Inertial Labs
Attitude is Everything

Utilizing Methods of Precision Agriculture to Create a Sustainable Tomorrow

Introduction

Precision Agriculture is one of the most used cases of autonomy in this century. Recent reports show that by the year 2025, Precision Agriculture is expected to grow to become a 43.4-billion-dollar industry worldwide[1]. For an industry that didn't begin gaining traction until the 1990's, it's quite an impressive market.

As it stands, the farming industry has some of the most constrained budgets of any industry on the planet. When it comes to investing in new methods of farming, the most important factor driving change is the cost of labor. If the technology that is involved in the potential methods of Precision Agriculture being considered are more expensive than human efforts to do the same job, then farmers simply have no reason to invest in the change. This creates a demand for inexpensive technology to maximize profitability.

Inertial Labs is teaming up with companies across the globe to engineer solutions that are helping farmers become more profitable. Whether you are a large-scale farming operation, or a small, local supplier of fresh fruits and vegetables to a farmer's market, automating your processes should be a hassle-free option that increases profit margin.

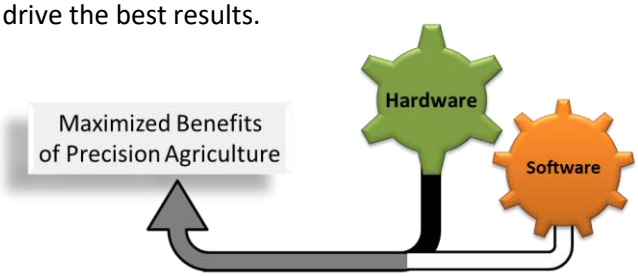
What are the Benefits?

Methods of Precision Agriculture expand across all levels of the agriculture industry. If you're environmentally conscious, this is a market for you. Perhaps you prefer to produce crops that are organic, minimizing the amount of exposure they get to fertilizers? Don't like wasting water? Maybe it's as simple as you would like a little bit more free-time in your day. Whatever the case, automating work and adopting methods in line with the Precision Agriculture industry can lead to some, if not all of the following benefits:

- Ability to health-monitor and respond based on current conditions of soil and crops
- Maximize profitability
- Reduction of material wastes by precision planting
- Ability to project crop yields
- Minimizing carbon footprint by micro-spraying pesticides

Components of Precision Agriculture

The components of Precision Agriculture can be broken down into two major categories: Software and Hardware. In order to have an effective solution, ideally the two are used in parallel, feeding information back and forth to constantly drive the best results.



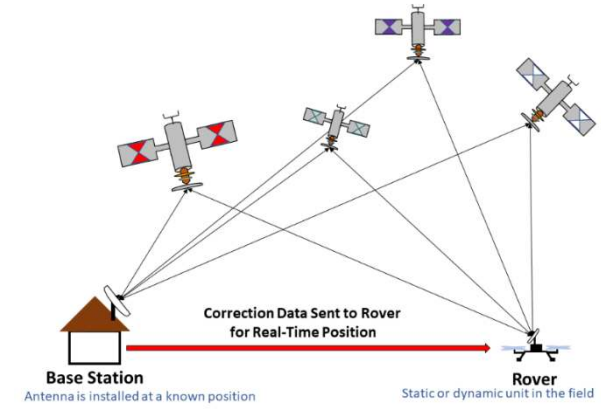
Hardware

Autonomous Farming Vehicles outfitted with devices like: cameras, Inertial Measurement Units (IMUs), Global Positioning System (GPS) receivers, LiDAR sensors, light and heavy response machinery to mitigate poor crop conditions, datalogger, etc. Regardless of what the task is, any vehicle that operates autonomously has to be able to communicate with an outside source and/or be able to detect motion in its own reference frame. Many farming vehicles like seeders, tillers, sprayers, harvesters and surveying drones can be automated using these devices.

Currently, this is one of the largest expanding industries across the globe. Autonomous vehicles have expanded farming techniques far beyond those of the 20th century and now embrace methods that help maximize production by: identifying soil characteristics; predicting and measuring field drainage both above and below ground; and generating electromagnetic soil maps.

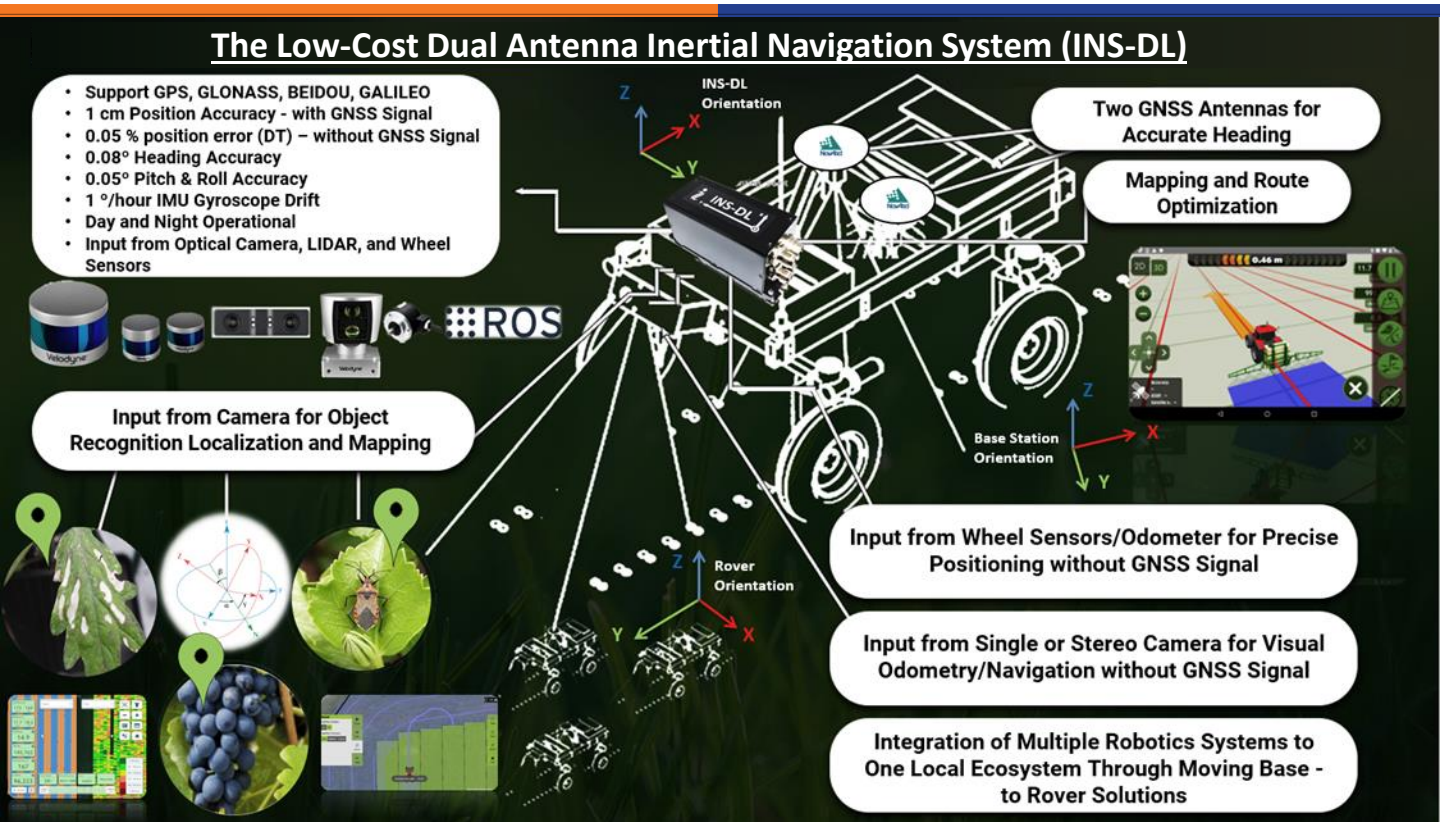
Base Stations are key to autonomous operations on the farm. Real Time Kinematic (RTK) corrections can be sent from a localized position to ensure that autonomous vehicles are operating with precision accuracy. Some Base Stations, like the one offered by **Inertial Labs**, can send corrections at different frequencies up to a 50 kilometer away.

The visual below shows how many Precision Agriculture vehicles use a Base Station to ensure they are getting precision position accuracy.



Integration Solutions are the most critical feature for the agriculture industry. Most products are manufactured and sold at an individual component level, or a full system level. However, many agriculture business operators already have machinery that has been operated reliably for years. Investing in a new system just isn't practical when it comes to an industry that operates on tight financial constraints. Companies like **Inertial Labs** offer solutions that can be integrated into desired existing platforms with ease, to make sure that you are paying for performance without the added cost of a unnecessary machinery.

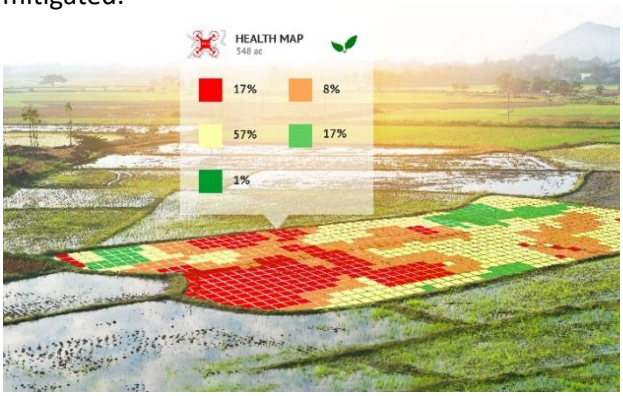
The Low-Cost Dual Antenna Inertial Navigation System (INS-DL)



The **Inertial Labs** INS is the one-stop solution for autonomous navigation and communication. The INS supports inputs from cameras, odometers, echosounders, Doppler Velocity Logs (DVLs), radars, encoders and other external sensors that can be configured to generate solutions utilizing computer vision and machine learning algorithms. The INS also has an internal Inertial Measurement Unit (IMU) that can be made to order depending on consumer needs based on forces, rates of motion, and accuracies needed for the platform.

Software

Mapping Software is the basic necessity when it comes to software needs for Precision Agriculture. Mapping software will give you the ability to view your crops conditions from a birds-eye-view. Depending on the software that is used, different functionality of viewable layers can help you observe characteristics such as: soil saturation levels; nitrogen and phosphate levels; estimated profit margins; current conditions of soil or crops; and even locations that have been treated whether from micro-spraying chemicals or mitigating crop conditions (harvesting, weeding, pruning, etc.). All these layers have the ability to be viewed on 2D or 3D models to help you understand exactly how your farm operates and where losses can be mitigated.



Automation Software is currently one of most lacking tools in the industry today for Precision Agriculture. Although many autopilot softwares today can be used to generate autonomous flight-paths using a waypoint feature, it is then up to the user to create or purchase an expensive personalized software to program functionality of the autonomous vehicle once it arrives to a waypoint. An effective automation software should take into account aiding data from the vehicle and let the user configure actions to be taken when triggered events occur out in the field.

For example, If a vehicle utilizing Computer Vision identifies a grape of a specific color (identified on RBG or CMYK spectrum) it could mean it needs to be: watered, treated with pesticides, fed fertilizer, harvested, or to be removed from the vine. This identification process of the crop can only be done by advanced Machine Learning processes using a well developed automation software that helps a farmer monitor all crop conditions without having to manually identify them.

Partnering with You

Inertial Labs offers a complete buddle that is tailored specifically for users that are interested in pursuing the benefits of the Precision Agriculture industry. Industry partners like Pliant are working with Inertial Labs to create practical solutions to the world of Precision Agriculture.

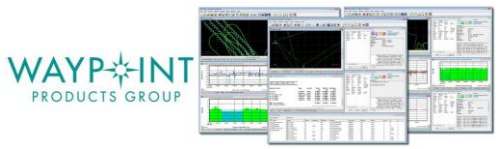
Since their founding in 2008, Pliant has grown to become an innovative and multidisciplinary company specializing in the manufacturing of solutions involving robotics, vision, and controls; on frontiers involving both hardware and software. Pliant began its partnership with Inertial Labs in the early months of 2017 as a platform integrator for supplying complete solutions in the market of Precision Agriculture. In recent years, Pliant has become increasingly involved in the field on autonomy. With companies like Inertial Labs by their side, Pliant has brought autonomous navigation solutions that exceed market expectations in price-value and performance due to their ability to navigate in GNSS-denied environments, mitigating time and financial loses which would previously had been at the expense of the farming industry.

Inertial Labs Bundle for Precision Agriculture

Inertial Labs offers a complete buddle that is tailored specifically for users that are interested in pursuing the benefits associated with the Precision Agriculture industry. Supplied by Inertial Labs, the INS-B accepts RTCM messages from the continuously operating reference station, the RTK Base Station. Depending on the application type, the INS-B can either come as an environmentally sealed IP67 rated enclosure, or as an OEM model for easy mounting on platforms where weight is a top priority.

The RTK Base Station supports Lefebure NTRIP Caster, a useful tool that configures RTK correction data to be easily accessible over your Internet through the use of a local IP address.

In addition, post-processing of data is now easier than ever. With the use of Inertial Explorer, a powerful NovAtel software, processing data can now be done in a matter of minutes. Simply create a project, input parameters, and combine datafiles from the field unit (INS-B) and the RTK Base Station to run the project and correct error. Inertial Labs has a knowledgeable support staff on standby and well-documented manuals to help walk you through processing your data, so you can be confident that regardless of your experience level, processing of results can be done with ease.



What Do You Think?

Here at Inertial Labs, we care about our customers satisfaction and want to continuously be able to provide solutions that are specifically tailored to problems that are occurring today, while vigorously developing products to tackle problems of tomorrow. Your opinion is always important to us whether you are a student, an entrepreneur or an industry heavyweight. Share with us your thoughts of our products, what you would like them to be able to achieve, or just say hello at opinions@inertiallabs.com

Inertial Labs
Attitude is Everything

Main Bundle Features	Up to 50 km RTK baseline; Fast acquisition times; 8/64 GB internal datalogger; Ideal for Autonomous Operation or Remote Sensing; ZUPT & Tunnel Guide for Land Vehicles	
Pitch and Roll (Accuracy)	0.08° (RMS, RTK)	0.006° (RMS, PPK)
Heading (Accuracy)	0.1° (RMS, RTK)	0.03° (RMS, PPK)
Horizontal Position (Accuracy)	0.01 m (RMS, RTK)	0.005 m (RMS, PPK)
Position (Accuracy, Free Inertial, Land Vehicles)	0.2 % DT (w/o odometer input) 0.05 % DT (w/ odometer input)	
Tactical Grade IMU	Gyro: 0.2 deg/√hr (AWR) Gyro: 1 deg/hr (Bias in-run) Accel: 0.015 m/s/√hr (VRW) Accel: 0.005 mg (Bias in-run)	
Weight	320 grams	
Size	120 x 50 x 53 mm	

(1) Schmaltz, Remi. "What Is Precision Agriculture and How Is Technology Enabling It?" AgFunderNews, 8 July 2019, https://agfundernews.com/what-is-precision-agriculture.html.

About Inertial Labs Inc.

Established in 2001, Inertial Labs is a leader in position and orientation technologies for commercial, industrial, aerospace and defense applications. Inertial Labs has a worldwide distributor and representative network covering 20+ countries across 6 continents and a standard product line spanning from Inertial Measurement Units (IMU) to GPS-Aided Inertial Navigation Systems (INS). With application breadth on Land, Air, and Sea; Inertial Labs covers the gambit of inertial technologies and solutions.

Inertial Labs
Attitude is Everything

Scan me!!!

Inertial Labs, Inc.
39959 Catoctin Ridge Street,
Paeonian Springs, VA
20129 USA
phone: +1 (703) 880 4222
sales@inertiallabs.com
www.inertiallabs.com