporated has announced that it has entered into a definitive agreement with investors led by Accel-KKR to acquire Seequent—a leader in software for geological and geophysical modeling, geotechnical stability, and cloud services for geodata management, visibility, and collaboration —for $900 million in cash, subject to adjustment, plus 3,141,361 BSY Class B shares. The acquisition of Seequent is expected to initially add approximately 10% to each of Bentley Systems' key financial metrics (ARR, annual revenue, and EBITDA) and is expected to be measurably accretive to Bentley's organic growth rate. Most significantly, the combination will deepen the potential of infrastructure digital twins to help understand and mitigate environmental risks, advancing resilience and sustainability.

Phase One Announces P3 Drone Payload for Asset Inspection

Phase One, a leading developer of digital imaging technologies, has announced the P3 Payload, a versatile solution designed for fast, efficient, and safe inspection of critical infrastructure with an Unmanned Aerial Vehicle (UAV). The P3 Payload includes a Phase One iXM 100MP or 50MP camera, one of the RSM lens options, and a new gimbal with integrated rangefinder.

Farmonaut Partners With GarudaUAV to Provide Drone-Based Remote Sensing Technologies for Farming in India

Farmonaut has come together with a leading Indian drone services company, GarudaUAV, engaged in aerial data acquisition, analysis, and reporting for the promotion of drone-based remote sensing technologies for farming amongst the farmers. Through this partnership, Farmonaut is working towards educating Indian farmers about the benefits of remote sensing technology in farming and promoting the use of drone-based crop health monitoring services to the farmers.

Archaeologist Brings 18th Century Fort to Life with LiDAR and 3D Modeling

A Canadian archaeologist is using advanced mapping and visualization technologies to bring one of the earliest European settlements in North America back to life. Dr. Jonathan Fowler combined a centuries-old map with a modern 3D terrain model to portray Fort Anne and its surrounding in stunning detail – just as the Nova Scotia site looked in 1706. Fowler created the 3D representation of Fort Anne using the Surfer surface mapping package from Golden Software of Golden, Colo. For more than 35 years, Surfer has been used by more than 100,000 scientists and engineers to interpret complex data for oil & gas exploration, environmental consulting, mining, engineering, and geospatial projects. To create the 3D map of Fort Anne, Fowler loaded airborne LiDAR data into the Surfer package to generate a 'bare Earth' terrain model depicting the topography of the area as it exists today, minus vegetation and buildings. Fowler exaggerated the LiDAR elevation values slightly in Surfer to emphasize relief.

Trimble Announces Trimble TSC5 Controller, a Rugged, Lightweight Field Data Controller for Land and Construction Surveying

Trimble has introduced the Trimble® TSC5 Controller, a new rugged-yet-lightweight field solution that continues Trimble's legacy of creating high-quality controllers for land and civil construction surveyors. Built for practical, everyday tasks, the Trimble TSC5 combines high performance and dependability so professionals can complete tasks efficiently and accurately. The Trimble TSC5 features a 5-inch screen, keypad and all-day battery for reliable field data collection. Its ergonomic design is lightweight, easy to grip and ideal for rugged environments. The TSC5 is resistant to shock, dust and water. A brightly lit, anti-glare screen and backlit alphanumeric keypad enable fast, efficient operation in tough conditions. The Trimble TSC5 Controller running the Trimble Access field software is now available through Trimble's Geospatial distribution partners.

ISRO Launches 3 More Space Tech Incubation Centres to Promot Innovation by Students

To give a platform to budding space entrepreneurs, ISRO has inaugurated three space technology cecnters at National Institute of Technology at Nagpur, Bhopal and Rourkela. As reported by Times of India (TOI), the space agency has already opened three such centers at NITs Agartala, Jalandhar and Tiruchirappalli to explore the enterpreneurship of the students in the space domain, and they are functional now.

Golden Software Enhances Surfer Visualization Functionality for Deeper Data Insights

Golden Software, a developer of affordable 2D and 3D scientific modeling packages, has enhanced visualization and other functionality in the new version of its Surfer gridding, contouring and 3D surface mapping package. Surfer users now have a greater number of options for displaying their scientific data in the new version.

Esri's Site Scan for ArcGIS Introduces New Capabilities for US Drone Pilots

Esri, the global leader in location intelligence, has released a new integration in its Site Scan for ArcGIS flight planner with business partner Airspace Link, Inc., the leading North American provider of federal, state, and local government drone flight planning, authorization, and management solutions. The integration makes it possible for users to have insights into critical information relevant to the areas of their drone operations such as controlled airspace, special events, and no-fly-zones. This provides drone pilots with better situational awareness when planning automated drone flights. If a flight plan intersects with controlled airspace, users can submit a request to the FAA within the Site Scan flight planner application by leveraging Airspace Link's Low Altitude Authorization and Notification Capability (LAANC) authorization capability.

PRODUCT LAUNCH

December 16, 2020 - March 15, 2021

Leica Geosystems Announces BLK3D Update

Leica Geosystems, part of Hexagon, has announced the Leica BLK3D update. The new handheld imager has doubled its operating range and in-picture measurement accuracy for many indoor and outdoor applications, such as exterior building measurements for scaffolding, façade, roofing, and architecture projects. The BLK3D Update is rolled out with the new BLK3D Mobile and Desktop software version 3.0.

Hexagon | NovAtel Introduces New Marine-certified GNSS Receiver for Nearshore Applications

The multi-constellation MarinePak7 GNSS receiver supports Oceanix Correction Service and SPAN GNSS+INS technology for an assured 3D positioning solution. With SPAN GNSS+INS technology capabilities, the MarinePak7 deeply couples GNSS and inertial measurement units (IMUs) for a 3D understanding of your position. Delivering exceptional positioning, heading, attitude, velocity and heave measurements, the MarinePak7 is optimized to succeed in the demanding marine environment for nearshore applications. An intuitive user interface reduces training and setup time, making it an ideal solution for use in demanding marine applications, including dredging, hydrographic survey, marine construction and nearshore renewable energy operations.

Topcon File Formats Now Supported by Applications in CADD Software, n4ce

Topcon Positioning software and hardware users can now integrate files with Applications in CADD platform, n4ce, with the latest update from the developer. The significant update from older Topcon file versions now means that n4ce users can export files to machine control systems and import to Topcon's MAGNET Field platform. All .tp3, .ln3, .tn3 and .maxml files are now included in the supported file type list.

Leica Geosystems Introduces One App for All Terrestrial Laser Scanning Portfolio

Leica Geosystems extends the Leica Cyclone FIELD 360 mobile-device app to all Leica Geosystems 3D terrestrial laser scanners for in-field data acquisition and visualisation, enhancing the existing and well-established 3D reality capture workflow. With the simple push of a button from the mobile-device app, all Leica Geosystems' laser scanner users can capture high-quality data and verify registration directly in the field with a few simple clicks, saving valuable time in the office. The Leica ScanStation P-Series, the versatile, high-speed and survey-grade 3D laser scanners, now benefit from the existing workflow and proven productivity gains of the Cyclone FIELD 360 mobile-device app.

Add-on for the YellowScan CloudStation Suite Improves Accuracy and Ease of Use for Point Cloud Rendering

YellowScan has announced the immediate availability of its new software add-on module: Terrain. This new module enhances the processing power of CloudStation, YellowScan's powerful data processing tool that provides users the ability to create and manipulate point cloud data from their LiDAR mission's. It enables you to extract, process and display data immediately after acquisition, giving you the ability to program the auto-generation of flight lines and export .LAS files in just a few clicks. The surveyor can also visualize the result of the classification and select which classification class to visualize (unclassified, ground, other).

Leica Geosystems Offers Mobile, Agile 3D Reality Capture Solution for Boston Dynamics Spot

Leica Geosystems has announced a reality capture solution for a variety of industries. By combining Boston Dynamics agile mobile robot Spot with the industry-proven Leica RTC360 3D laser scanner, scanning time spent by human operators is significantly reduced by programming the devices to repeat automated scanning paths through sites. This requires minimal monitoring by the user, allowing for increased scanning efficiency, productivity, and flexibility when planning reality capture tasks. Professionals in many different industries such as construction, manufacturing, facility management, public safety, defence, media and entertainment or any other industry with autonomous scanning needs can benefit from programmed scanning tasks, especially for locations that must be repeatedly scanned.

GEO EVENTS

April 23-25, 2021
GISTAM 2021
Prague, Czech Republic
http://www.gistam.org/

May 19-20, 2021
GEO Business
London, UK
https://www.geobusinessshow.com/

July 4-10, 2021
XXIV ISRPRS Congress
Nice, France
http://www.isprs2020-nice.com/

August 24-27, 2021
FME International User Conference 2021
Vancouver, Canada
https://www.safe.com/fmeuc/

September 27 – 30, 2021
11th international Conference on Geographic Information Science
Poznań, Poland
https://www.giscience.org/

September 27 – October 2, 2021
FOSS4G
Online
https://2021.foss4g.org/

October 11-14, 2021
3D GeoInfo 2021
Online
https://3dgeoinfo2021.github.io/

October 25-28, 2021
Northwest GIS User Group conference
Yakima, Washington, USA
https://nwgis.org/nwgis2021

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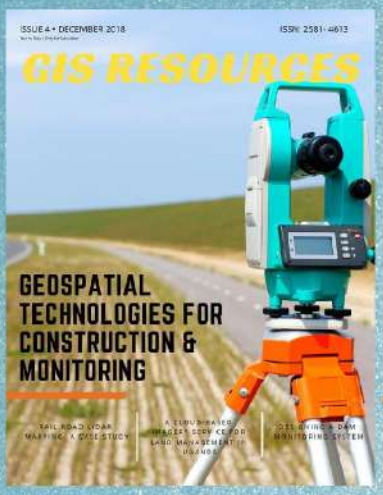

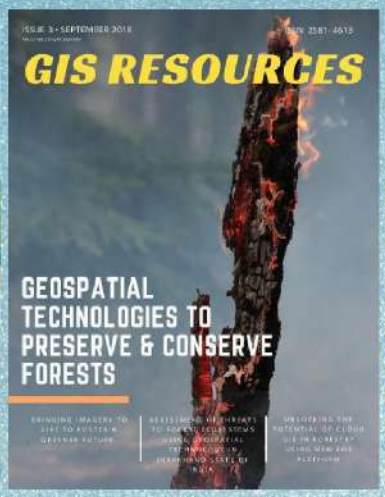

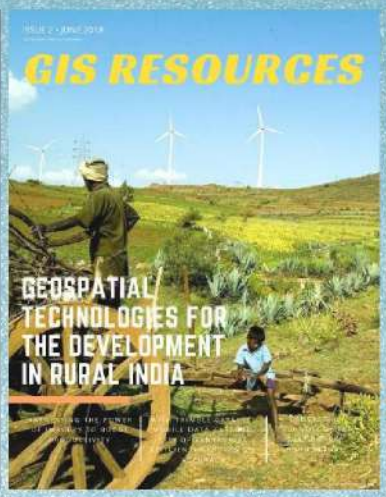

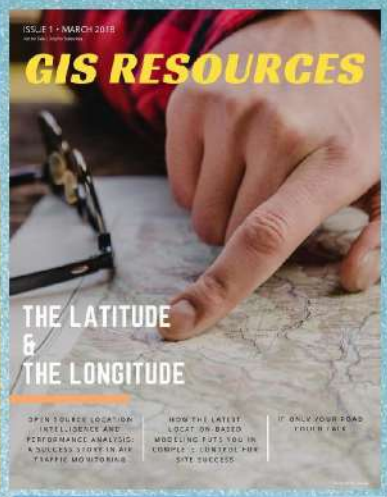

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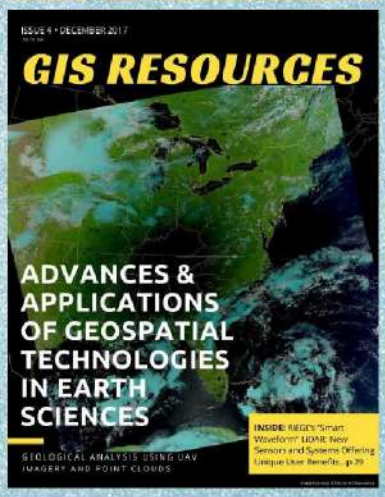

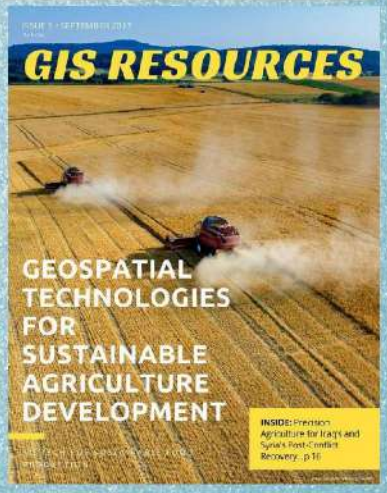

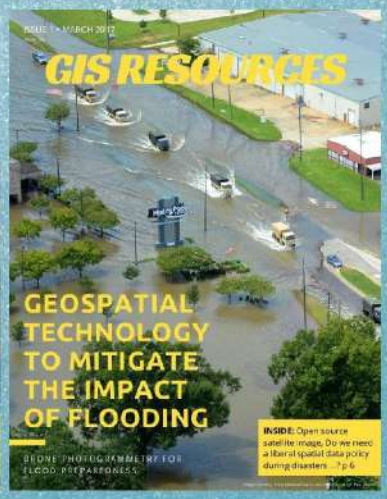

For enquiry, write us at support@gisresources.com