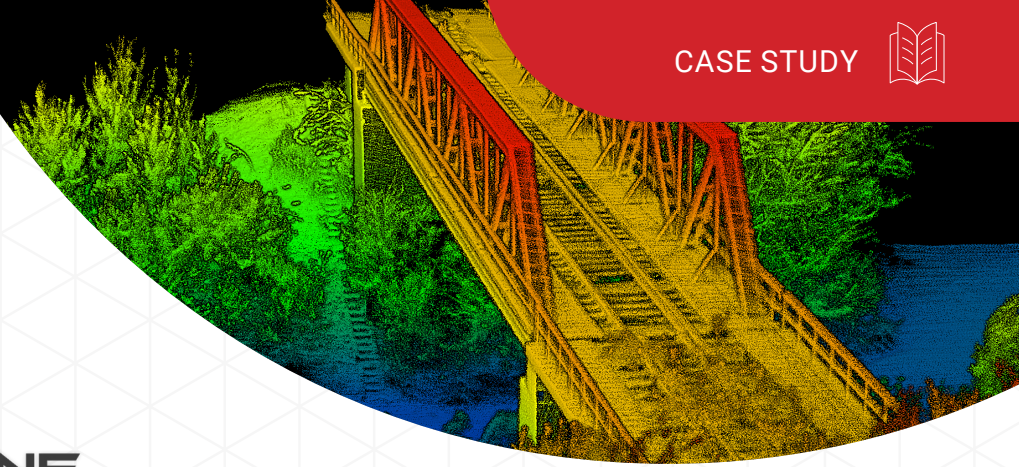


**DRONEZONE**

Dronezone srl.

Dronezone srl build payload including Inertial Navigation System (INS) and LiDAR to survey a railway bridge.

Summary

Company:

Dronezone srl.

Application:

Infrastructure Monitoring

Industry:

Drone manufacturing and rental

Country:

Romania

Website:

www.dronezone.ro

OxTS Products:

xNAV650

OxTS Georeferencer

OxTS NAVsuite

OxTS Technology Features:

Boresight Calibration,

Onboard Data Logging

Drone:

DZX8 Heavy

LiDAR:

Velodyne Puck VLP-16

OxTS partner Dronezone srl. were tasked with mapping an old railway bridge. The scan was to identify possible weaknesses in the structure and to understand possible degradation over time.

Dronezone srl. have been an OxTS partner for several years. They have used OxTS INS devices to provide specialist position, navigation and timing (PNT) information for their custom-built drone survey payloads.

Dronezone equip their payloads with a number of sensors as required by each individual project. They both lease and sell drones which include the DZX8 Heavy, DZ6 ARA and the DZ4H Orion.

Background

Dronezone are builders of professional-level UAV's and drones designed alongside their customers to meet a wide set of requirements and project needs. They equip their drones with several sensors as required by each project to meet the needs of topography, surveillance, road or traffic inspections and agricultural projects amongst others.

As well as building drones for sale, Dronezone also contract out their drones and provide photogrammetry and LiDAR scanning services.

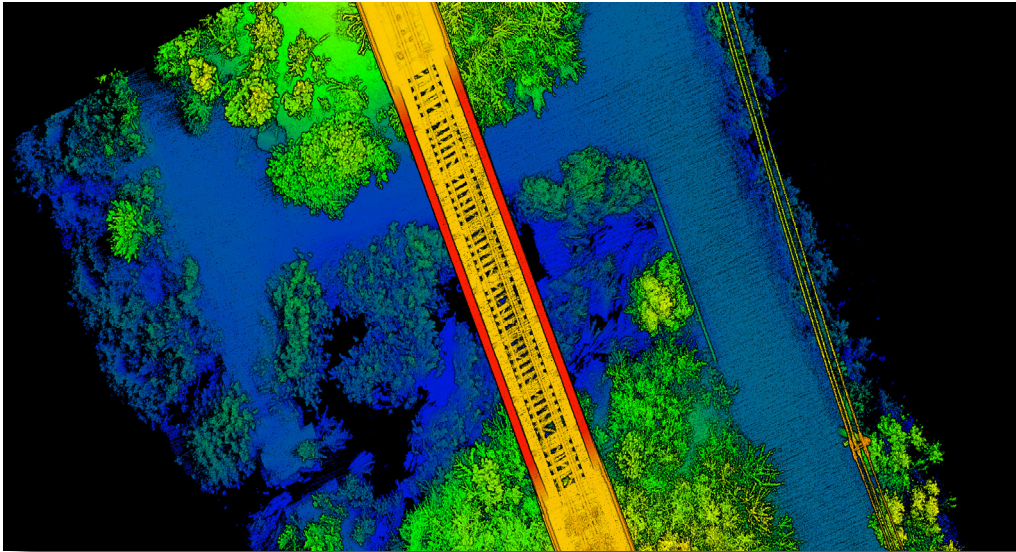
For this project, Dronezone were tasked with conducting a survey of an old railway bridge close to their headquarters in Bucharest, Romania.

What was the overall aim of the project?

Due to concerns about its safety and the danger from overgrown foliage, Dronezone were asked to survey the bridge to understand its structural integrity, whether any future restoration work was needed and if so, in what timeframe. At the end of the project, Dronezone needed a clear and accurate survey of the bridge so that they could answer these questions.

To enable Dronezone to clearly demonstrate the current state of the bridge, they made the decision to conduct a LiDAR survey. LiDAR surveys involve a surveyor using a LiDAR sensor to create a 3D representation of the world around them - also known as a pointcloud.

The final pointcloud can then be used to independently navigate around the surveyed area looking for points of interest, and in this case potential weaknesses in the bridge.

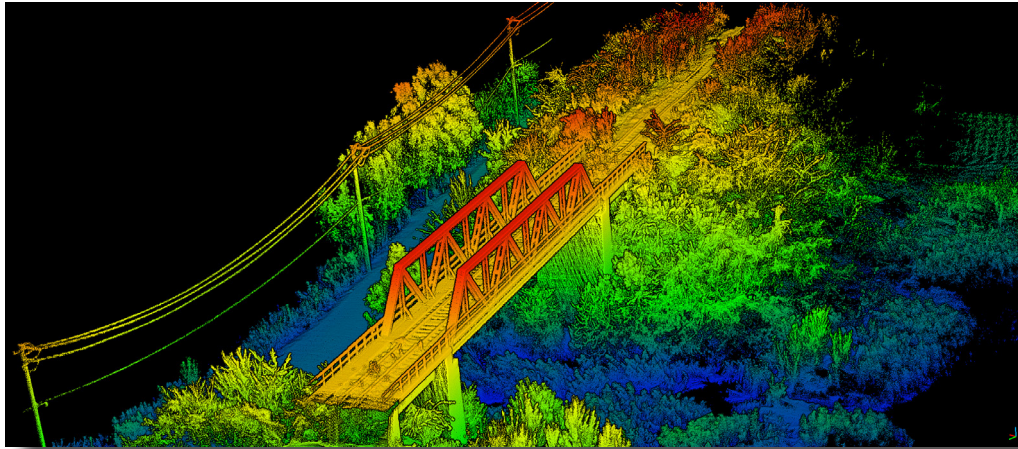


Dronezone bridge survey - bird's-eye view

Challenges

To conduct an accurate scan of the bridge there were a number of factors that Dronezone had to consider. Firstly, to recreate an accurate 3D model of the bridge, they needed to ensure that every angle was surveyed. This was particularly difficult using traditional mobile mapping methods as it was important to survey the underside of the bridge and the outer faces. Furthermore, to enable full and concise diagnostics of the bridge's condition, the pointcloud needed to be of the highest possible accuracy.

The decision was made to conduct a UAV survey of the bridge using Dronezone's DZX8 heavy drone. This decision brought about its own set of challenges including how to build a payload capable of carrying multiple sensors (INS and LiDAR) whilst ensuring it is able to continue flying long enough to conduct the required survey.



Dronezone bridge survey pointcloud

The accuracy of the navigation sensor was also an important factor to consider. The scan was to be conducted using one of Velodyne's low resolution scanners, so the INS had to be accurate to help enhance the clarity of the final pointcloud.

To ensure the best possible data is collected, the coordinate frames of the navigation (INS) and survey (LiDAR) devices had to be calibrated to the highest possible precision. Failure to measure these angles accurately enough can lead to unusable data. This is very difficult to do by eye, so another method had to be used.

Solution

The team needed to build a payload that was lightweight, small, could be configured quickly and easily (including integration between the navigation and survey devices) and provide the accuracies required to meet their needs.

Once Dronezone decided to conduct a UAV survey of the bridge using the DZX8 Heavy drone, they realised that the payload needed to be as light as possible to ensure they had the required flight time to complete the survey.

The survey device they chose to use, the Velodyne VLP-16 LiDAR, weighs 830 grams, meaning that the navigation device needed to be light. Dronezone chose to use the xNAV650 INS from OxTS.

The xNAV650 not only provided Dronezone with a lightweight (130 g), compact (77 x 63 x 24 mm) device that would have minimal impact on the flight time of the DZX8 heavy, but it also provided them with the precise measurements they needed to be able to confidently produce an accurate 3D pointcloud of the bridge.

The chosen sensors included on the payload have the following specification:

- **INS roll/pitch accuracy:** 0.05°
- **INS position accuracy:** 0.02 m RTK/PPK
- **INS heading (2 m baseline) accuracy:** 0.1°
- **Features:** data processed using NAVsuite and OxTS Georeferencer
- **LiDAR range accuracy:** up to ±3 cm (typical)

To further improve the quality of the final pointcloud, Dronezone used a data-driven method to calibrate the angles between the xNAV650 and Velodyne VLP-16 sensor. The boresight calibration process (part of OxTS' LiDAR georeferencing software OxTS Georeferencer) took only a few minutes to complete and significantly improved the result.

Most LiDAR surveys are single pass, however Dronezone surveyed the bridge from every possible perspective. Without a finely calibrated set up it would be impossible to produce a clear and accurate pointcloud and the final result would suffer from significant blurring and double-vision.

Integration with the Velodyne VLP-16 LiDAR was another key reason why Dronezone chose the xNAV650. OxTS Georeferencer comes with a number of pre-integrated LiDAR sensors, including the Velodyne VLP-16, meaning that set-up time was minimal.

Hardware products used



xNAV650

A high-grade miniature inertial navigation system from OxTS. It uses survey-grade dual frequency GNSS receivers and custom MEMS IMU for centimetre-level position accuracy and precise orientation and true heading. It logs the navigation on the internal storage for downloading and viewing post-mission.

For many applications like corridor mapping and precision agriculture with UAV based LiDAR platforms, the xNAV650 provides one of the best price/performance ratios on the market.



Velodyne VLP-16

The Velodyne VLP-16, or "Puck", is a 3D LiDAR laser scanning system ideal for use in UAV aerial mapping applications.

In order to create an adjusted, properly georeferenced pointcloud suitable for feature extraction and analysis, an inertial navigation system is required. When synchronised with a LiDAR system, the GNSS + IMU data fusion provides accurate, robust trajectory information that combines with the mobile LiDAR data.



DZX8 Heavy

The DZX8 heavy drone is used predominantly in the area of infrastructure monitoring and is ideal for LiDAR surveying.

Its light and rigid carbon frame allows for a long flight time without vibrations. In ideal conditions and without interference the maximum signal telemetry is 5 km.

Configuration of the devices was straightforward. With all OxTS INS devices, the software applications used to configure, display, post-process and analyse the INS data (NAVsuite) are simple to use, further shortening the project's time-to-survey.

NAVsuite is a complimentary addition to every INS purchased from OxTS.

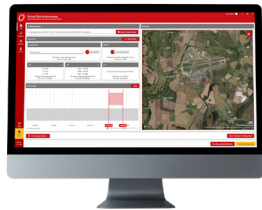
“Once we decided to survey the bridge using the DZX8 Heavy drone, the obvious choice was to use the xNAV650 as our navigation device. Despite it's small, lightweight form factor we're fully confident in it's ability to supply us with the accurate measurements we need” .

Nora Jurca, Business Development Manager - Dronezone srl.

OxTS has designed the xNAV650 to integrate seamlessly with the Velodyne VLP-16, and other LiDAR sensors. By designing a flexible array of connector interfaces to connect the devices, and providing on-board storage within the INS to record and store the LiDAR and navigational data, the weight of the payload is reduced by removing the necessity for an additional onboard computer. It also provides users with a simple way to post-process data.

OxTS LiDAR Survey Specialist, Paris Austin, and Jacob Amacker, OxTS' Survey and Mapping Product Engineer were on hand to answer any questions Dronezone had during the surveying process.

Software products used



OxTS Georeferencer

OxTS Georeferencer is OxTS' proprietary LiDAR georeferencing and boresight calibration tool.

Using OxTS Georeferencer, customers can combine the inertial measurement data from their OxTS INS with the raw LiDAR data from a wide range of sensors to create a highly accurate 3D pointcloud.

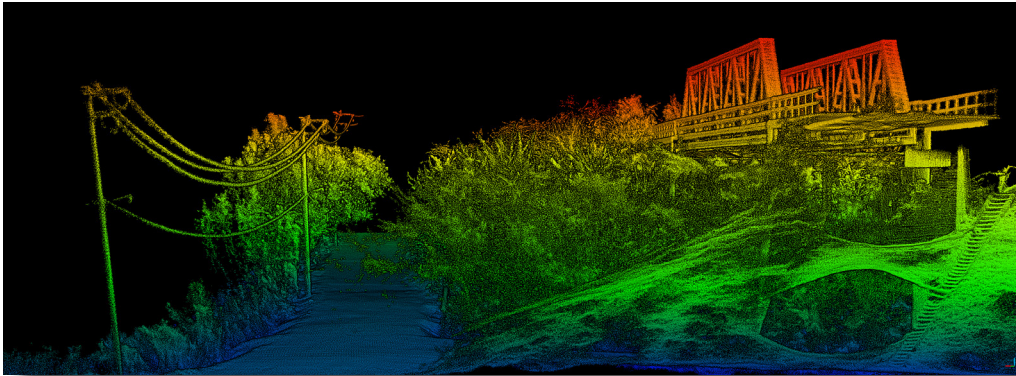
OxTS NAVsuite

OxTS NAVsuite is OxTS' complimentary suite of software tools that provides customers with the ability to configure, monitor, analyse and post-process their INS data.

The suite of applications is a free-of-charge addition to every purchased OxTS INS.

Results

Working collaboratively alongside OxTS, Dronezone was able to complete the bridge survey in a timely manner. They developed a payload that included all of the required sensors and the accurate inertial measurements produced by the xNAV650 were necessary to create a high-quality final pointcloud.



Dronezone bridge survey

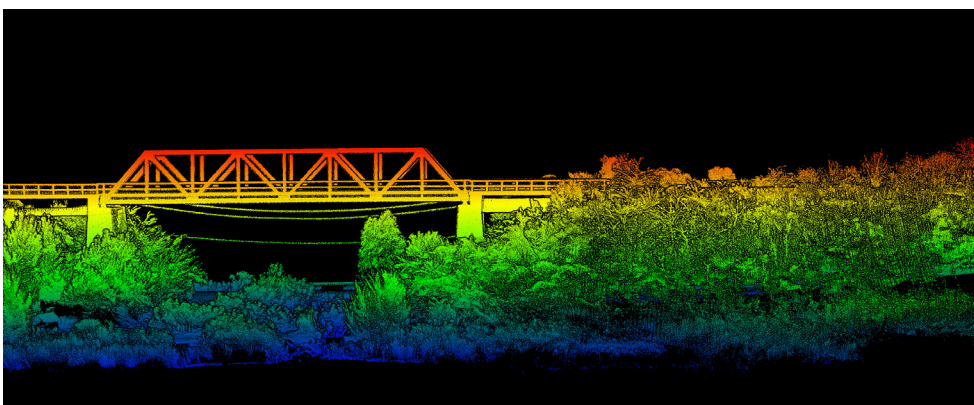
The pointcloud was of a very high standard and the project team were easily able to identify areas of the bridge that needed closer inspection. The foliage surrounding the bridge was also included in the survey and the team were able to determine the areas that needed further attention.

The weight of the xNAV650 was such that it did not negatively impact the amount of fly-time the UAV could achieve and a single flight was needed to survey the bridge and surrounding area.

The integration work between the Velodyne VLP-16 and the xNAV650 INS was also minimal. The project team was able to connect the two sensors and configure them quickly and easily, owing much to the pre-integration work already completed by OxTS.

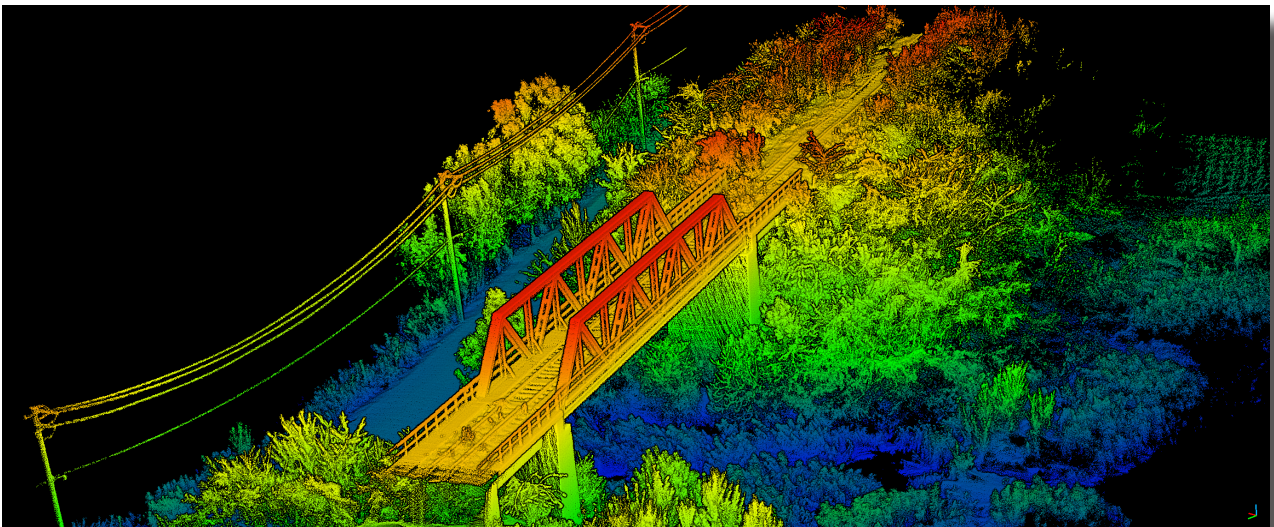
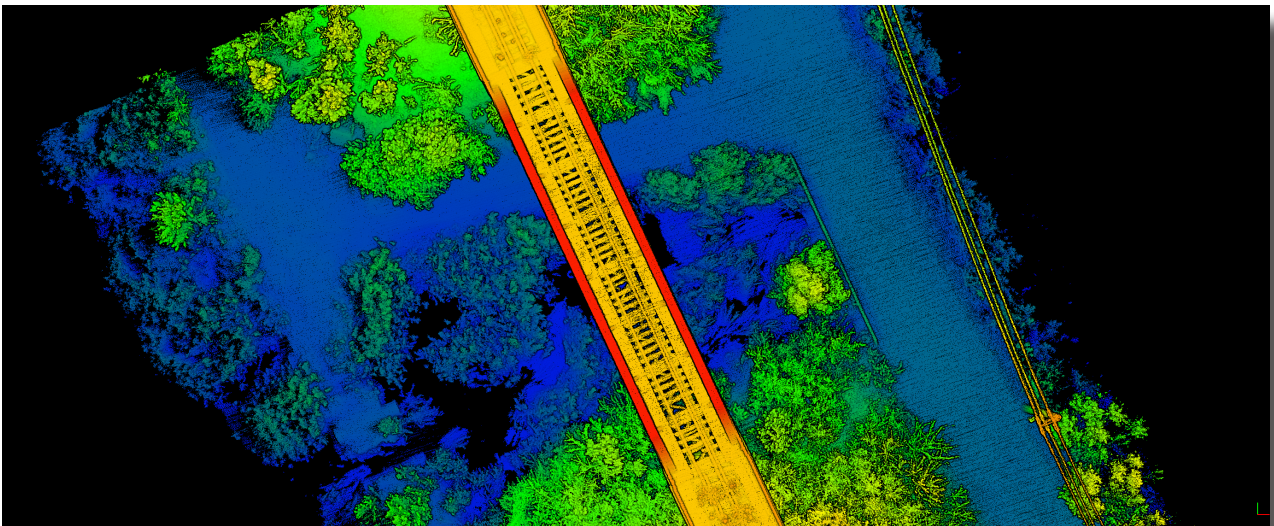
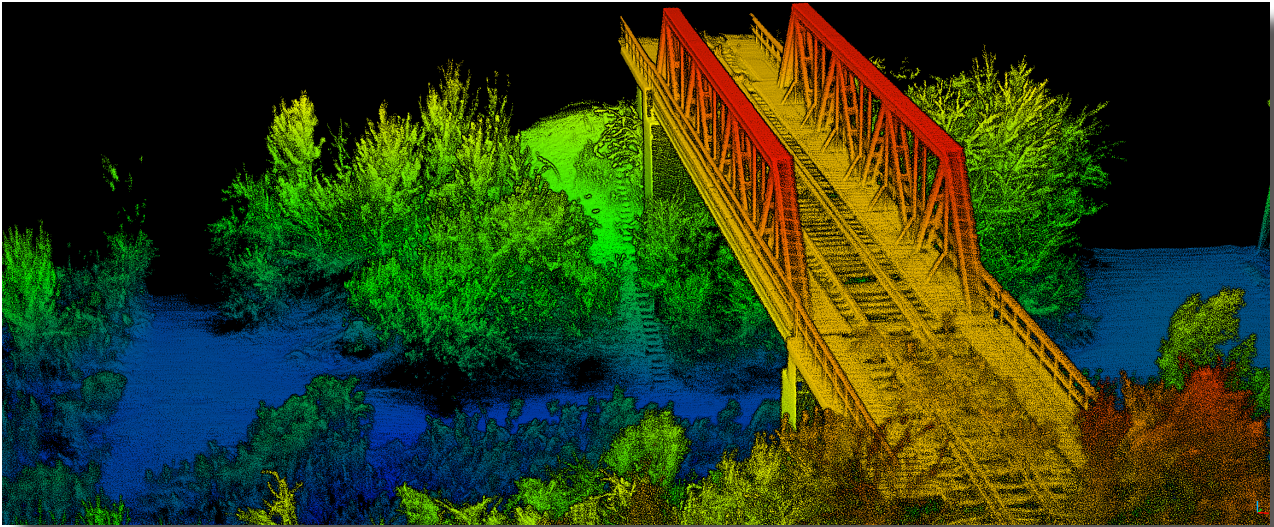
“This is an impressive example of what you can get out of the data and the quality of the pointcloud you can produce using an appropriate sensor with the right INS solution, and processing software.”

Dieter Gabriel, EMEA Marketing Manager - Velodyne LiDAR



Dronezone bridge survey - side view

Final Pointcloud Screenshots





The OxTS team work with their customers to present the best solution for their needs

The global leaders in inertial and GNSS since 1998

Accurate and reliable georeferencing solutions for land, air and marine applications.

At OxTS we're passionate about inertial navigation and how we can help our customers with our technology. With over two decades of experience in combining the best of high precision GNSS receivers and world-class inertial navigation expertise, OxTS' products have become the industry standard for automotive testing and are widely used in other industries.

Our products provide position, roll, pitch, heading and other measurements of vehicles on land, sea and in the air. Our highly accurate RT3000 series is used by almost all car manufacturers in the world for vehicle dynamics testing, validating advanced driver assistance systems (ADAS) sensors and developing self-driving cars.

Our range of combined, compact GNSS/INS systems is used for sensor position and orientation on mobile mapping vehicles and for direct georeferencing data from airborne surveying.

Find full details about our range of Inertial Navigation Systems at www.oxts.com.

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