Velodyne LiDAR

Hardware integration guide

OXTS Survey

Overview

The Velodyne VLP-16 is an all-purpose LiDAR that can be used for pointcloud creation in surveying applications or autonomous vehicle aiding. With 16 lasers it is the least powerful of the Velodyne range. This guide will use the integration of a VLP-16 LiDAR with an xNAV650 INS as an example, but the principles are the same for all Velodyne sensors and OxTS INS devices.

Requirements

For the LiDAR to function correctly with an INS it needs to be receiving NMEA messages from the INS and time synchronisation messages. NMEA messages can be sent over ethernet or serial RS232 and time synchronisation must be done using pulse per second (PPS) signals.

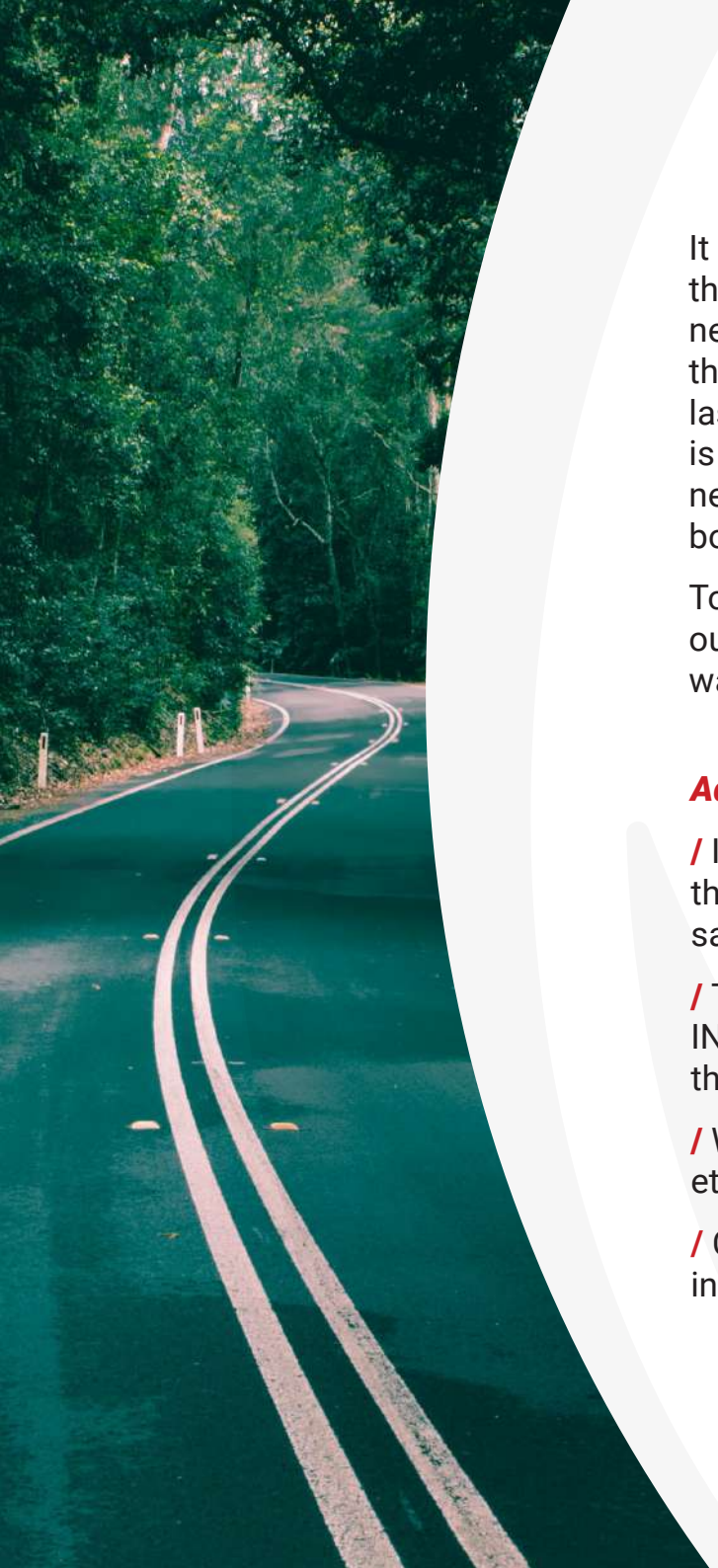
A way to record the data of the LiDAR must also be considered. The data can be streamed to a PC and recorded using software such as WireShark. Alternatively, if you are using the VLP-16 with OxTS' LiDAR georeferencing software, OxTS Georeferencer, the data can be logged straight onto the INS in LCOM format. This is only possible with the VLP-16, not other LiDAR sensors from Velodyne due to the higher CPU usage required.

Hardware

In order to fulfil the requirements above, a cable must be created to communicate between the two devices. The exact design of the cable will depend on your data capturing requirements. Wiring diagrams are included in the manuals of our INS devices and the Velodyne VLP-16 manual to give you all the necessary information. If you are using an xNAV550 INS there are additional options which you can explore with this support article - view article.

Wiring information regarding our INS devices and user cables is available either in our user manuals or on request. The following guide will use information about the xNAV650 user cable that is included towards the end of the xNAV650 user manual. Similarly, wiring information is included in the manuals of Velodyne's products. NMEA and PPS messages must be sent from the INS to the LiDAR, PPS must be done over the dedicated wire and NMEA can be sent over serial or over ethernet.

Signal	xNAV650 Cable J1 Pin	xNAV650 Cable Wire Colour	Velodyne Wire
RS232 RX	3	Red	(Not needed)
RS232 TX [SENDS NMEA]	4	Orange	White [GPS serial receive]
Signal ground	11	White/Black	Black [Ground]
PPS [SENDS PPS]	12	White/Brown	Yellow [GPS SyncPulse]
Signal ground	13	White/Red	(Not needed)
I/O signal 2	9	Grey	(Not needed)
I/O signal 1	10	White	(Not needed)
Power +	2	Brown	Red [Power]
Power -	1	White/Yellow	Black [Ground]



It is entirely possible to put a connector (eg M12) onto the INS user cable and to match this to a connector placed on the Velodyne unit. NMEA and PPS can be sent through this new connection and there is no need to use the interface box. Furthermore, if the unit is the VLP-16 then LiDAR data can be logged directly onto the INS, but if it is a unit with more lasers it will need to have an ethernet breakout to a separate logging device (eg PC). This is particularly useful on UAV applications so that only one power source connection is needed. When space is limited a Y cable can be used to deliver power from a source to both the INS and LiDAR.

To make a single connection and log data onto the INS you will need to match the ethernet output wires of the LiDAR to the ethernet input wires on the INS, in doing this you may want to also have a breakout cable to view data live on a PC.

Additional Notes

/ If you are using both the xNAV and LiDAR through an ethernet switch or into a PC through different ethernet connections, then the connections will have to be put onto the same IP range.

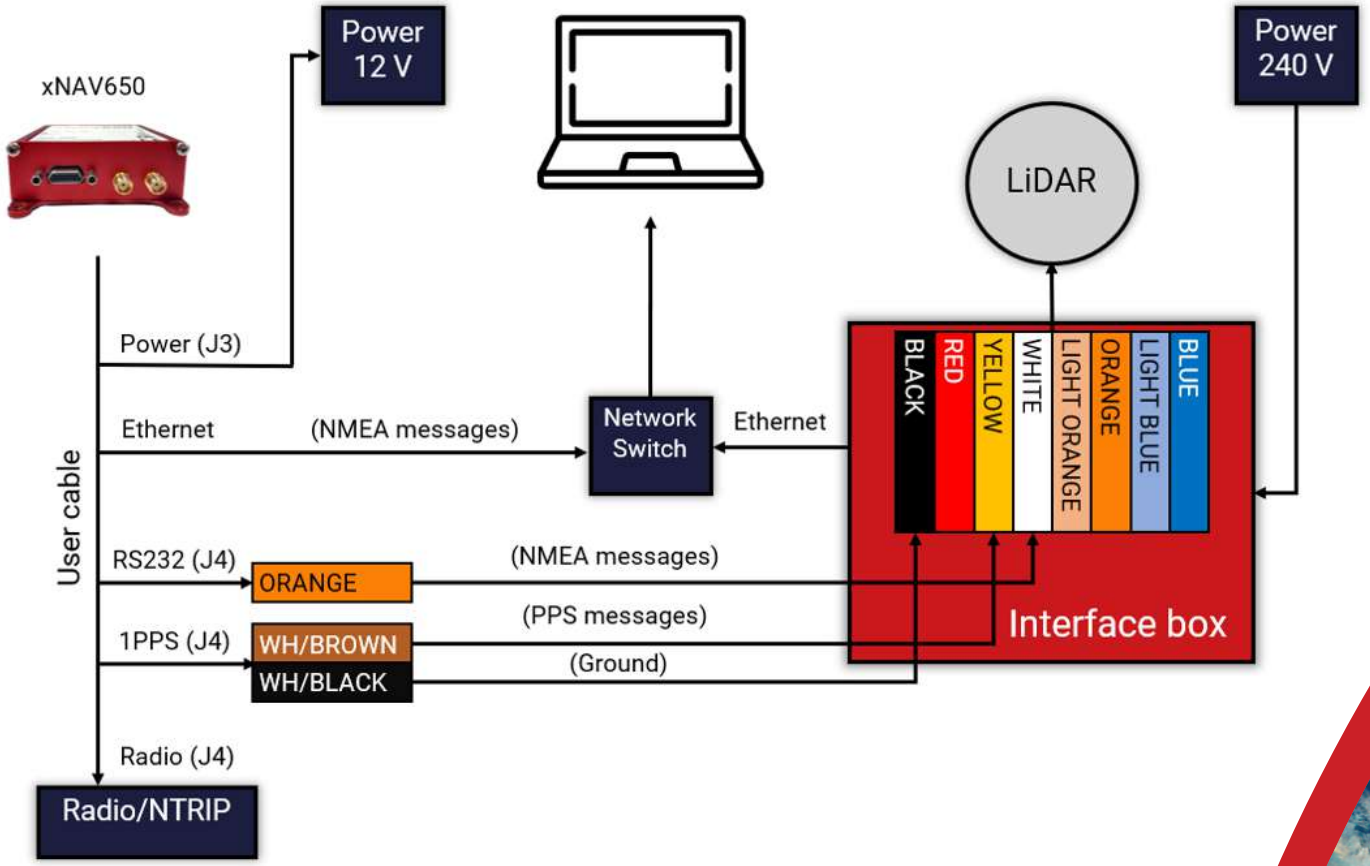
/ These PIN numbers apply to the xNAV650 device. The same principle applies to all OxTS INS devices, however the PIN numbers for the signals will depend on the INS in use due to the different connector types.

/ When working with high data rate LiDAR units it is often necessary to use a gigabit ethernet switch.

/ Check with Velodyne whether removing the interface box will void the warranty. More information can be found in the LiDAR manual.

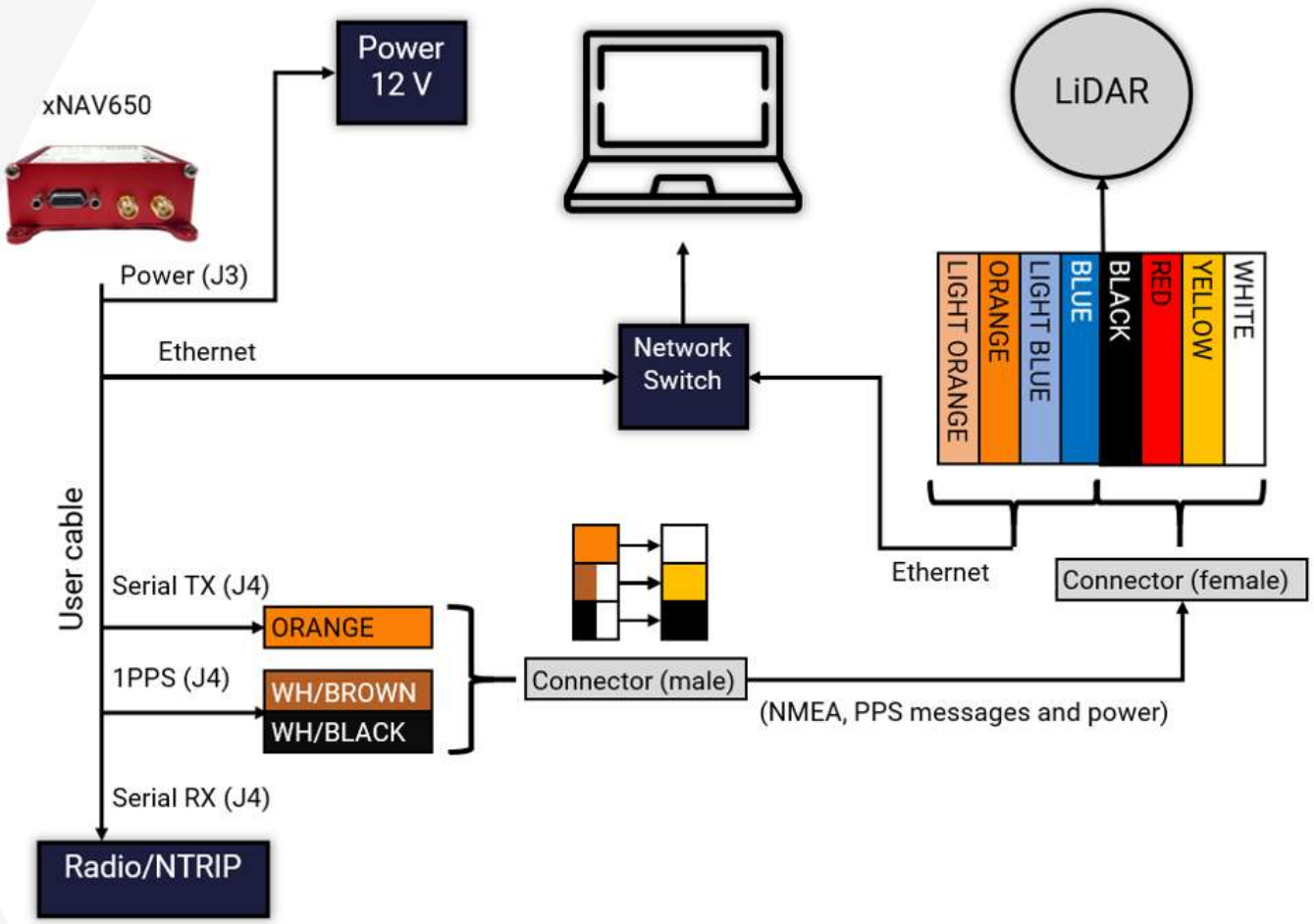
Velodyne PPS Setup

PPS and NMEA messages can be sent using a traditional PPS setup using the interface box:



Velodyne Direct Connection Setup

PPS and NMEA messages can be sent using a direct connection:

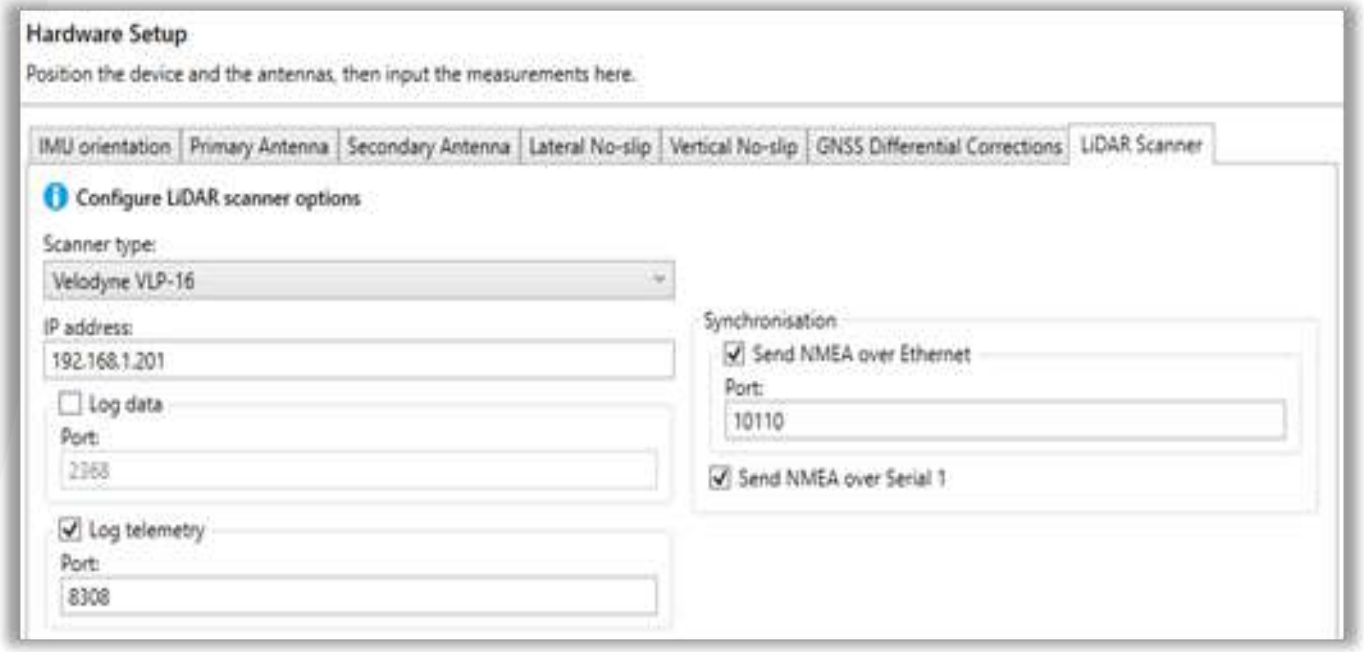


Configuration

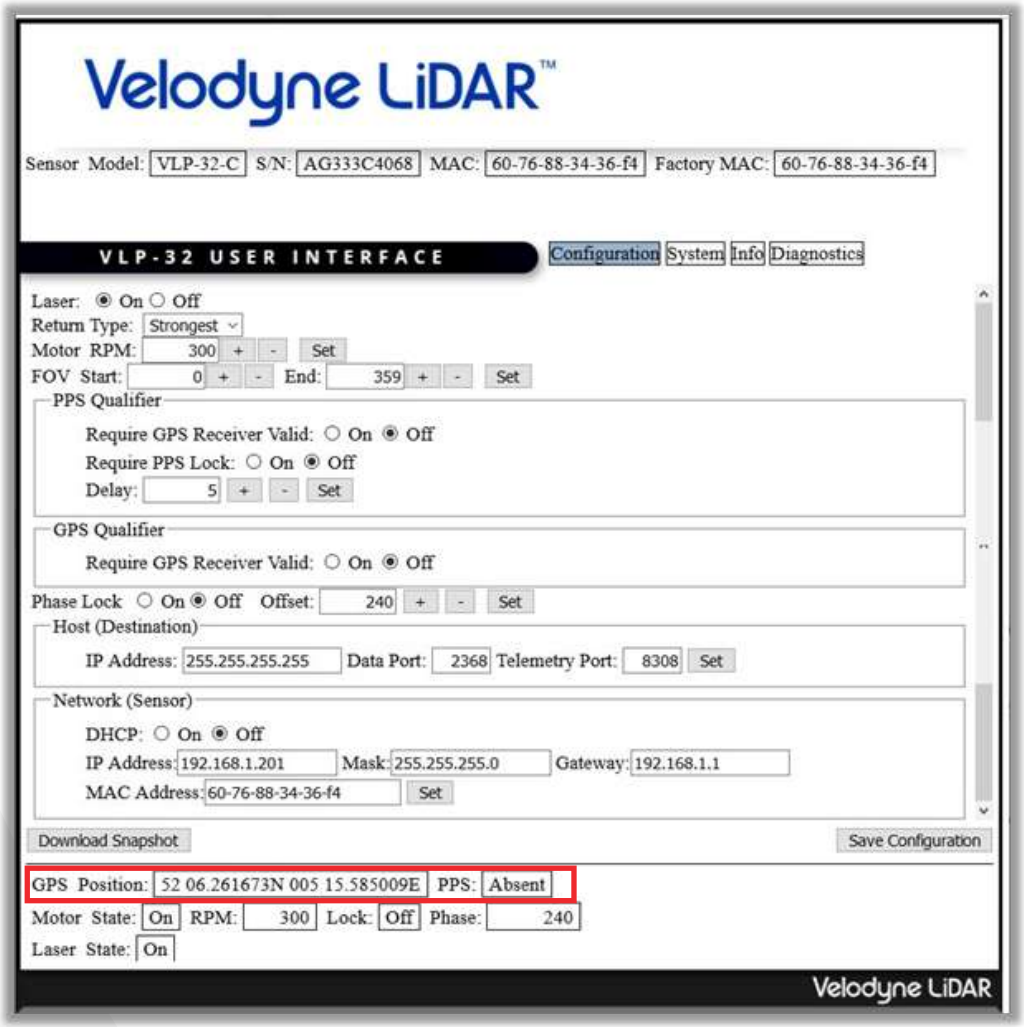
To configure your INS device to work with the LiDAR you need to ensure that the correct messages are being sent. This can usually be done on the LiDAR Scanner tab of OxTS' complimentary INS device configuration software, NAVconfig.

Select Velodyne VLP-16 from the drop-down menu. If your cable has been created to send NMEA over ethernet, check this box, if it has been created for serial NMEA then check that box. If you are going to log data directly onto the INS as LCOM then select both boxes on the left 'log data', and 'log telemetry'. The IP address of the LiDAR unit is needed if you are sending NMEA over ethernet but a broadcast address of 255.255.255.0 can also be used.

You do not have to use the LiDAR Scanner tab, these settings can also be applied with further options in the Interfaces section of NAVconfig. A different type of NMEA message other than GPRMC can be selected here.



Before you begin collecting data, if you have an ethernet connection to the Velodyne unit available then you can check the web interface to see that PPS is ‘locked’ and that position data has been received and is updating.



Post processing

INS data is processed as normal. It is highly recommended that RTK base station corrections are used when processing in NAVsolve, OxTS' powerful post-processing tool, to get the best quality pointcloud.

OxTS Georeferencer and the boresight calibration solution is compatible with the VLP-16 and other Velodyne LiDAR sensors listed on our OxTS Georeferencer web page - OxTS Georeferencer.

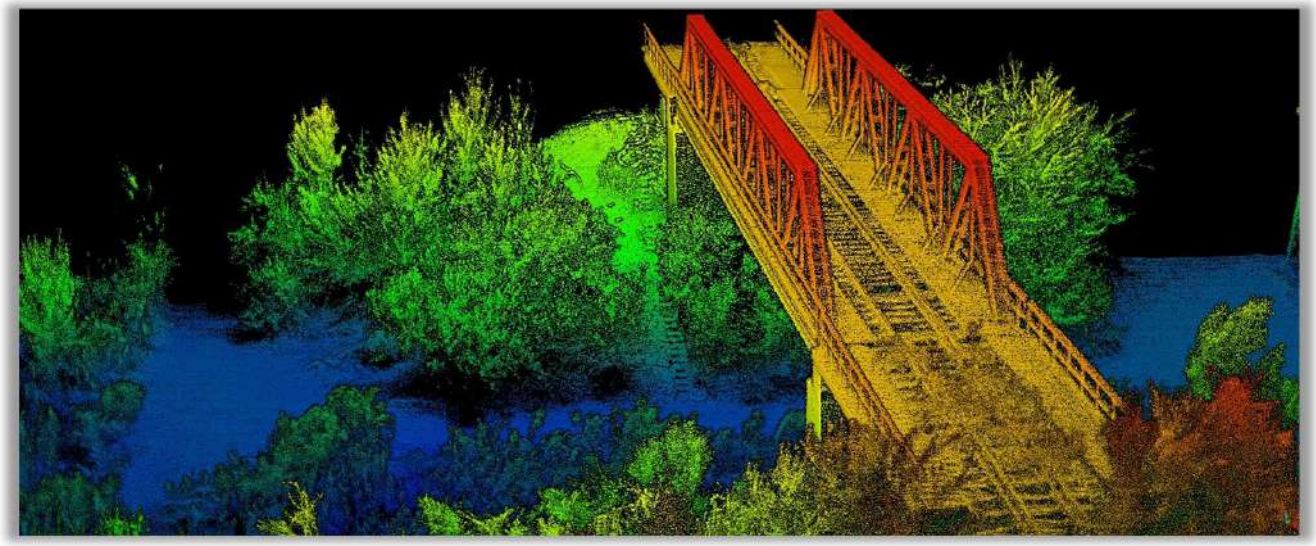
This will allow you to combine your INS data and your LiDAR PCAP or LCOM to georeference a pointcloud.

A support article for using Georeferencer can be found on the OxTS support site and here:

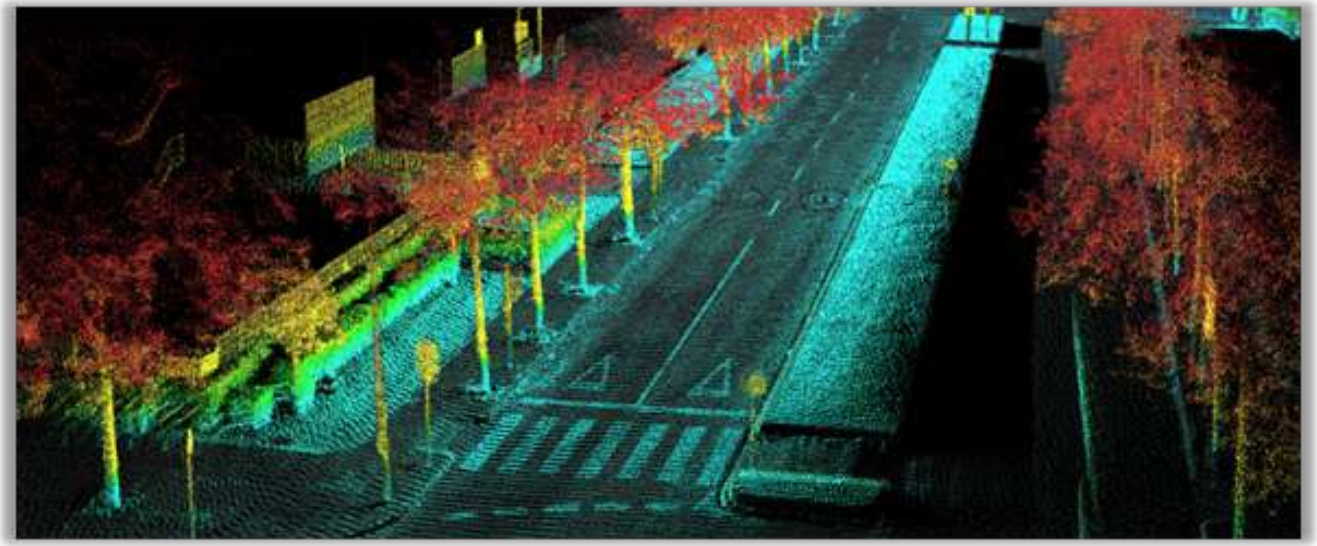
A guide for using OxTS Georeferencer can be found on the OxTS support site here - view article.

Example data

The bridge survey below was produced using a Velodyne VLP-16 LiDAR sensor alongside an OxTS xNAV650 INS. The data was processed using OxTS Georeferencer.



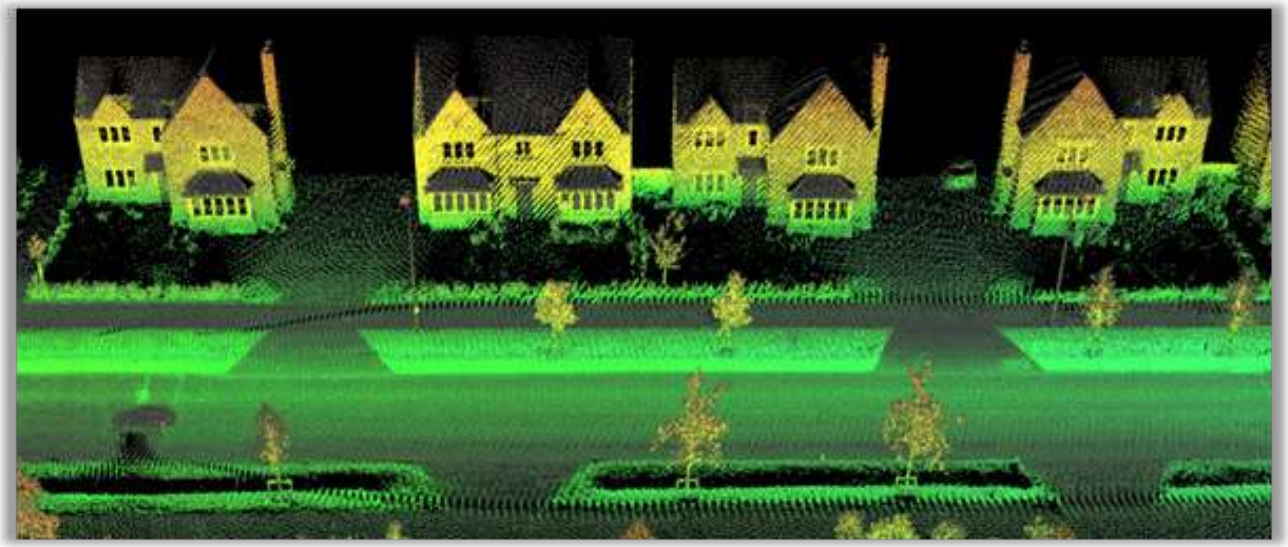
This road survey was produced using a Velodyne VLP-16 LiDAR sensor alongside an OxTS Survey+ INS. The data was processed using OxTS Georeferencer.



Example data (cont...)

The second road survey example was again produced using a Velodyne VLP-16 LiDAR sensor alongside an OxTS Survey+ INS. The data was processed using OxTS Georeferencer.

The below street survey was produced using a Velodyne VLP-16 LiDAR sensor alongside an OxTS xNAV v3 INS. The data was processed using OxTS Georeferencer.



Need further assistance?

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