TECHNICAL NOTE

COMPARISON OF STANDARD AND HIGH-PERFORMANCE GPS/IMU

The primary difference between Headwall's standard and high-performance GPS/IMU systems is accuracy of altitude, roll, pitch, and heading data.

GPS/IMU ACCURACY AFFECTS LIDAR DATA CAPTURE & VISUALIZATION

When utilizing otherwise identical airborne platforms, the quality of the point-cloud data captured from the integrated LiDAR systems differs due to employing either the Standard (Gen 2) or High Performance GPS/IMU.

Headwall highly recommends purchasing the High-Performance GPS/IMU for LiDAR-equipped systems.

Note the clarity of the point-cloud image on the right, captured on a Headwall unmanned aerial vehicle (UAV) system equipped with the High-Performance GPS/IMU, versus the image on the left, captured on a system equipped with the Standard (Gen 2) GPS/IMU.

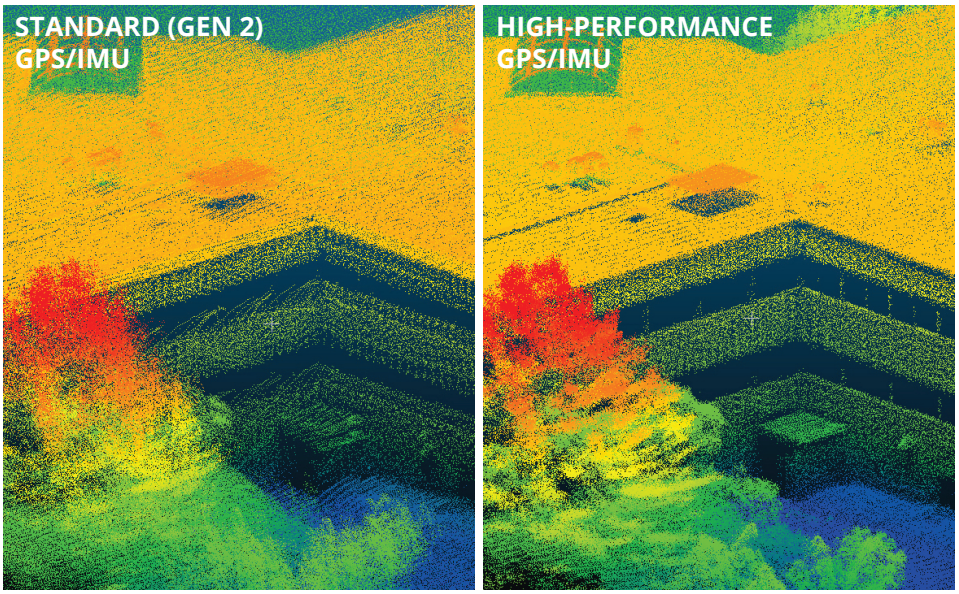

Figure 1. Here are point-cloud images taken from otherwise identical Headwall airborne hyperspectral imaging platforms with LiDAR. The point-cloud image on the left was taken using the Standard (Gen 2) GPS/IMU. The point-cloud image on the right was taken with the High-Performance GPS/IMU. Point-cloud data was visualized using the open-source program CloudCompare[1], with coordinates exported to scalar fields and the display range for height (Z) made as close to identical as possible (red = high, blue = low).

GPS/IMU ACCURACY AFFECTS ORTHORECTIFICATION AND ORTHO-MOSAICKING

In addition to affecting LiDAR data, inaccuracies in GPS/IMU data result in image distortions that impact the ortho-mosaicking of flight-swath images, as shown in Figure 2.

Headwall's High-Performance GPS/IMU coupled with software that uses Post-Processing Kinematics (PPK), a GPS correction technique that corrects location data after drone data has been captured and downloaded, significantly reduces image distortions, enabling more accurate ortho-mosaicking of multiple flight swath images.

Figure 2. Multiple flight swaths were orthorectified and stitched together in the above images, left using the Standard (Gen 1) GPS/IMU and right using the High-Performance GPS/IMU. Notice the image distortions of the parking lot lines and the reflectance tarp with standard GPS/IMU data. The legacy Standard (Gen 1) GPS/IMU system had a single GPS antenna, and at speeds below 10 meters per second, the resulting ortho-mosaicked images can be inferior to those produced using the High-Performance GPS/IMU.

TECHNICAL NOTE

COMPARISON OF STANDARD AND HIGH-PERFORMANCE GPS/IMU

WHY BUY THE HIGH-PERFORMANCE GPS/IMU?

- Significantly more accurate than Standard (Gen 1 or Gen 2) GPS/IMU, even without postprocessing
- Superior vertical accuracy over Standard (Gen 1 or Gen 2) GPS/IMU that aids LiDAR applications

The Headwall Standard (Gen 2) GPS/IMU can be distinguished from the legacy Standard (Gen 1) GPS/IMU, by the presence of two antennae on the Gen 2 model, versus a single antenna on the Gen 1 model.

Neither of the Standard models have GPS post-processing implemented, as the High-Performance GPS/IMU has (using PPK).

AVAILABLE SMART TARGET BASE STATION

Headwall portable base stations enable PPK anywhere a GPS signal is available. Data can be downloaded 1 to 2 hours after flight versus waiting 24 hours or more when relying on NGS Continuously Operating Reference Stations (CORS) data.

Contact Headwall or your local authorized reseller for more information about our Smart Target Base Stations.

Figure 4. Headwall offers an optional Smart Target Base Station that compares its own fixed location to generate GPS error-versus-time data to correct drone GPS measurements.

STANDARD (GEN 2) GPS/IMU

HIGH-PERFORMANCE GPS/IMU

Figure 3. Ortho-mosaicking using the Standard (Gen 2) GPS/IMU can be visually comparable to the High-Performance GPS/IMU. So, why use the High-Performance GPS/IMU? The vertical accuracy of the High-Performance GPS/IMU is significantly better than that of either model of the Standard (Gen 1 or Gen 2) GPS/IMU. This can be crucial for applications that require accurate LiDAR point-cloud data. See the Geolocation Error table and the Specifications table below.

GEOLOCATION ERROR FOR DIFFERENT ALTITUDES (ALL VALUES IN METERS)						
Altitude (m)	10	20	50	100	200	500
Standard GPS (Gen 2)[2]	±3.833	±3.891	±4.064	±4.354	±4.933	±6.669
High-Performance GPS[3]	±2.651	±2.705	±2.864	±3.131	±3.664	±5.262
High-Performance GPS[3] (after PPK)	±0.102	±0.117	±0.163	±0.239	±0.392	±0.850

GENERAL ACCURACY RATINGS						
GPS/IMU Model	X (m)	Y (m)	Z (m)	Roll (deg)	Pitch (deg)	Heading (deg)
Standard GPS (Gen 2)[2]	2	2	2.5	0.1	0.1	0.3
High-Performance GPS[3]	1.5	1.5	1.5	0.04	0.04	0.03
High-Performance GPS[3] (after PPK)	0.05	0.05	0.05	0.025	0.025	0.08

[1] CloudCompare is an open-source software program for 3D point-cloud and mesh processing and visualization that is free to use for any purpose, including commercially or for education. This freedom is defined by the GNU General Public License (GPL).

[2] Weight of Headwall Standard GPS (Gen 2, part number 1010A-00278) with enclosure = 30g

[3] Weight of Headwall High-Performance GPS (part number 1005A-31279 or 1004A-31277) without enclosure = 60g, with enclosure = 200g

JUNE 2019

Manufactured by Headwall Photonics, distributed in the UK and Ireland by **analytik**.

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