
NV5 Geospatial
CLASS Solutions
Put CLASS into your data acquisition
NV5 GEOSPATIAL
Delivering Solutions - Improving Lives

CLASS

/klɑs/
adjective Showing stylish excellence: ***They are a class organization***
verb Assign or regard as belonging to a particular category: ***Conduct that is classed as overachieving***
noun **1** A set or category of things having some property or attribute in common and differentiated from others by kind, type, or quality **2** The system of ordering a society in which people are divided into sets based on perceived social or economic status **3** Comprehensive Low-Altitude Sensor Solution, an innovative sensor approach to the simultaneous acquisition of high-density, high-resolution lidar, stereo imagery, and oblique imagery by NV5 Geospatial, North America's leading geospatial solutions firm: ***NV5 Geospatial operates with CLASS***

Why NV5 Geospatial?

NV5 Geospatial is the geospatial pioneer pushing the boundaries of data and analytics to deliver actionable intelligence to those who need to map, model, and manage their world.

We lead the nation as the only end-to-end geospatial solutions provider with the capability to deliver the highest quality data and geographic insights.

We combine unmatched expertise and experience with the latest technology and proprietary software to map and analyze all types of terrain.

But we are so much more than what we measure.

We lead our peers in innovation and are active participants in the research community, constantly exploring new and novel ways to solve our client's greatest challenges.

And we have CLASS

Why CLASS?

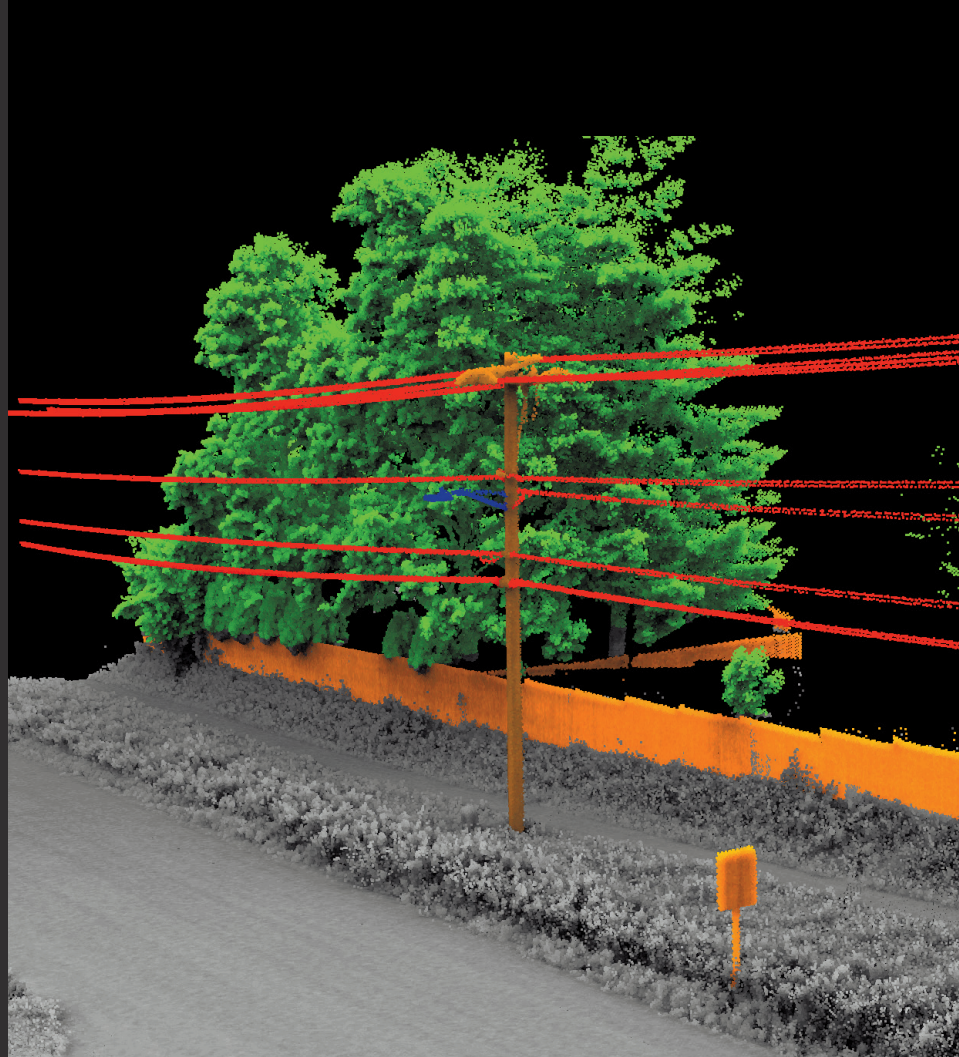
NV5 Geospatial is constantly looking for new and better ways to help our clients meet their greatest challenges. We are a worldwide leader in designing and implementing new and innovative technology that wouldn't be available otherwise.

We continue to see considerable growth in many areas requiring high-resolution, high-accuracy data capture and understand the benefits of developing sensor packages that can acquire all data in a single deployment. With no commercial availability of sensor packages with the ideal combination required – dual look lidar, RGB and NIR nadir imagery, forward and rear looking oblique imagery, and video – we embarked on configuring our own sensor packages to meet those needs.

The Advantage

The comprehensive, high-density, high-resolution data gained from our CLASS systems offer many advantages for remote sensing. These advantages include:

- High-density lidar point clouds – typically 50-100 points per square meter (ppsm)
- High resolution nadir imagery for mapping with common resolutions ranging from 1/3” to 1/2”
- Similar resolutions in the oblique images where our analysts can read signs, inspect infrastructure, or accurately catalog asset conditions



Where CLASS Works Best

Our CLASS systems provide innovative solutions for many use cases. They are ideal for any project that demands a combination of high-density, high-resolution, and high-accuracy from a single low-altitude pass of a rotary wing platform. Many corridor projects fit this description, but so do specialty wide-area projects.

Typical Applications Include

- Corridor Mapping: Power Line, Railway Track and Pipeline Inspection
- Terrain and Canyon Mapping
- Resource Management
- Surveying Urban Environments
- Agriculture & Forestry
- Small Scale Rapid Response

Airports

Electric transmis-
sion and distribution
systems

Infrastructure inspec-
tion (dams, building,
bridges)

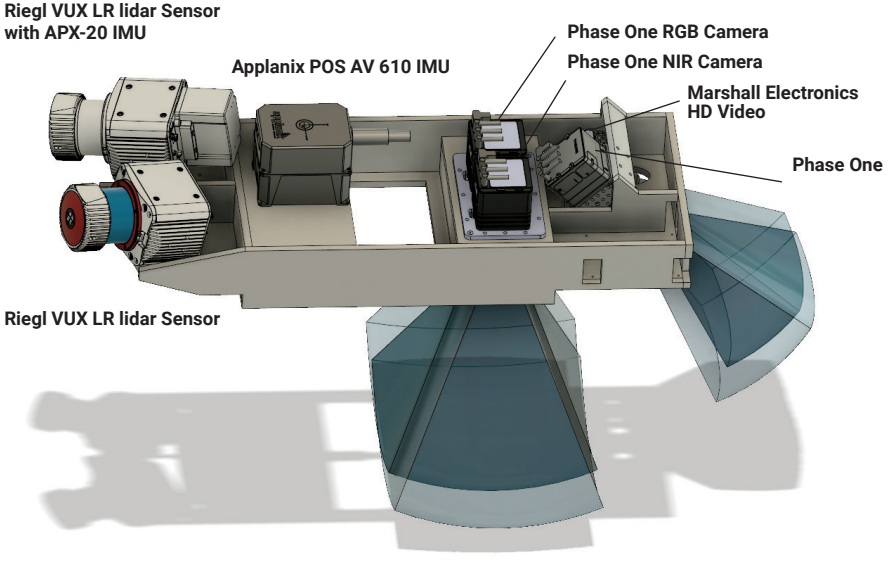
Geophysical risk
(landslides, volcanos)

Pipelines

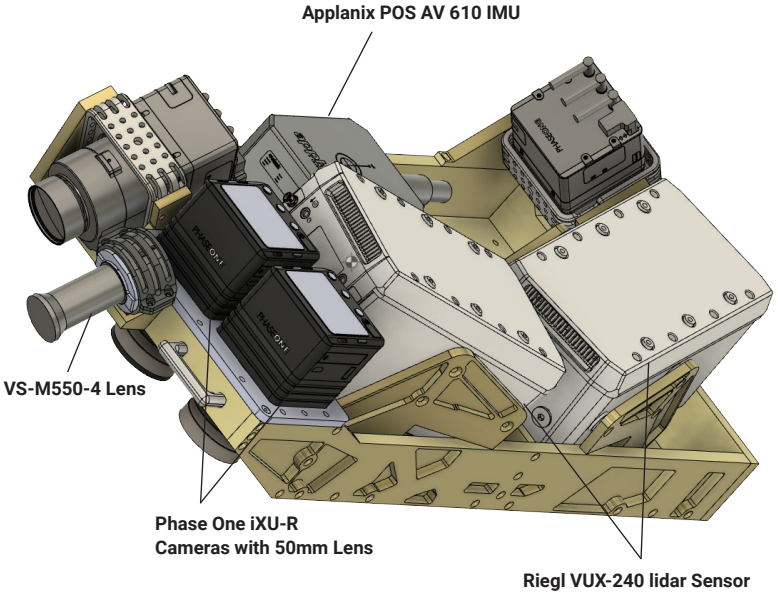
Transportation cor-
ridors
(roadways and rail)

Riverine environ-
ments

Our Comprehensive Low-Altitude Sensor Solutions (Class 1.0)



(Class 2.0) Bridging the Void



CLASS 1.0

Lidar:	x2 Riegl VUX-1LR
Lidar Pulse Rate:	820 KHz / Scanner
Max FOV:	90 °
Max Operating Altitude:	550m
Cameras:	Forward Oblique: PhaseOne IXM-RS100F Oblique with 70mm Lens Nadir 4-Band: PhaseOne IXM-RS100F RBG+NIR with 50mm Lens
Max Corridor ROW for Single Pass (Lidar, Nadir, Oblique):	300'
(Maximum) Average Point Density for Corridor Collection:	500' AGL(Above Ground Level)@ 50kts: 40ppm
Resolution:	100mp Nadir & Oblique

CLASS 2.0

Lidar:	X2 Riegl VUX-240
Lidar Pulse Rate:	1800KHz / Scanner
Max FOV:	75°
Max Operating Altitude:	1400m
Cameras:	Forward & Rear Oblique: PhaseOne IXM-RS150F Oblique with 70mm Lens Nadir 4-Band: PhaseOne IXM-RS100F RBG+NIR with 50mm Lens
Max Corridor ROW for Single Pass (Lidar, Nadir, Oblique):	800'
(Maximum) Average Point Density for Corridor Collection:	1000' AGL @80kts: 150ppm
Resolution:	150mp Oblique, 100mp Nadir

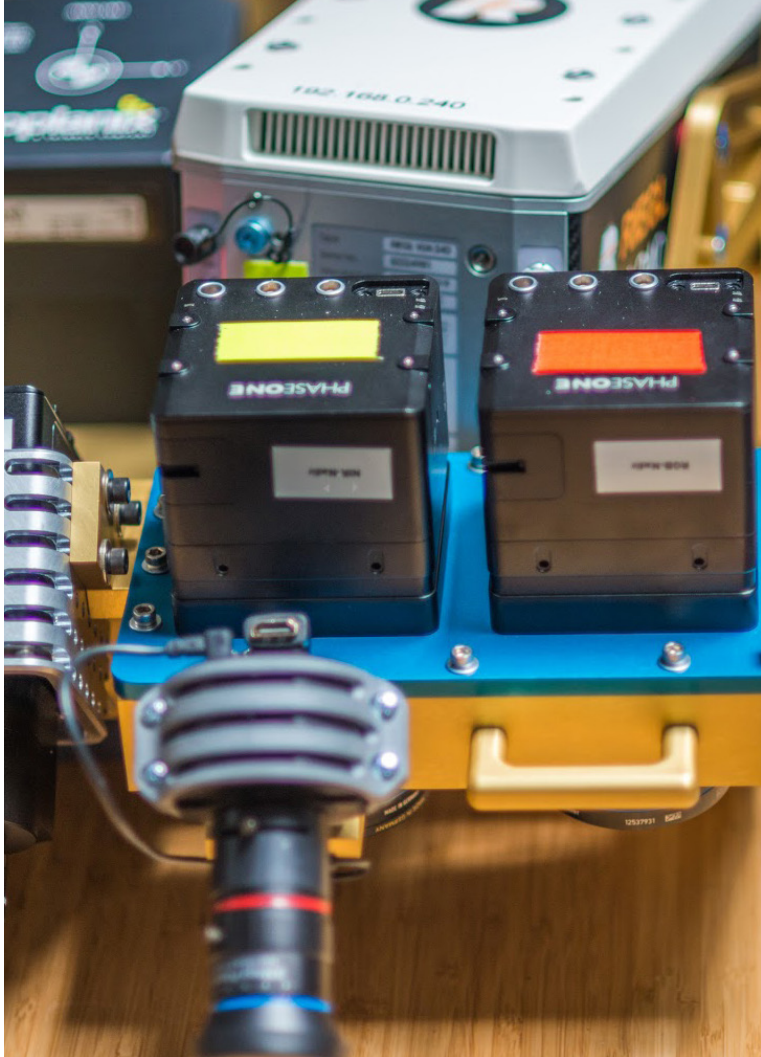
CLASS in Action

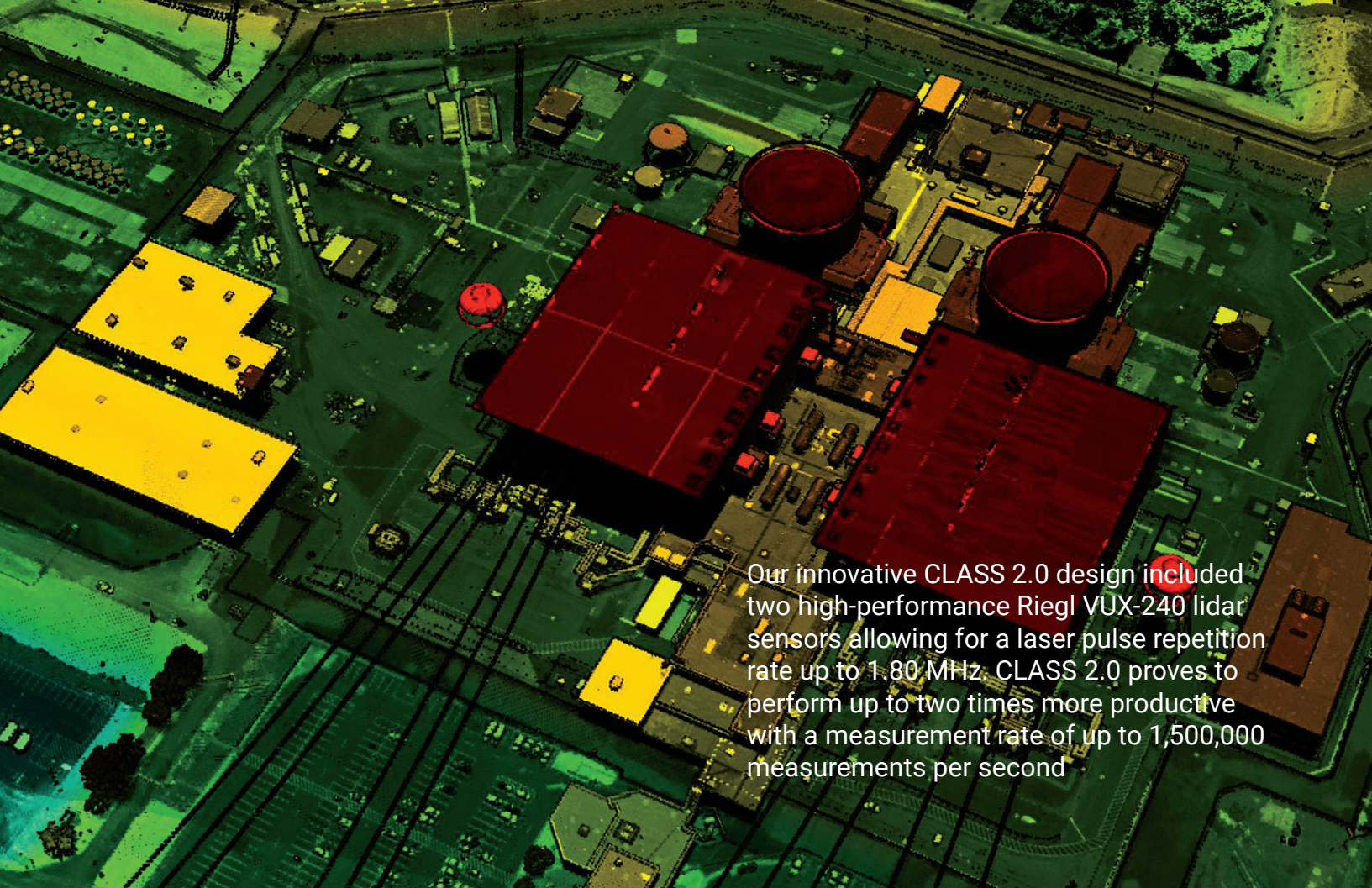
Our CLASS systems can operate at flight altitudes ranging from 300 ft (91 m) above ground line (AGL) up to 4,600 ft (1,402 m) AGL. Typical flying heights for transmission line engineering (TLE) and transportation projects are targeted at 500-1500' AGL. At this altitude, the nadir cameras have a nominal resolution of 0.046 ft (1.4 cm).

The accurate positioning of lidar returns and camera orientation demands recording of Global Navigation Satellite System (GNSS) and Inertial Navigation System (INS) data for position and orientation of the sensor. Our CLASS systems include the Applanix POS AV 610, which is the premier airborne GNSS/INS system on the market. The 610 was selected to achieve the highest level of accuracy from these systems.

The Power of Two

Our unique design of CLASS 1.0 included two high-performance Riegl VUX-LR lidar sensors. The two sensors allow for a combined maximum pulse rate of 1.64 MHz, or 1.64 million points per second of flight. There are significant advantages beyond the obvious doubling of the effective point density as compared to using a single sensor. The added advantages accrue from the orientation of the two sensors. The scan patterns cross at nadir and are canted fore and aft to provide a slight oblique pattern for the scans. These sensors retain the considerable ability to penetrate vegetation, but more importantly, the crossing oblique scans have increased ability to accurately render vertical features in the landscape. This proves useful for many use cases including utility infrastructure, buildings, bridges, signage, and vegetation.





Our innovative CLASS 2.0 design included two high-performance Riegl VUX-240 lidar sensors allowing for a laser pulse repetition rate up to 1.80 MHz. CLASS 2.0 proves to perform up to two times more productive with a measurement rate of up to 1,500,000 measurements per second

Nadir Imagery

Two Phase One iXM precision metric cameras separately capture RGB and NIR nadir imagery for photogrammetric mapping and orthophoto production. They provide stable stereo geometry, opening the door for many precision uses.
These 100 Megapixel cameras have a footprint of 11,664 pixels across track and 8,750 pixels along track. This footprint provides significant capabilities, in terms of both resolution and swath width.

Oblique Imagery

Oblique imagery provides additional perspectives on above-ground features and allows us to view elements that might be occluded in typical vertical images. They allow easier identification of objects and better interpretation overall.
There are three simplistic examples where oblique imagery can provide considerably improved intelligence.

- Understanding texture and height of buildings.
- Determining the nature and content on signage
- Assessing the number of attachments and nature of the assets on utility poles and transmission structures

CLASS Accuracies

The elevation accuracy of the lidar data depends on the

- altitude
- instrument accuracy
- the positional accuracy of the GNSS/IMU

We have consistently demonstrated positional accuracy of better than 5cm RMSEz for typical operational altitudes of 150 to 200 meters. In any lidar survey, the ability to achieve high accuracy depends on good field practices and an adequate number and distribution of ground calibration points.

Performance

There are obvious questions related to the performance of the sensor combination at varying heights and acquisition speeds. Our flight planners have extensive experience developing flight plans that maximize sensor performance, matching accuracy, image resolution, point density, and swath width to project specifics.

Dual Riegl VUX-LR LiDAR @ 70° FOV & 45 knots			Phase One iXM RS100F 4-band Imagery		
Height AGL (ft)	Swath Width (ft)	Pulse Density (ppsm)	Swath Width (ft)	GSD (cm)	GSD (in)
300	420	110	320	0.84	0.33
350	490	95	374	0.98	0.39
400	560	85	427	1.12	0.44
450	630	75	481	1.26	0.50
500	700	65	534	1.40	0.55
600	840	55	641	1.68	0.66
700	980	45	748	1.96	0.77
800	1,120	30	854	2.24	0.88
900	1,260	20	961	2.52	0.99
1,000	1,400	10	1,068	2.80	1.1

The tables provide general information regarding density, resolution, and effective swath widths within the imagery and lidar scans.

CLASS 2.0 Riegl VUX-240 LiDAR 100% Power, 75° FOV					
Speed (kts)	Target AGL (ft)	Target (m)	Swath Width (m)	Density (ppm)	Pulse Rate (KHz)/Scanner
300	420	110	320	0.84	0.33
350	490	95	374	0.98	0.39
400	560	85	427	1.12	0.44
450	630	75	481	1.26	0.50
500	700	65	534	1.40	0.55
600	840	55	641	1.68	0.66
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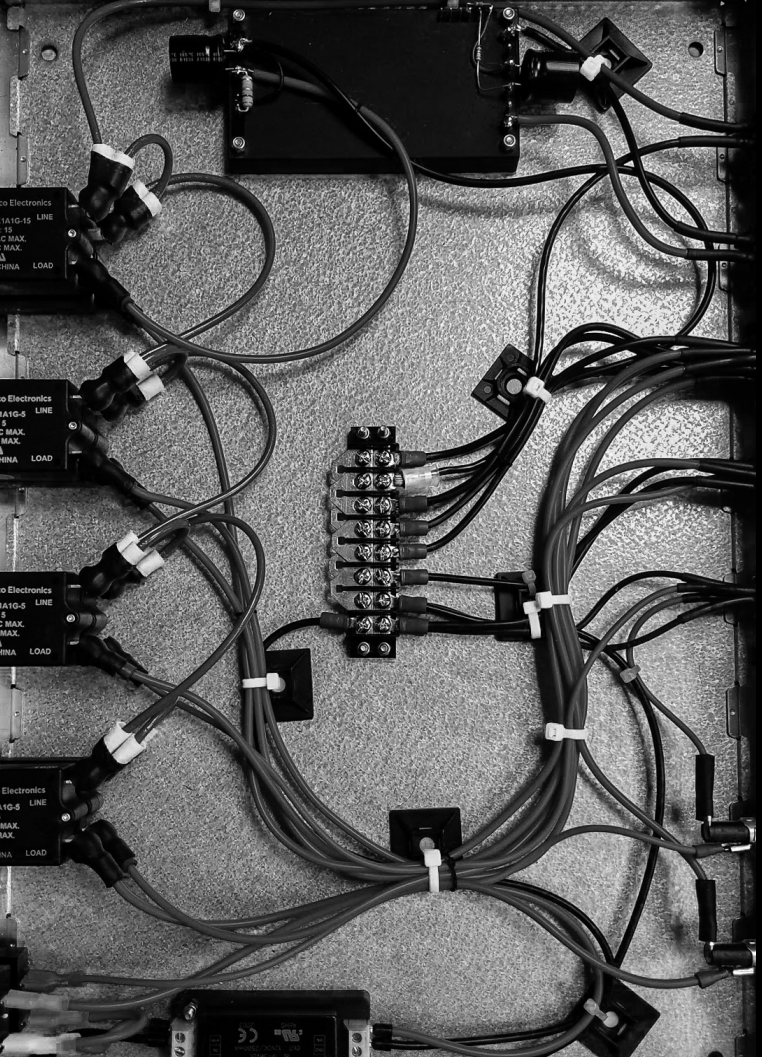
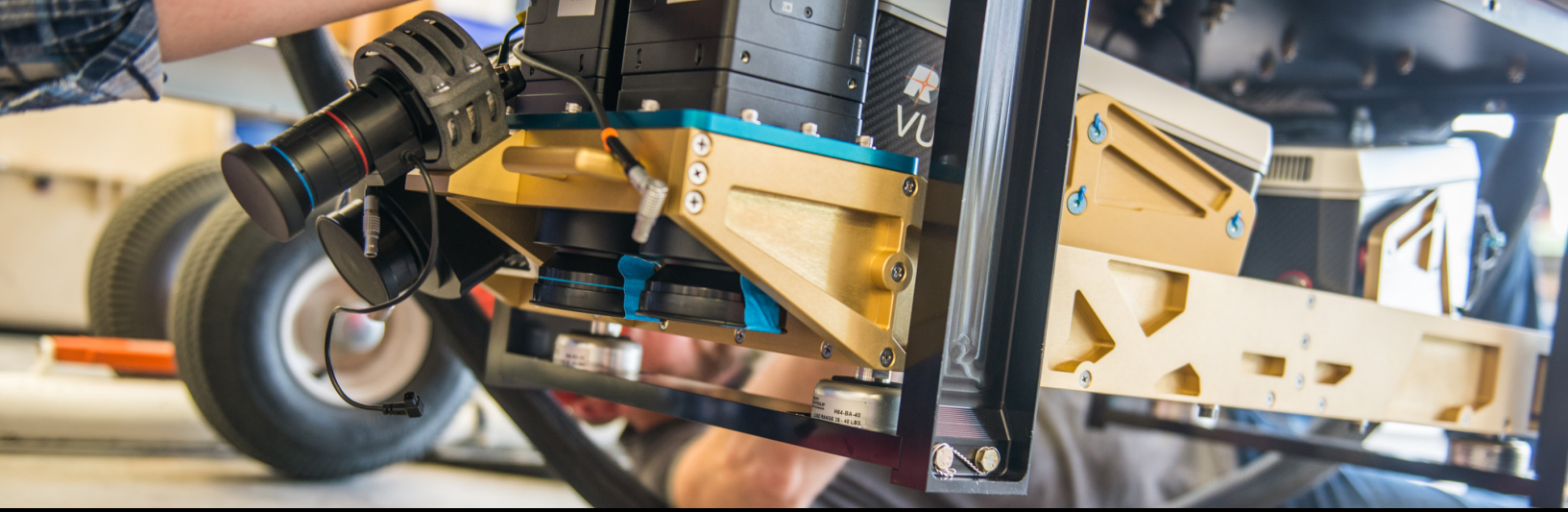


Fabrication

We designed and assembled our CLASS systems utilizing state-of-the-art commercially available components. The CLASS 1.0 integrated package consists of two Riegl VUX-LR lidar sensors, three Phase One iXM 100 digital cameras, a Marshall video camera, an Applanix POS AV 610 inertial navigation system (INS), and an AIMMS weather probe.

Two of the Phase One cameras are positioned at nadir while the third and the video camera are positioned for a forward-looking oblique view at a 45 degree look angle. The two VUX lidar sensors are co-located but canted to provide an overlapping fore and aft cross hatch scan in a single pass. All sensors are integrated with the INS system to provide highly accurate positioning and orientation information. TopoFlight software is used for flight management and camera triggering.



Installation

The sensor is designed for rotary wing application. All sensors are integrated in a Meeker mount that attaches to the bottom of a helicopter and is FAA approved for the Bell 206 series (e.g., 206B, 206L, and 407). The Bell 206 is one of the most common rotary wing platforms in the world, which allows flexible and cost-effective mobilization of the sensor package to a wide range of locations.

The lidar and digital camera components have a small form factor that make them UAS ready. One of our Riegl VUX-LR sensors includes an integrated Applanix APX-20 GNSS/IMU that allows efficient transfer to a UAS platform. The Phase One cameras are also small enough to integrate on a UAS platform, but our intent is to utilize consumer grade cameras for UAS flights.

"Could not have asked for a better job put forth by the management team on this important task order. Job well done"
US Army Corps of Engineers

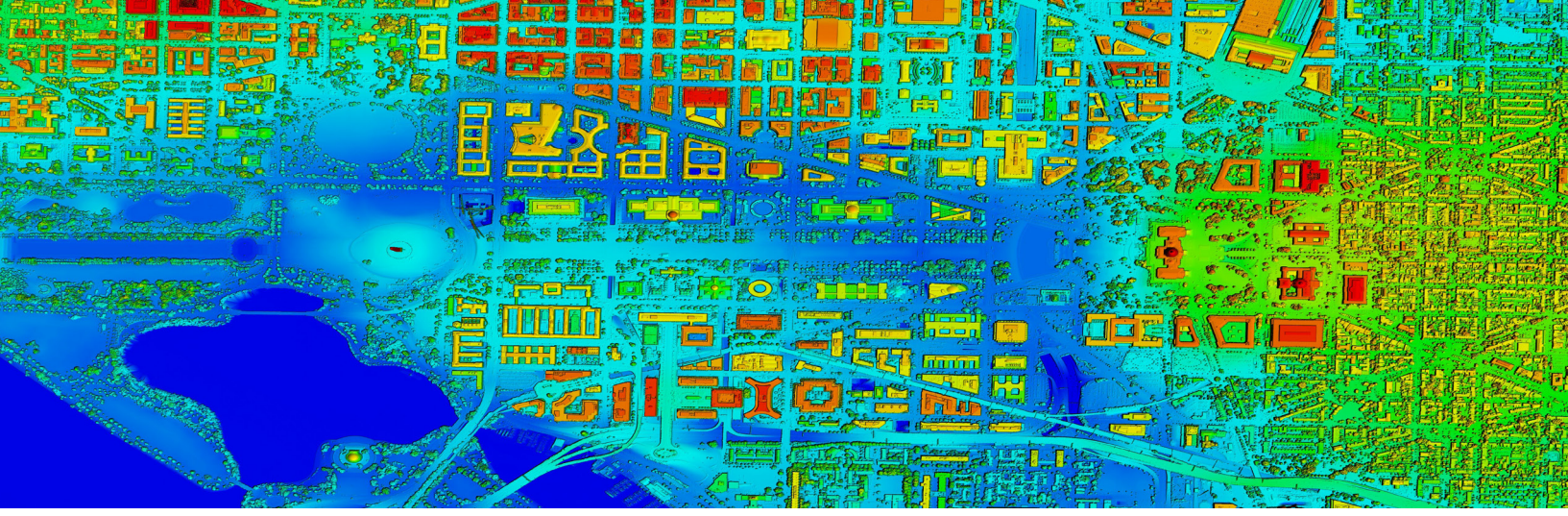
We stand alone among our peers in analytical capabilities

North America's most comprehensive and capable remote sensing firm

"I was so impressed at how they truly understood what the goals of its client were and mapped a plan to meet those goals"
The Nature Conservancy

Office Locations

Remote sensing & geospatial experts



Contact Us

We would like to hear from you. Reach out to us with any questions about technology, challenges in optimizing the value, or deriving the most critical answers from the data.

My Contact

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