OxTS LiDAR Surveying

Highly accurate and repeatable navigation data for pointcloud analysis

OXTS
Survey

www.oxts.com

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Surveyors need **accurate and reliable georeferencing of geospatial data, with confidence in all environments.** OxTS Survey delivers the navigation data to make this possible.

OxTS manufacture highly accurate Inertial Navigation Systems (INS), widely used to help surveyors efficiently map any environment.

Our range of Inertial Navigation systems integrate seamlessly with a wide range of LiDAR sensors giving surveyors the confidence that they can survey on their own terms.

Survey+ v3 INS

Measurements

What INS measurements can I integrate with my LiDAR data?

OxTS' range of survey devices combine high-grade Micromechanical Systems (MEMS) Inertial Measurement Units (IMU) with survey-grade GNSS receivers to output **cm-level** position accuracy.

- **Absolute position** - LiDAR Surveyors receive absolute position taken from multiple satellite constellations provided by OxTS Inertial Navigation Systems.

- **Orientation** - All OxTS' Survey customers receive highly accurate pitch and roll data to feed into their projects.

- **GPS time** - It's important for surveyors to not only know where in the world they're surveying but also when for the purposes of measuring change over time. OxTS Inertial Navigation Systems allow surveyors to integrate this measurement into their LiDAR surveys.

These measurements allow surveyors to confidently produce accurate, georeferenced pointclouds for client and internal projects.

"Combining high-performing inertial measurement units with survey-grade GNSS receivers means that we can be confident that our customers are receiving the most accurate position and orientation data possible"

*Jacob Amacker, Product Engineer, OxTS*

Product Line-Up

OxTS Survey Products

OxTS Survey products cover four main survey scenarios; **mobile mapping, UAV and drone based mapping, integrator projects** and **pointcloud processing.**

"Our product line-up is designed to service every survey scenario. We provide surveyors with a full navigation solution that they can use, quickly and without hassle"

Paris Austin, Head of Product - New Technology, OxTS

OxTS Survey products have been developed with LiDAR surveying in mind. Our range of Inertial Navigation Systems place accurate navigation data into the hands of surveyors whichever the application they're trying to deliver. The aim being to allow them to confidently collect and process data that will produce highly accurate pointclouds.
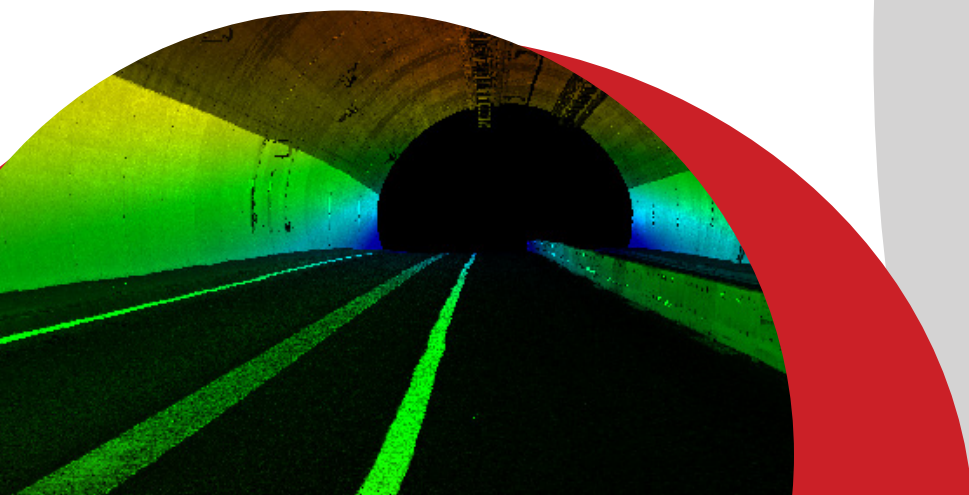
Hardware comparison guide

The following hardware comparison guide compares the key features of OxTS' survey-specific Inertial Navigation Systems.

For a more detailed overview of each product please refer to the applicable datasheet available to download from the OxTS website.

Performance	Survey+ v3	xNAV650
Overview	Our flagship INS for land-based mobile and manned aircraft mapping. Ideal for poor GNSS environments, such as dense urban areas.	Our smallest and lightest INS yet with the performance you can rely on. Ideal for drone and UAV based mapping applications.
Heading accuracy (1σ)	0.05°	0.1°
Pitch/Roll Accuracy (1σ)	0.03°	0.05°
Positioning	GPS L1, L2 GLONASS L1, L2 BeiDou B1, B2 Galileo E1, E5	GPS L1, L2C GLONASS L1, L2 BeiDou B1, B2 Galileo E1, E5

Position accuracy (CEP)
  DGPS
  RTK
	
	0.4 m
	0.01 m
		
		0.4 m
		0.02 m

GNSS-outage drift (60 s)*	0.30 m	0.95 m
Board set available	No	No
Hardware		
Dimensions	184 x 120 x 71 mm	77 x 63 x 24 mm
Mass	1500 g	130 g
Input voltage	10 - 48 V dc	5 - 30 V dc
Power consumption	14 W	4 W
Interfaces	Ethernet (x3), Serial (x3)	Ethernet, Serial
IP Rating	IP65	-

*This is for a mobile mapping vehicle using a wheelspeed sensor.

Both Inertial Navigation Systems have the same internal storage (32 GB), onboard data-logging rate (3 MB/s) and offer dual antenna as standard. Precision Time Protocol is also offered as an optional upgrade on both.

All devices output the same data format and are used the same way with OxTS' complimentary post-processing software and OxTS Georeferencer.

OxTS Georeferencer

Combine OxTS Inertial Navigation data with raw LiDAR data to output highly accurate, georeferenced pointclouds

OxTS Georeferencer is a software tool that combines INS trajectory data with raw LiDAR data to create a georeferenced 3D pointcloud.

OxTS Georeferencer has a number of pre-integrated LiDAR sensors, however new LiDAR sensors are continually being added and code degeneralisation means that new families of LiDAR can be integrated quickly and easily.

"OxTS Georeferencer is a game-changer for OxTS. With multiple LiDAR integrations we can give surveyors the ability to create highly accurate, georeferenced pointclouds irrespective of the LiDAR sensor they use"

Jacob Amacker, Product Engineer, OxTS

Boresight Calibration

To provide surveyors with the most accurate pointclouds it's important that the angles between the Inertial Navigation System and LiDAR sensor are measured as accurately as possible.

This is particularly difficult and can lead to **boresight misalignment** if measured incorrectly, rendering the survey results unusable.

To overcome this problem a data-driven calibration technique is required.

OxTS Georeferencer includes a boresight calibration tool that gives surveyors the opportunity to quickly and simply perform a data-driven calibration, ensuring accuracy and survey repeatability.

Calibration Procedure

The calibration technique is simple and easily repeatable. Get underway quickly and realise the benefits in minutes.

- Set-up retroreflective targets
- Have the LiDAR view the target from as many angles and distances as possible
- Use OxTS Georeferencer to calibrate the LiDAR orientation

The Results

The pointclouds below clearly show the difference between a boresighted and unboresighted pointcloud. The example on the left suffers from double-vision and is unclear, whilst the boresighted example on the right is sharper and the double-vision has been eliminated.

Before calibration

After calibration
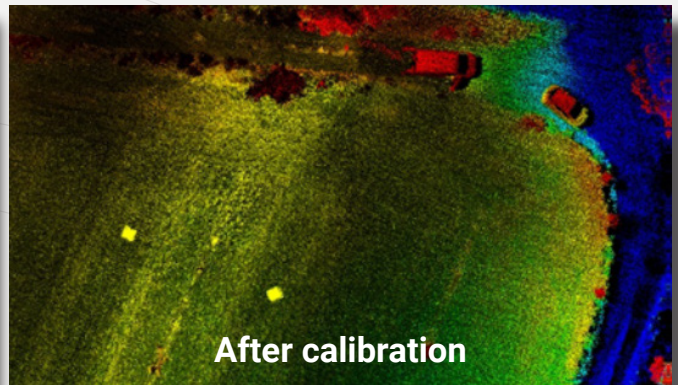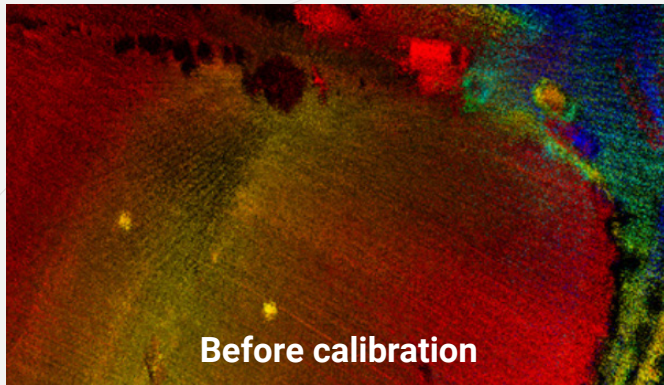
OxTS Navigation and LiDAR Software

OxTS LiDAR Survey processing features have been developed to ensure the highest quality data from our INS, in real-time and post-process, to create the very best results.

Software features

- **gx/ix tight-coupling technology -** gx/ix is OxTS' advanced GNSS processing engine. Use gx/ix to ensure accuracy in tough GNSS environments such as urban canyons.

- **Vertical Advanced Slip** - In situations where the GNSS signal is blocked or lost, use vertical advanced slip to ensure vehicle position accuracy is protected.

- **Advanced Smoothing** - OxTS advanced smoothing processing feature ensures navigation data is consistent and smooth for the duration of the survey.

- **Precision Time Protocol (PTP)** - Synchronise all clocks on a network using the INS' high-quality clock source - GNSS - to stamp out time drift and take advantage of a simple ethernet plug and play set up.

Software tools

- **NAVsolve -** Use NAVsolve to utilise combined processing of data, optimise data post survey and process RINEX base station files (PPK).

- **NAVgraph** - Use NAVgraph to crop and export survey data and to help you investigate, analyse and troubleshoot data sets.

As part of our commitment to our customers, OxTS NAVsuite software is provided at no extra charge when you purchase an OxTS INS.

Applications

Where can OxTS LiDAR Survey products be used?

There is an almost endless number of use cases for OxTS' INS and LiDAR Survey products.

"Our products have helped multiple customers address an ever-growing, wide range of applications through integrating INS data with raw LiDAR data. In each case the end result has been an improvement in the speed of the survey and most importantly a vastly improved ROI ."

Paris Austin, Business Manager, OxTS

Example Applications

Infrastructure monitoring
Repeatability and absolute accuracy are key when discovering faults in infrastructure

Geographical survey
Long baseline surveying needs absolute positioning

Building information modelling (BIM)
Fine details can only be captured with high-precision navigation data

Construction monitoring
Ensuring repeatability and absolute accuracy is essential when monitoring construction progress

There are many more potential applications. You can contact us for advice on any application you're considering performing. If a project requires you to know where you are and where you're pointing, we can help. Please see contact information on the back page.

LiDAR Integrations

Through OxTS' Georeferencer software, OxTS' range of survey-specific Inertial Navigation Systems allow surveyors to integrate inertial measurements with raw LiDAR data to produce georeferenced pointclouds.

OxTS offers tried and tested integrations with several major LiDAR manufacturers.

OxTS Georeferencer software will turn data from **Ouster**, **Hesai** and **Velodyne** LiDAR sensors into pointclouds.

Our systems are able to send navigation data over serial and ethernet and time synchronization data over serial **and via PTP** making integration simple for most LiDAR units.

Integrations with the below LiDAR have already been built. However, we are happy to work with almost any LiDAR sensor on the market.
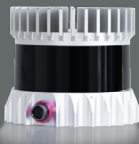
Velodyne

OxTS Georeferencer supports integrations with a wide range of Velodyne LiDAR sensors. These include the **VLP-16 Puck, Puck LITE (beta), VLP-32C** and the **Alpha Prime VLS128 (beta).**

Hesai

There are a number of Hesai LiDAR sensors currently supported. These include the Pandar 40, 40P, 40M, 64, QT, 128, XT-16 and more.

Ouster

All Ouster Gen2 LiDAR are currently supported (in beta) within OxTS Georeferencer. This includes the **OS0, OS1*** and **OS2** LiDARs with **32, 64*** and **128** lasers in the uniform distribution. *The **OS1-64** is tested.

Z+F

The Zoller + Fröhlich 9012 Profiler sensors have been used in-house with OxTS Survey hardware. Z&F post processing software is required.

*Hardware integration guides are available for all LiDAR, and software support for a selection.

Pointcloud Examples

The following pointclouds were gained through quick and simple LiDAR integration with an OxTS Inertial Navigation System.

Example 1 - Building

The Building example was captured using a **Hesai Pandar XT** and an **OxTS xNAV650 INS**. Data processed using **OxTS Georeferencer software**.
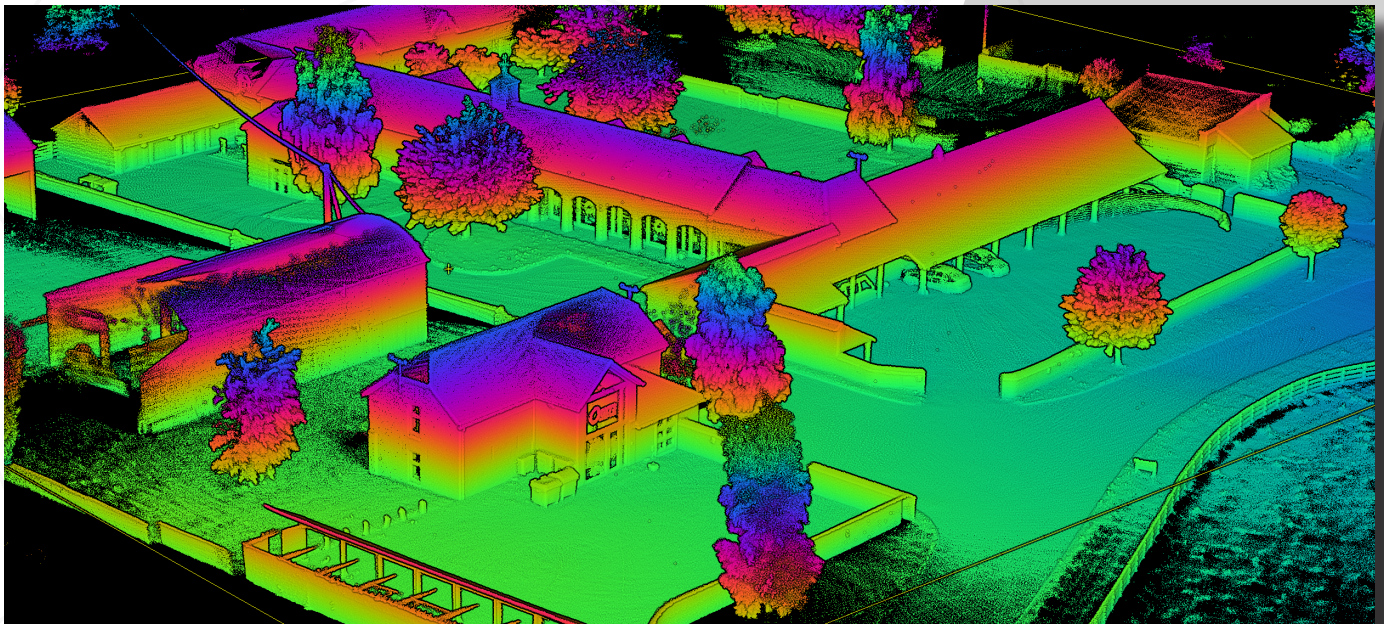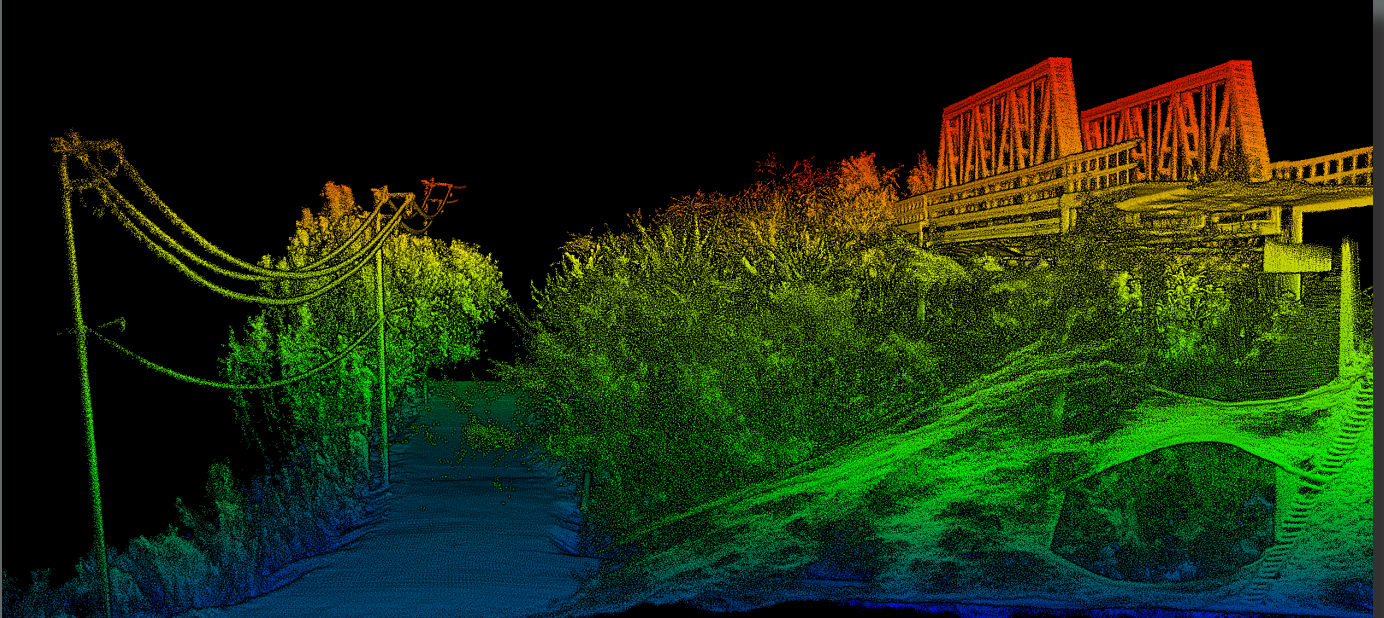

Example 2 - Building

The Public House example was captured using a Livox Avia LiDAR and an **OxTS xNAV650 INS**. Data processed using **OxTS Georeferencer software.**
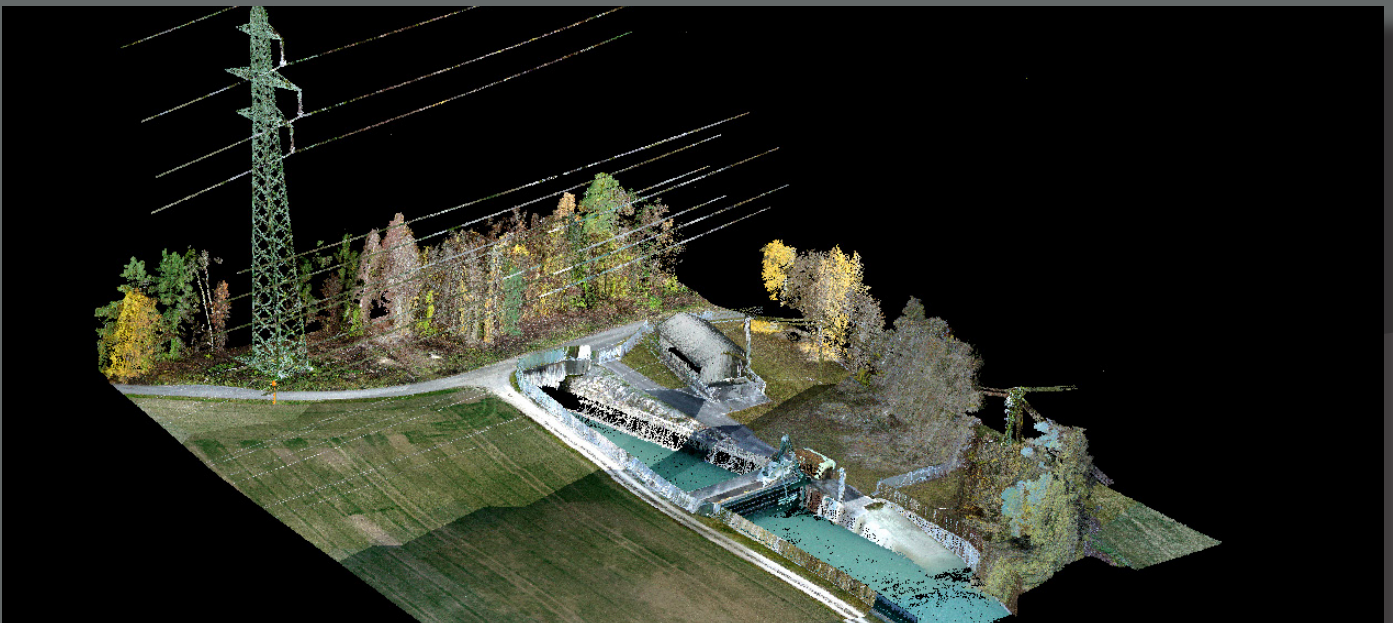
Example 3 - Bridge Survey

The Bridge Survey example was captured using a **Velodyne VLP-16 LiDAR and an OxTS xNAV650 INS**. Data processed using **OxTS Georeferencer software**.

Example 4 - Pylons

The Pylons example was captured using a **Riegl VUX-1LR LiDAR** and an **OxTS Survey+ v3 INS**. Data processed using **Riegl RiPROCESS software**.

OxTS Inertial Navigation Experts since 1998

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