



Ensuring Accuracy for LiDAR Surveys from a UAV



Trimble and Routescene achieve a high-accuracy and cost effective UAV solution

Routescene sought out a GNSS solution that was scalable in accuracy, lightweight, cost effective, and compatible with a wide range of base station receivers on the market. Backed by 40+ years of experience and engineering, Routescene selected the Trimble BD940 receiver module to be integrated into their UAV LiDAR system.

Solution

Trimble BD940 Receiver Module

A compact, triple-frequency GNSS receiver that allows for integration into tight spaces, a perfect fit for UAV LiDAR systems.

- ▶ RTX, OmniSTAR and RTK ready
- ▶ Equipped with an EMI shield which allows for easy integration
- ▶ Solder down module design for increased physical robustness with flexible configurations

OVERVIEW

Routescene designs and manufactures integrated 3D mapping solutions specifically for use on drones. Designed to survey sites where accurate mapping is essential but difficult to achieve, the system is perfect for hard to reach, dangerous or hostile environments such as landslides, steep slopes and densely vegetated areas. Achieving as high a level of accuracy as possible is required for such challenging applications and can be achieved using Trimble's products.



Location
Scotland, UK
Colorado, US



THE CHALLENGE

A typical objective for any survey is to achieve a predetermined level of accuracy appropriate for the application and site being surveyed.

Unlike static terrestrial surveys, a drone LiDAR survey is dynamic and requires a GNSS or inertial navigation system (INS) to determine its position and orientation; it is not as simple as mounting a LiDAR sensor underneath a drone.

To meet this objective and quantify accuracy many factors have to be considered, such as the positional accuracy of the GNSS receiver, the angular accuracy of the INS and the angular accuracy of the LiDAR sensor. It's complicated!

The rapidity of change - the position and orientation of the drone (Unmanned Aerial Vehicles or UAV) - changes every millisecond which compounds the problem.

THE SOLUTION

To design the perfect Routescene UAV LiDAR solution, the perfect blend of sensors were chosen. The individual accuracy of each sensor was considered to achieve the best overall accuracy possible for the system. The final

UAV LiDAR solution consists of three main components:

- ▶ Routescene LidarPod
- ▶ Advanced Navigation Spatial Dual sensor
- ▶ Routescene Ground Station



The Routescene LidarPod

Routescene LidarPod®

The 3D mapping instrument mounted underneath the drone, the Routescene LidarPod, is a state of the art Real Time Kinematic (RTK) GNSS and INS product which provides accurate position, velocity, acceleration and orientation under the most demanding conditions.

From earlier offshore hydrographic survey

experience, the design team knew that obtaining an accurate heading was challenging. Therefore, if a single GNSS antenna was used, there would be excessive uncertainty that would make post-processing difficult. A dual antenna GNSS/INS solution was therefore selected.

Integrating a GNSS/INS Solution

Routescene required a GNSS/INS solution that was:

- ▶ scalable in accuracy
- ▶ lightweight
- ▶ cost effective
- ▶ compatible with a wide range of Base Station receivers on the market

Having reviewed all available GNSS/INS products on the market, Routescene selected a solution based on the Trimble BD992 receiver module. This latest generation GNSS receiver is combined with magnetometers and a pressure sensor, together with a temperature calibrated Inertial Motion Unit (IMU) containing the accelerometers and gyroscopes. These are coupled in a sophisticated fusion algorithm to deliver accurate and reliable navigation and orientation information.

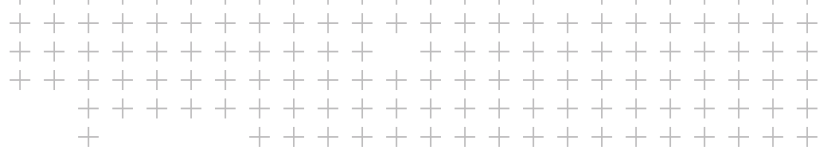
Routescene Ground Station

The Routescene Ground Station is an essential component of the package. It ensures:

- ▶ RTK GNSS corrections are transmitted to the LidarPod via a UHF radio link.
- ▶ Quality assurance and status information are transmitted from the LidarPod to the Ground Station. This information is displayed in QA Monitor, Routescene's real-time in-flight data monitoring application.
- ▶ Complete independence, with as little reliance as possible on third party resources and infrastructure. This is important since surveying can occur anywhere in the world and in remote unmapped regions.



The complete Routescene UAV LiDAR system



Routescene incorporated an RTK “Base” GNSS-receiver into the Command & Control Ground Station to enable the position of the LidarPod to be corrected in real-time or optionally post-processed to obtain PPK level of accuracy.

To enable Ground Control for the UAV LiDAR and associated photogrammetry survey to be undertaken by traditional GNSS survey methods, the Routescene Ground Station can also be used as a stand-alone GNSS RTK base station to transmit RTK corrections to a compatible GNSS rover. Using the Routescene Ground Station as the GNSS RTK base station has two main benefits 1) in remote regions you can still survey in your control points using RTK GNSS, 2) the reference system for the whole survey, LiDAR plus Ground Control will be at a

very high relative accuracy and unambiguous as you have used a single common Reference point to tie your survey together.

“We chose to incorporate the Trimble BD940 receiver into the Routescene Ground Station, to ensure full compatibility with the GNSS receiver in the LidarPod, and because of its ability to output RTK corrections in a variety of different formats. Flexibility and reliability were paramount to us to ensure minimal or no downtime during a project. Directly compatible and complementary to the BD940 receiver is the Zephyr antenna, which was chosen to ensure the GNSS signals were received and processed with as little signal loss as possible,” said Gert Riemersma.

“When designing the Routescene UAV LiDAR solution we carefully selected the perfect blend of sensors, considering the accuracy of each individual sensor, so we could achieve the best overall accuracy possible for the system.”



GERT RIEMERSMA
Routescene Founder and
Chief Technical Officer

About Routescene

Routescene is a global operation with headquarters in Edinburgh, Scotland and Routescene Inc is based in Colorado, USA. Routescene builds survey-grade end-to-end systems to solve specific industry problems, save time, improve efficiencies and productivity. The Routescene integrated system comprises workflow methodologies, software including specific data processing tools, hardware and firmware.

For more information, visit: www.routescene.com

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