Honeywell

THE POWER OF **CONNECTED**

VSI LABS IS PERFECTING THE AUTONOMOUS VEHICLE WITH HONEYWELL IMU TECHNOLOGY

Products from the pioneer in Inertial Measurement Units are the right choice for maximizing safety and performance.

> **"I would certainly recommend Honeywell IMUs for a variety of applications. They provide really accurate raw data and always stay well-calibrated."**
>
> *—Matthew Linder, Autonomous Solutions Engineer, Team Leader, VSI Labs*

Overview

As the leading researcher of active safety and automated vehicle technologies, VSI Labs is on a mission to help set the standards for successful self-driving cars. At its proving ground outside of Minneapolis, the company tests a multitude of component systems for automakers and automotive industry suppliers. To enhance its work on localization—the precise understanding of where an autonomous vehicle is at all times—VSI Labs relies on Inertial Measurement Units (IMUs) from Honeywell.

Quick Facts

Honeywell Installed Solution

- HG1120 IMU

Customer Results

- Precise localization for autonomous vehicles
- Accurate raw data and consistent calibration
- Excellent support and service
- Continuous improvement and innovation

Why Honeywell IMUs

- World class inertial sensor development, calibration, and compensation
- Proven reliability, dependability, and ruggedness
- RS-422 Asynchronous, CAN2A/CAN2B, and SPI Interface Protocols
- User-configurable options with selectable output data rates and filtering
- Precision Delta Velocity/Angle outputs for direct yaw, pitch, and roll integration

Customer

- Name: VSI Labs
- Location: Saint Louis Park, Minnesota
- Industry: Autonomous Vehicle Research
- Website: vsi-labs.com

Background:

Building automated vehicles (AVs) requires the seamless orchestration of many technologies, including robotics, computer vision, artificial intelligence, sensor fusion, control theory, and more. Making all of these technologies work together demands critical safety programming practices and methods. As the leading researcher of active safety and automated vehicle technologies, VSI Labs is on a mission to help establish best practices for the development of self-driving cars.

Since 2014, the Minnesota-based company has been examining the functionality and integration of AV componentry, from raw sensors to domain controllers. "We conduct applied research on the design, development, and integration of automated vehicle technologies," says founder & principal advisor Phil Magney. "Basically, we figure out what it takes to build an automated vehicle—and more importantly, what it takes to integrate the necessary components."

Using its own fleet, VSI Labs examines major functional elements of AV systems, from by-wire control systems and sensor fusion to odometry and precision localization.

"We're helping our customers understand where the gaps are within the development of an AV," Magney continues. "Where are the challenges, and how do you solve them? We're helping companies save time and money in the design and development of their AV technologies."

A fundamental component of active safety and AV technology is localization—a vehicle's ability to understand where it is in space—something engineers refer to as "ground truth." The technology that makes this possible is the Inertial Measurement Unit, or IMU.

"You could not build an automated vehicle without an IMU device," Magney says. "When you are operating an automated vehicle, the vehicle needs to have as much intelligence as possible to understand where it is....The IMU helps reduce the error rate and maintain a trajectory that's closer to ground truth."

Solution:

Matthew Linder, lead AV engineer at VSI Labs, expands on the key role IMUs play in localization: "Typically what we use for our project is [the IMU's data on] linear acceleration—how fast the car is moving in three dimensions—and angular velocity—the speed of the vehicle rotating in three dimensions." The IMU works with LIDAR (a laser-based detection system) and GPS to provide a vehicle with continuous data about its location.

"A lot of times, the problem we have is with the GPS," Magney explains. "If the GPS is getting too many errors, or is experiencing too much interference from buildings or clouds, then the whole system is going to struggle a bit. The IMU, however, helps bridge the gaps between GPS readings from point A to point B."

IMUs help boost LIDAR's effectiveness, too. While LIDAR works relatively slowly (taking several milliseconds to complete an algorithm), IMU works in the background, providing lightning fast updates.

To bolster its research, VSI Labs chose IMUs produced by Honeywell Aerospace. Since first developing the technology in the 1990s, Honeywell has become the world's leading producer of IMUs, which are currently used by leading aerospace, military, and commercial customers across various industries.

Honeywell's continuous innovation has led to smaller, more precise devices indispensable to today's air- and spacecraft, undersea vehicles, and—of course—autonomous vehicles. In fact, Honeywell recently produced the 500,000th IMU at its facility in Minneapolis—not far from VSI Labs' headquarters.

Linder, for one, is ecstatic about the successful integration of Honeywell's IMU with LIDAR to achieve precision localization. "That is a complicated task to get just right and now it's working really well."

Benefits:

Both Magney and Linder are enthusiastic about the benefits Honeywell IMUs bring to the table. "Honeywell is the best partner to have for a variety of reasons," says Magney.

One key benefit has been the responsiveness of Honeywell's support services. "Whenever I have a question about the IMU or need help getting something set up, it's really easy for me to reach out to the Honeywell product lead," Linder says. "He'll get back to me right away, and will even offer to come by if necessary."

The Honeywell device's size, speed, accuracy were other key selling points. "I would certainly recommend Honeywell IMUs for a variety of applications," says Linder. "They provide really accurate raw data and always stay well-calibrated; you don't need to calibrate them yourself or recalibrate them."

Linder also likes how easy it has been to integrate Honeywell IMUs with VSI Labs' own systems, thanks to the Controller Area Network (CAN). "CAN is the network vehicles use for sharing messages," Linder explains. "The IMU has an interface for that, which we can connect to our computers."

Magney views Honeywell's IMUs as the linchpin for the success and safety of autonomous vehicle systems. "We could do what we're doing without an IMU. We could eliminate different sensors and we'd still be able to accomplish the task," he contends. "But we don't want to do that, because in the context of an automated vehicle you want to apply as many technologies as possible to improve performance and safety. The Honeywell IMUs give us that capability."

Looking ahead, Magney also values the suite of advanced technologies Honeywell has developed to enhance the performance of IMUs in autonomous vehicles, particularly its correction services. These advanced devices couple the IMU with GNSS (Global Navigation Satellite System) services, says Magney. "We look forward to being able to apply those technologies in the next build, which we're actually undergoing now."

It's no exaggeration to say that for Linder, IMUs are helping him to fulfill a dream. "I'm really passionate about working in the automated vehicle industry. It's an industry with a lot of controversy, but I am passionate about benefits to society that it'll bring, and I am really motivated to see that through."

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