ALLEN & COMPANY
Founded in 1988

SURVEYING • MAPPING
GEOSPATIAL SERVICES
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zldjkfc

TUCKER RANCH:

A Culmination of Advanced Technology for Surveyors

11/2023


NavVis VLX 3

INTRO

As a leading surveying, mapping, and geospatial services firm, Allen and Company (ANC) sought to establish a location where it could acquire a diverse range of data capture using a variety of devices and tools from its array of resources. The objective of selecting a location suitable for multiple rounds of data acquisition was met by Tucker Ranch —a prime location where the company could educate and train our Construction, Surveying, and Subsurface Utility Exploration (SUE) departments on all available scanning technologies, their accuracies, and the range of deliverables that can be produced. The company's goal was to show our team of surveyors how they could leverage this technology within their current work and educate them on the results and applications of the different types of sensors available, allowing them to make an educated decision on which scanners would work best to integrate into their current workflows.

As ANC embarked on this journey, our Advanced Technologies' specialists realized the work we were doing had an added benefit for the geospatial community. It was at that point that we began to realize the potential opportunity to evaluate other data acquisition sensors we had considered purchasing, in an environment where the data was directly comparable at the same exact location between multiple datasets and collection methods. Seeking to make this a collaborative effort among other industry leaders, we reached out to vendors who offered a product or technology that would be conducive to collecting data at this site—and the response was overwhelming, with the study now including multiple viable solutions.

In our experience, when evaluating a sensor, customers receive data sets from vendors of a cherry-picked site that can show off their sensor in the best possible conditions.

In most cases, the customer is unable to compare two or more sensors directly in the same environment, or under the conditions that your company would typically perform. Through our Tucker Ranch Project, ANC was able to entice sensor manufacturers to visit a neutral site, acquire data, and return their data to Allen and Company for our Advanced Technologies' specialists to analyze. It was at this point that we understood the inherent value to others in the industry, as we were able to compare different sensors and collection methods across a wide range of prices and setups—providing them with a plethora of information to make an informed decision on which technology could be used to achieve their geospatial goals and objectives.

Tucker Ranch is a public park located near ANC's Winter Garden, Florida office. Tucker Ranch consists of a circular road with parking spaces encompassing the park, with large trees and structures. Under the trees, there is a playground with equipment and ADA ramps. Our specialists determined this would be an excellent subject area to test a multitude of geospatial and data capture sensors. The parking lot/road within the park allows mobile sensors to get a 360-degree drive around that park. The large area also presents enough space to fly airborne sensors using UAVs, allowing for a quick and effective mission to be flown for data capture.

Given the versatility of the site, you will be able to see different capabilities of the sensors that appeal to many individual uses and applications. The trees with the playground underneath allow you to see the ability of a sensor to penetrate vegetation and get multiple returns below the trees. The walkways, ADA ramps, and curbs allow users to examine a sensor's ability to pick out defined features, such as mapping curbs and paint lines for an ALTA survey. The site has some ditches and elevation changes, which also allow evaluating a sensor's ability to produce topographic mapping with enhanced resolution and detail.

Tucker Ranch serves as an optimal training site for ANC since it is located 2.5 miles from our HQ office in Winter Garden, allowing us to perform drone pilot training, as well as junior crew chief and crew chief training. To assist with this training, we established First Order horizontal and Third Order vertical control. To establish this control, our specialists set up seven intervisible ANC Control Points (Mag nail with numbered disk) around the loop to create a seven-sided irregular Polygon. We then performed a Closed-Loop Traverse with a one-second Total Station and achieved a horizontal misclosure of 0.033'. After that we ran a Closed-Loop Digital Level Run from Orange County Benchmark designation R407002 through the Control Points to Orange County Benchmark designation C1278035 with a vertical misclosure of 0.002'.

Next, we adjusted this Level Loop to provide NAVD 88 elevations on said Control. We then adjusted the Closed-Loop traverse using the Compass Rule to provide temporary coordinates. At this point we performed two-hour static GPS observations on the northerly-most and southerly-most Control Points (#13,000 and #13,003) and submitted these observations to OPUS (National Geodetic Survey On-line Positioning User Service) to obtain First-Order Horizontal Coordinates. We then oriented our adjusted traverse to these OPUS coordinates. The product of these efforts has produced a Geodetic Control Network with First-Order Horizontal Coordinates and Third Order NAVD 88 Elevations.

To survey this sight conventionally, ANC would have established control in the same manner which took a day and then begin getting shots with a total station. Profiling the road and paint stripes would take a day, the curb stops depending on level of detail, two shots vs full profile could take another few hours to a day. To get the water lines and all the other shots to capture the topographic features is about another day (assuming no alligators). To capture the walkways for ADA compliance it's about another day worth of getting shots. The drip line of the tree canopy and wires and poles running through the site and all the structures in the park would take another day to capture. Cutting lines though the ditch at the north end of the park for profiling would take another day or two. All told to survey this site conventionally we are looking at about a week in the field. In comparison to collecting this with a terrestrial system it's likely a day for control and then another day to collect all the data, for UAV and mobile systems the acquisition likely would have taken place the same day as doing the control.

To process the conventional data, it likely would take three days to create the surface assuming nothing is missing and requiring another trip to the field. Whereas to process the LiDAR and extract all the features it likely would have taken a day to process the data and two days for all the feature extraction.

With the availability of modern remote sensing techniques using LiDAR and Photogrammetry, Tucker Ranch can be scanned by your chosen sensor and the data would then be processed in the vendors' processing software. The data would then be verified against control, and once the raw point cloud is adjusted to control, we can begin digitizing the features from the dataset. With remote sensing techniques, customers can spend less time in the field and more time in the office post processing the data—allowing them to deliver their expertise and produce all required deliverables. Depending on the level of feature extraction and the software tools available, this process dictates how easy the tasks are to process.

SENSORS

The data capture sensors can be segmented into three categories: Terrestrial, Mobile, and Aerial. Within those categories, some of the sensors may be used or adapted to multiple different types of acquisitions. When evaluating a sensor, it is important to consider what the primary use of the sensor is going to be, since each acquisition type has trade-offs—depending on the deliverable or output you are trying to achieve.

ZF Imager

Mobile

A mobile sensor consists of a LiDAR sensor mounted to a car or other vehicle that is then driven throughout the subject area. With mobile sensors in general, you can achieve hyper-dense data close to the vehicle, and then more sparse data further away. A mobile system can be more efficient for collecting long stretches of roads, or the outside of buildings or power lines along a road with very high-density specs. Since the mobile sensors are mounted to a truck, you are limited to mapping areas that the vehicle can access. This means that roofs and anything shaded or shadowed by another object may not be collected, preventing you from using it in confined spaces. Due to the very dense data near the vehicle, mobile sensors can be very effective for surveying in the transportation sector. However, with mobile datasets you can expect accuracy challenges in areas where you lose GPS satellites often, at which point you must rely on the IMU and DMI units. Typically, these units will have a lower quality trajectory solution than an airborne sensor.

Additional items to consider when buying a mobile scanner are the integration cost/vehicle compatibility, maximum speed for the point density and spacing you desire, IMU quality, and whether the system has a DMI, and camera integration. Mobile data can pose challenges and could require senior analysts to work with in cases where the data doesn't come out exactly as expected.

Airborne

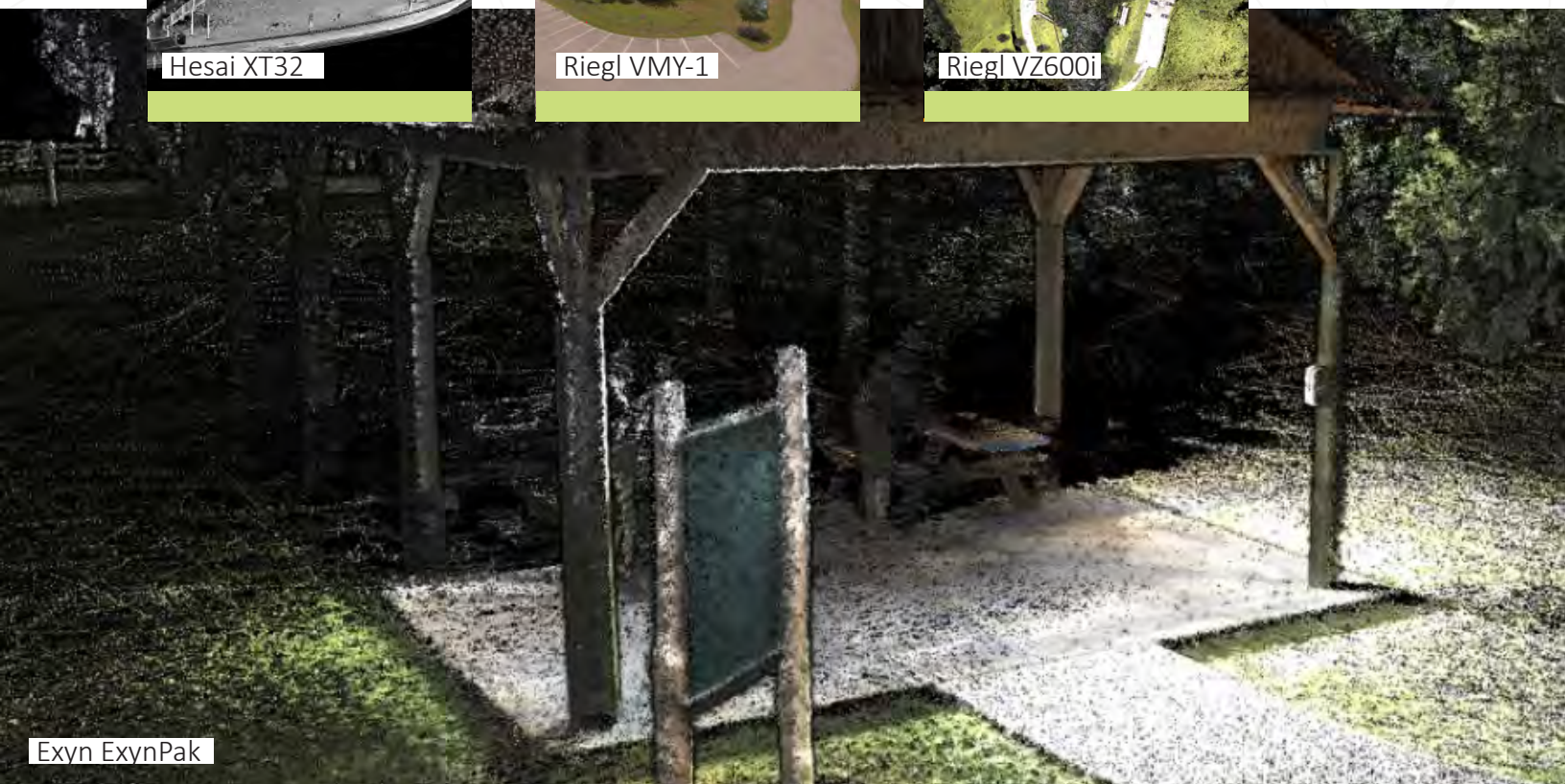
Airborne sensors are mounted in or on a UAV, helicopter, or aircraft, allowing you to capture data across large areas quickly and accurately. In the Tucker Ranch Project, we focused primarily on UAV sensors, since the UAV market is flush with options along all price ranges and levels of versatility. UAV LiDAR is a highly portable solution that offers a good overview of an entire project site in a quick and effective manner. That said, there are some trade-offs since when using a UAV, you will need to employ an FAA Part 107 certified pilot to operate the drone. In terms of data, an airborne system does a good job at acquiring a total data capture of the area. Additionally, depending on the density and the number of returns per pulse, the sensor may be capable of penetrating a dense forest canopy and get returns of the ground. Airborne sensors are excellent for wide-area mapping and topography, and powerline surveys. However, with an airborne survey, you may not be able to acquire data under solid objects or where the point density on vertical surfaces may be sparse. In some situations, UAV sensors can be mounted on a vehicle and become mobile sensors, but they can also be mounted to helicopters for broader area data collection.

Other items to consider when comparing airborne scanners, including the maximum number of returns per pulse, the power of the laser, the beam divergence, the IMU quality, and camera integration options. The maximum number of returns is very important, not all sensors are created equal in this department and can range from a single return per pulse to 5+ returns depending on the sensor. The more pulses per return will allow you to penetrate through gaps in vegetation better and increase the likelihood that you will get good ground returns. These sensors can be ideal for companies who already have some scanning experience and are looking to add more to their offerings. The learning curve isn't too complex, but having a specialist with expert knowledge of the settings can increase the effectiveness of the data collection, allowing them the opportunity to ensure accuracy and precision in the process.

Hesai XT32

Riegl VMY-1

Riegl VZ600i



Exyn ExynPak

Riegl VZ600i

Terrestrial

Terrestrial sensors are yet another option that are typically a tripod-based system on-site where a scan is initiated and then moved to the next setup location and another scan. These provide a low-entry bar, typically in terms of cost and operation. Additionally, terrestrial scanners provide hyper-rich data but with a slower acquisition time than some of the other sensors. One of the benefits about terrestrial sensors is their ability to scan inside and outside of buildings to create hyper-dense point clouds of a structure or area. However, one adverse consideration is that these sensors can only scan from areas where you can set the sensor up on firm ground. This means that if you don't have roof access in a facility, you may not be able to incorporate the roof area into the scanned dataset.

Consequently, items to consider when comparing terrestrial scanners includes time to complete each scan position, the accuracy shift at range, backend processing time to align the different scan positions with each other, camera options for colorized point clouds and structured e57's. In our experience, these are also great entry points. Each vendor under this study has an adequate training program to get your team up and running in a matter of

SLAM note

With laser scanners, an important consideration among all the sensors is the method used to acquire the positional information of the data. For the most part, you have two options: SLAM and GPS-based positioning to choose from when looking at sensors. GPS based scanners use a GPS signal and an IMU to obtain a global position of the sensor. If the system loses GPS or IMU for too long, then the positional solution can degrade, and you could end up with poor accuracy. Therefore, these types of systems do not perform as well in areas with very poor GPS signal. However, when you have good GPS satellite connections you are likely to acquire more spatially accurate data without having to register it to survey control.

With SLAM systems, the sensor doesn't worry about its global position, but it focuses more on its relative position to the objects around it. With a slam system the unit uses the LiDAR to figure out where it is located relative to its surroundings and can position the data accurately relative to itself with this information. To globally position the data, you must then register it to known control points that are visible in the LiDAR.


Faro Focus

Conclusions

When considering all the sensor options available on the market, it can be difficult to determine which sensor will suit your company best. There is no single sensor that is perfect for every job, and it will be up to you to analyze the data and determine which sensor will meet your needs the most. Given the wide range of application methods and sensors available, determining what you need can be a balancing act where you are weighing cost versus acquisition speed/ease versus data quality versus processing speed. Allen & Company trusts that the available data downloads and information we have prepared can help other professionals and organizations understand how sensors can be applied to traditional surveys, helping them make an informed decision on what equipment would suit your needs best.

Looking back on this case study and how it evolved, we believe that the data is very valuable in its own right. When looking at the data from the various sensors, it will be beneficial to keep in mind that they are not direct comparisons and, in some cases, they are using different settings or ranges of scanning, so it may not showcase the full potential of the sensor.

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About the Team

- Shawn Asher - Integration and Partnership Manager
- James Rush - QA/QC Manager
- Daniel Brice - Operations Manager
- Shawn Maturo - SUE Director
- Lee Sanders - Project Manager
- Josh White - Geospatial Analyst / UAS Pilot
- Rob Santi - Reality Capture Specialist
- Shea Gleadle - Reality Capture Manager
- Martin Alvarez - Geospatial Analyst 2
- Mark Follis P.S.M.- Manager of Construction Services
- Enoc Lopez - Crew Chief

Vendors and Partners

BAAM.TECH

emesent

FARO

TRIAD DRONES

NAVVIS

Optech

RIEGL

Zoller+Fröhlich

exyn technologies

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The data captured by ANC and the sensor manufacturers that participated in this collaborative report can be downloaded for further exploration at:

www.allen-company.com/rcn2023

In addition to the data sets available for download, ANC has included a supplemental portion of this report to feature sensor information provided by the vendors detailing specific information about the sensors used in this study. Please feel free to contact the sensor manufacturers with any further questions or potential product demonstrations.

Allen and Company would like to personally thank all the vendors and partners that agreed to participate in this study. Without your participation, the culmination of this data would not have been possible. We greatly appreciate the time and energy invested in helping us bring this study to surveyors and reality capture companies everywhere.

Fondly,

The Allen and Company family

A new DJI GS RTK app and Remote Controller with built-in screen, giving users a streamlined control scheme for surveying missions and other data acquisition scenarios. To take full advantage of the Phantom 4 RTK's positioning modules, the new TimeSync system was created to continually align the flight controller, camera and RTK module. Pilots with experience using 3rd party apps on DJI drones can access the world's leading drone app ecosystem for their Phantom 4 RTK with the SDK Remote Controller. Support your Phantom 4 RTK missions with the D-RTK 2 Mobile Station – providing real-time differential data to the drone and forming an accurate surveying solution, or acquire accurate location coordinates when used as an RTK rover.

RTK

RTK module is integrated directly into the Phantom 4 RTK, providing real-time, centimeter-level positioning data for improved absolute accuracy on image metadata. In addition to optimized flight safety and precise data collection, the Phantom 4 RTK stores satellite observation data to be used for Post Processed Kinematics (PPK), which can be conducted using DJI Cloud PPK Service

The Zenmuse L1 integrates a Livox Lidar module, a high-accuracy IMU, and a camera with a 1-inch CMOS on a 3-axis stabilized gimbal. The L1 gives you real-time 3D data throughout the day, efficiently capturing the details of complex structures and delivering highly accurate reconstructed models.

Real-time point clouds provide immediate insights onsite, so operators are informed to make critical decisions quickly. You can also verify fieldwork quality by checking point cloud data immediately after each flight. For improved accuracy, post processing in DJI Terra fuses the IMU and GNSS data for point cloud and visible light calculations, in addition to conducting POS data calculations so you can effortlessly generate reconstructed models and accuracy reports.

Zenmuse L1

Livox Lidar Module

- Frame Lidar with up to 100% effective point cloud results

- Detection Range: 450m (80% reflectivity, 0 klx) / 190 m (10% reflectivity, 100 klx)

- Effective Point Rate: 240,000 pts/s

- Supports 3 Returns

- Non-repetitive scanning pattern, Repetitive scanning pattern

RGB Camera

- 20MP

- 1-inch CMOS

- Mechanical Shutter

exyn technologies

ExynPak

Portable 3D Geospatial Scanning

100% Effective in GPS-Denied, Dense Urban Environments

Highly accurate, rapid data collection with best-in-class drift mitigation

Real-time colorized point cloud data available while scanning

All data processing can be performed in-situ locally on the provided tablet without uploading to a server- no internet connection required

Standard processing and data refinement time takes roughly the same amount of time as it does to collect the data

Data export in the most common standard file formats: las, ply, and xyz

All necessary software for collection, processing, and export is included with system purchase- no recurring licensing fees

Modular collection- Use in handheld mode or mount the ExynPak on a vehicle, backpack, or other mode using our provided mounting guidelines

exyn technologies

Exyn Technologies features leading edge robotics with an unparalleled level of autonomy and highly precise geospatial scanning and on¬board processing, especially with the versatile ExynPak.

Our LiDAR-driven autonomy is seamless, and the scanned point cloud is precise, detailed, and available in near real time. Our systems have been proven through five generations of continually optimized product releases.

RTC 360

The Leica RTC360 3D laser scanner empowers users to document and capture their environments in 3D, improving efficiency and productivity in the field and in the office through fast, simple-to-use, accurate, and portable hardware and software.

Highly portable, highly automated, intuitive and designed for maximum productivity, the RTC360 solution efficiently combines the RTC360 a high-performance 3D laser scanner, Leica Cyclone FIELD 360 mobile device app for edge computing for automatically registering scans in real time, and Leica Cyclone REGISTER 360 office software to integrate your 3D model seamlessly into your workflow.

Capture scans, including enriching High-Dynamic Range (HDR) imagery, in less than two minutes.

Automatically record your moves from station to station to pre-register your scans in the field without manual intervention. Augment your data capture with information tags illustrating the opportunities for better planning, reflect site reality, and boost your teams' situational awareness.

FARO
Focus Premium

Speed: From scanning construction sites to capturing the as-built conditions of pre-existing structures, the Focus Premium gathers quality data faster and with greater precision than ever before.

Designed as a new scan mode for the Focus Premium, (available as an add-on subscription through FARO Sphere, the company's cloud-based project management platform) Flash Technology™ combines the accuracy of a 3D scan with the speed of a panoramic camera – enabling fast scans in under 30 seconds with colorized 360° images that save up to 50% scanning time.

Variability: The Focus Premium gives users options to choose various scan settings which impact the time spent on site as well as the quality of the data. Variability over how the Focus Premium captures data creates the opportunity for users to maximize the product's use, no matter the project or its complexity.

Stream: Real time top-down visualization in the field gives users confidence the Focus Premium is capturing every detail they need. After scanning, the data can be brought into our registration software, FARO SCENE, where it can be easily registered as it retains the prepositioning (from a pre-registration function) from the Stream mobile app. Using Stream and FARO's cloud-based platform, Sphere, data can be uploaded from the field and processed in the cloud. This information can then be downloaded and shared with all project stakeholders – wherever they reside – all without having to share a physical SD card in the office. This ease of information transfer saves time and allows for deliverables to be created much faster than more traditional digital (or analog) methods.

FARO

For over 40 years, FARO has been a pioneer in reality capture technology, bridging the digital and physical worlds through data-driven reliability, accuracy, precision, and immediacy. The Focus Premium captures accurate, photorealistic 3D representations of any environment or object in just a few minutes, even in the most extreme outdoors conditions.

CLS-A

The CLS-A is specifically designed to capture the highest accuracy point clouds from a UAV. For topographic mapping applications the CLS-A can operate at 400ft agl for maximum productivity while simultaneously capturing both the top of canopy and ground surface in forested areas. For applications requiring precision data, the CLS-A capture precise small features such as curbs and gutters in road construction, and discrete conductors and guywires for electric utility modelling. The CLS-A includes a 24 Megapixel camera to accurately colorize the point cloud for additional context. Integration kits for many commercial UAVs are available including the Freefly AltaX and the Inspired Flight IF1200A. The CLS-A is manufactured in Toronto, Canada with global support and multiple service plan options..

TELEDYNE

The CLS-A includes the Teledyne Optech Lidar Mapping Suite (LMS) software for processing collected data into a refined customer deliverable product. LMS includes support for processing both lidar and camera data including refining internal and external calibration parameters, trajectory corrections for strip alignment, processing datasets from different instruments together, transform between several hundred coordinate reference systems, control points reports, and tools to diagnose and correct problematic datasets.

TRIAD DRONES

The Tucker Ranch LiDAR data set was collected with a Triad Drones TRIDAR Hesai Pandar XT32 using an Emlid Reach RS2+ for comparative GNSS observations and was flown by the Triad Echo UAV. The Echo was released in 2023 as an update to the previous year model for a medium sized aircraft that could carry a variety of sensors. The Hesai M2X sensor is built in partnership with Inertial Labs and is one one of over 1000 fielded systems in the survey mapping and utility industry. The Hesai Pandar XT32 boasts a system precision of 2-4cm and a 24MP RGB Mapping Camera allows for colorization of the point cloud as well as PPK images for othomosaic creation at an affordable price tag, amking it perfect for day to day field work.

XT32

The Echo and Hesai XT32 combination is designed to be a workhorse. It is an easily transportable system, and with training, has the ability to survey an average of 30 acres per flight with centimeter accuracy. This makes the system perfect for doing tasks ranging from measuring powerline sag to easily generating 1 foot topos in densely foliated areas. Additionally, the sensor can be taken off the drone and mounted to any vehicle to further enhance any aerial data collection via mobile mount. For companies that want to enhance the data collection capabilities of their ground crew at an affordable price, the Hesai XT32/ Echo combination is hard to beat.

VLX3

All-in-one, highly-detailed reality capture. Comprehensively capture 3D measurements with two 32-layer lidar sensors in combination with groundbreaking SLAM software to deliver industry leading point cloud quality for a wearable device. Four cameras positioned on top of the device take high-resolution, sharp images in every direction for a complete 360º image — all without the operator appearing in the field of view.

NavVis

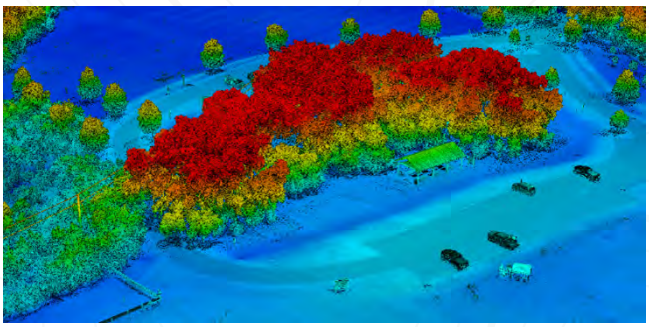
NavVis VLX 3 is the industry-leading, wearable mobile mapping system that efficiently delivers comprehensive, highly detailed reality capture data to laser scanning professionals for complex sites, both indoor and outdoor.

VUX-120^{23}

The VUX-12023 is capable of up to 100o of FOV and allows for wide swaths of capture. When this is paired with the long-range capabilities of the scanner and up to 2,000,000 points/second, large areas and corridors can be captured quickly and efficiently.

The scanner provides an internal data storage capacity of 1 TByte and a removeable CFast card and is equipped with interfaces for integration of an external INS/GNSS system. Additionally, the scanner can be interfaced with up to 2 external cameras.

The lightweight and sleek design of the system allows for smooth integration on a multitude of UAV systems, small manned airplanes, and helicopters as well. With the simple integrated design for either UAVs or manned aircraft, deployment and mounting of the scanner can be quick and easy.



RIEGL®

The VUX-12023 is RIEGL's newest generation of unmanned scanner that offers a unique nadir, +10o forward, and-10o backwards scanning pattern. This allows for better collection through vegetation and even allows for collection of vertical surfaces that would be tougher to pick up with traditional nadir scanners. This combined with up to 2400 kHz of PRR (pulse repetition rate) and up to 32 returns on a pulse creates a highly detailed and dense point cloud and allows for efficient collection.

Contact Info: RIEGL USA Website: www.rieglusa.com Contact Email: info@rieglusa.com

VMX-2HA

With 3.6 million measurements and 500 scan lines per second, this turn-key solution is ideally suited for survey-grade mobile mapping applications.

This powerful technology comprises of two RIEGL VUX-1HA^{22} High Accuracy LiDAR Sensors and a high-performance INS/GNSS unit.

A camera interface for up to 9 cameras enables true flexibility and choice of camera system for every project type.

With choices of 5mp, 12mp, 24mp, and options for Ladybug5+ 30mp, and Ladybug6 72mp integration, the VMX-2HA offers a camera solution for any problem.

The VMX-2CU precisely controls management of power, data acquisition, and operation of the laser scanners, INS/GNSS sensors and the optional cameras. A 10 GigE network and a set of SSD storage media with a total of 8 TB disk space enable big data handling for uninterrupted data recording of comprehensive missions.

A handy touchscreen and the RIEGL data acquisition software facilitate the operator's task in the field by providing real-time visualization of acquired scan data and imagery. The RIEGL software packages also offer comprehensive features in data processing. Including RIEGL's RiPRECISION, a rigorous data alignment algorithm merges overlapping mobile scan data. Furthermore, it enables the scan data to be fitted to specific control objects which results in a consistent point cloud of enhanced precision. With the data processing wizard, users can expertly move large datasets though the process without delay.

RIEGL®

The RIEGL VMX-2HA is a high speed, high performance dual scanner Mobile Mapping System which provides dense, accurate, and feature-rich data at highway speeds. The VMX line of systems has been RIEGL's flagship mobile mapping system for 14 years.

Contact Info: RIEGL USA Website: www.rieglusa.com Contact Email: info@rieglusa.com

VZ-600i

The most significant changes include a major reduction in weight and size. Weighing in at just 13lbs (6kg), the VZ-600i is extremely portable and can literally fit into an airplane's overhead baggage compartment. Impressive increases in the PRR (pulse repetition rate) from 1.2MHz to 2.2MHz provides fantastic detail and resolution, coupled with an industry-leading line speed of 420 lines/sec. Integrated internal cameras (3x 12mp CMOS sensors) capture images simultaneously during LiDAR scan acquisition, as well as the optional external high-resolution camera. An integrated IMU and RTK GNSS receiver provide accurate positioning and self-leveling. With an exceptionally short acquisition time of only 25sec and onboard automatic registration, the new VZ-600i redefines the meaning of productivity.

RIEGL®

RIEGL has proudly introduced the next generation of terrestrial laser scanner systems to the demanding static LiDAR survey market. Emanating from the proven capabilities and features of the VZ-400i, the new RIEGL VZ-600i brings unprecedented productivity and sets a new benchmark in terrestrial laser scanning efficiency for the engineering and construction industries, where maximum measurement precision and resolution are demanded.

High Productivity

- 60 scan positions per hour (with image acquisition)
- One-Touch button operation
- RIEGL VZ-i Project Map App for scan project monitoring
- simultaneous scan and image data acquisition
- Real-Time On-Board automatic registration
- One-Touch Processing Wizard in RiSCAN PRO for automatic production of detailed PDF-report

Ultimate Performance

- broad range capability (0.5 m up to 1000 m)
- 5 sec scan time for low resolution overview scans
- 25 sec scan time for 6mm resolution @ 10m distance
- pulse repetition rate up to 2.2 MHz
- 3D position accuracy up to 3 mm @ 50 m
- scan speed up to 420 lines/sec
- high speed data download of up to 500 MB/sec

Contact Info: RIEGL USA Website: www.rieglusa.com Contact Email: info@rieglusa.com

VMY-1

The central part of the system is the RIEGL miniVUX-HA LiDAR sensor providing up to 300,000 points per second.

There is an optional integration of up to four DSLR cameras, of a Ladybug5+.

The innovative design of the system enables folding for convenient transport and space-saving storage.

With the VMY-1, the system is configured as a dual use system. In about 15 minutes, the VMY-1 can be converted into a ULS system, ready to mount to a drone.

RIEGL data acquisition software facilitates the operator's task in the field by providing real-time visualization of acquired scan data and imagery.

Data from the VMY-1 is processed through RIEGL's post processing software RiPROCESS. RiPROCESS is the RIEGL software package for kinematic LiDAR data processing. It is designed for managing, processing, analyzing, and visualizing data acquired with RIEGL's mobile mapping systems.

The data you see from the Tucker Ranch project was run through RiPROCESS and took a total time of 16 seconds to process, and 15 seconds to export out the point cloud. Now that is some lighting fast processing!

RIEGL®

The RIEGL VMY-1 is an economically priced Mapping System of small dimensions, that is well suited for a variety of mobile mapping applications. The VMY-1 is also set up for the sensor to be quickly converted to an integration for a variety of drone platforms.

Contact Info: RIEGL USA Website: www.rieglusa.com Contact Email: info@rieglusa.com

IMAGER 5016A

The Z+F IMAGER 5016 combines compact and lightweight design with state-of-the-art 3D laser scanning technology, allowing your project delivery to reach new levels. The Z+F IMAGER 5016A is equipped with an intergrated HDR Camera, ternal Lighting, and positioning system. All components of tthis 3D laser scanner have been custome developed and manufactured to our specification. This results in the highest quality scan data at the highest acquisition speed and a more efficient workflow.

Z+F's true in-field-registration as part of the Blue Woflow reduces the time spend on dataprocessing significantly and lets you ensure that your project is properly aligned before you leave the site.

Zoller+Fröhlich (Z+F) has been pioneering 3D laser scanning technology since the mid-1990s. Our award-winning technology is easy to use and provides outstanding resolution of data in a wide range of environments. When using our 3D laser scanners with our proprietary blue workflow, you can significantly increase efficiency for your specific application.

Hovermap ST-X

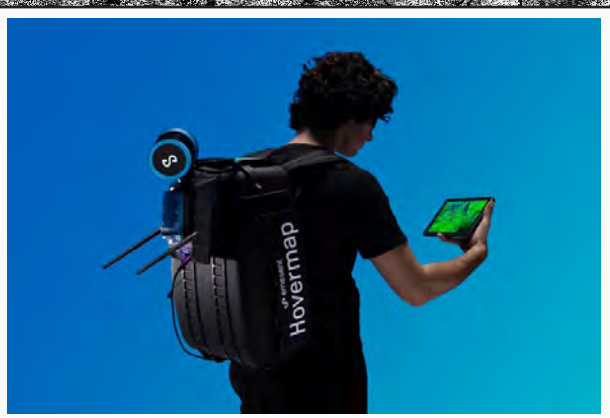
Backpack: Emesent Hovermap's ergonomically designed hard case backpack is engineered to maximize comfort during walking scans and keep Hovermap secure when traveling. With a tough, water-resistant polypropylene shell, the backpack provides external mounting and power for Hovermap.

Added thickness in critical areas provides superior support and protection while adjustable shoulder and side straps are made of soft air mesh to allow for comfort and quick moisture evaporation. Inside, the backpack includes a custom cut foam liner and battery mounting suitable for V-mount style batteries up to 45mm high. Additional accessories can be attached via four extra-strong molded side loops.

Emesent Colorization: Emesent Colorization allows you to augment Hovermap's 3D point clouds with true color, providing additional context for visualization and analysis. Delivering a new level of reality capture, our plug and play accessory allows you to achieve greater insights across a variety of applications and reveal previously difficult to discern details in your critical infrastructure.

Emesent Hovermap ST-X: Emesent Hovermap incorporates the latest in LiDAR sensing technology to deliver high density point clouds with exceptional coverage. Featuring a sensing range of up to 300 meters and more than a million points per second, Hovermap captures detailed, accurate survey-grade data over a wide area fast – accelerating your time to insight.

This powerful combination of precision engineering, world-leading SLAM algorithms, and robust drone autonomy capability provides highly accurate LiDAR mapping. Tough, lightweight, and IP65 weather sealed, Emesent Hovermap ST-X captures valuable data in previously inaccessible areas. Featuring the industry-leading capabilities of the award-winning Hovermap ST at its core, ST-X captures more detailed data, faster, and from further away, with 3x the scanning range and double the number of laser sensors. Lighter, and uniquely versatile, Hovermap ST-X extends the safety and efficiency of long-distance autonomous LiDAR mapping even more.



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Built on a decade of pioneering research at Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO), Emesent provides state-of-the-art SLAM-based LiDAR mapping and data analytics, specifically designed for inaccessible and GPS-denied environments.

At the heart of Emesent's offering is the award-winning Hovermap, a versatile and autonomous mapping system, which is complemented by Commander, a mission planning and control app. Data processing, auto-cleaning, and visualization is delivered via Emesent's Aura software."