

Polaris

Sensor Technologies, Inc.

See More. Know More.®



CUSTOM SENSOR SOLUTIONS

ADVANCED ELECTRO-OPTICS

R&D, ALGORITHMS AND MEASUREMENTS

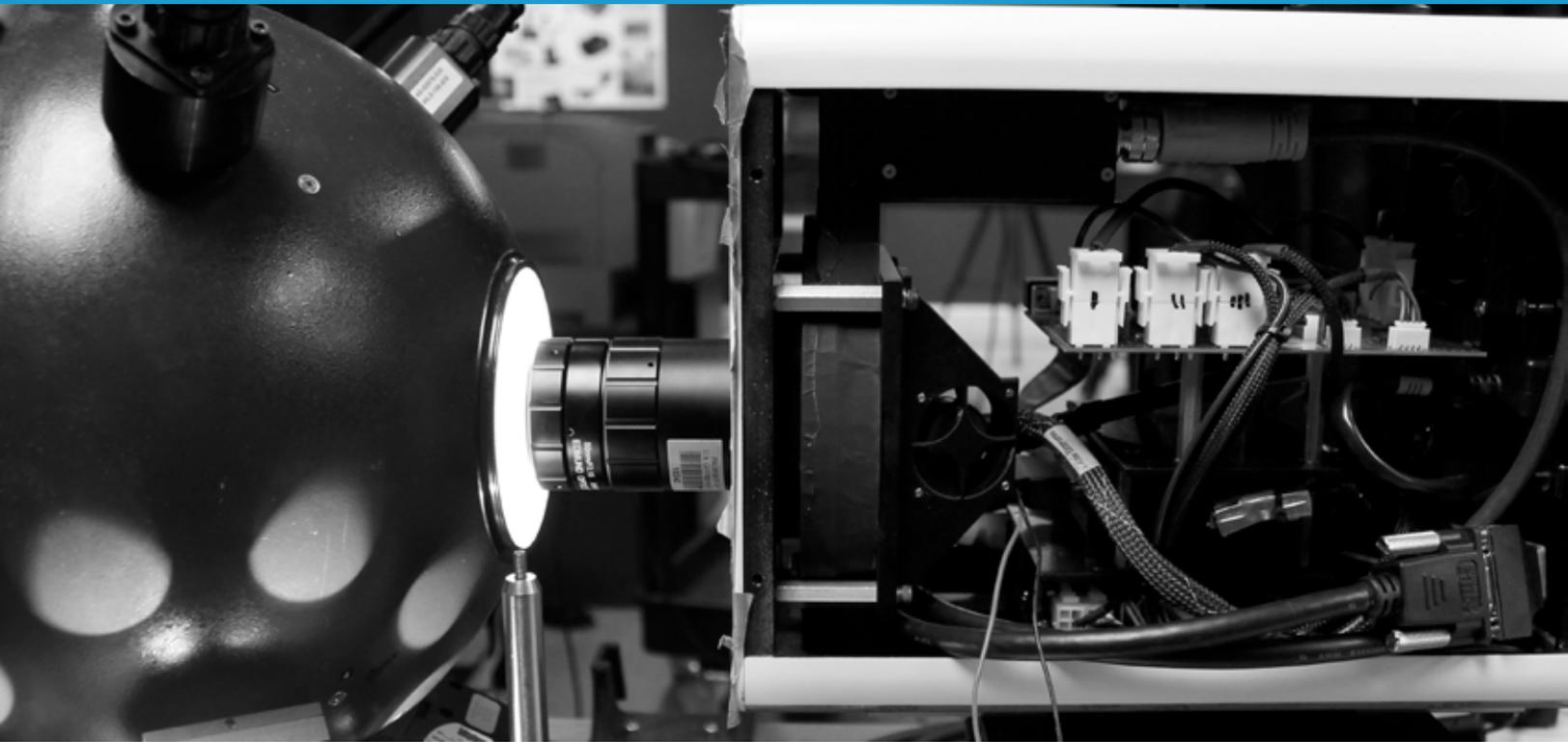
COMMERCIAL AND GOVERNMENTAL

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WHERE WE OPERATE



defense & security • vehicle automation • oil & diesel on water



WORLD CLASS CAPABILITIES

Research and Development

- Custom electro-optic sensors
- Polarimetric sensors
- Multispectral sensors
- Specific architectures
- VIS, NIR, SWIR, MWIR, LWIR
- Optical relays and micro optics
- Rapid prototyping
- Limited runs of production

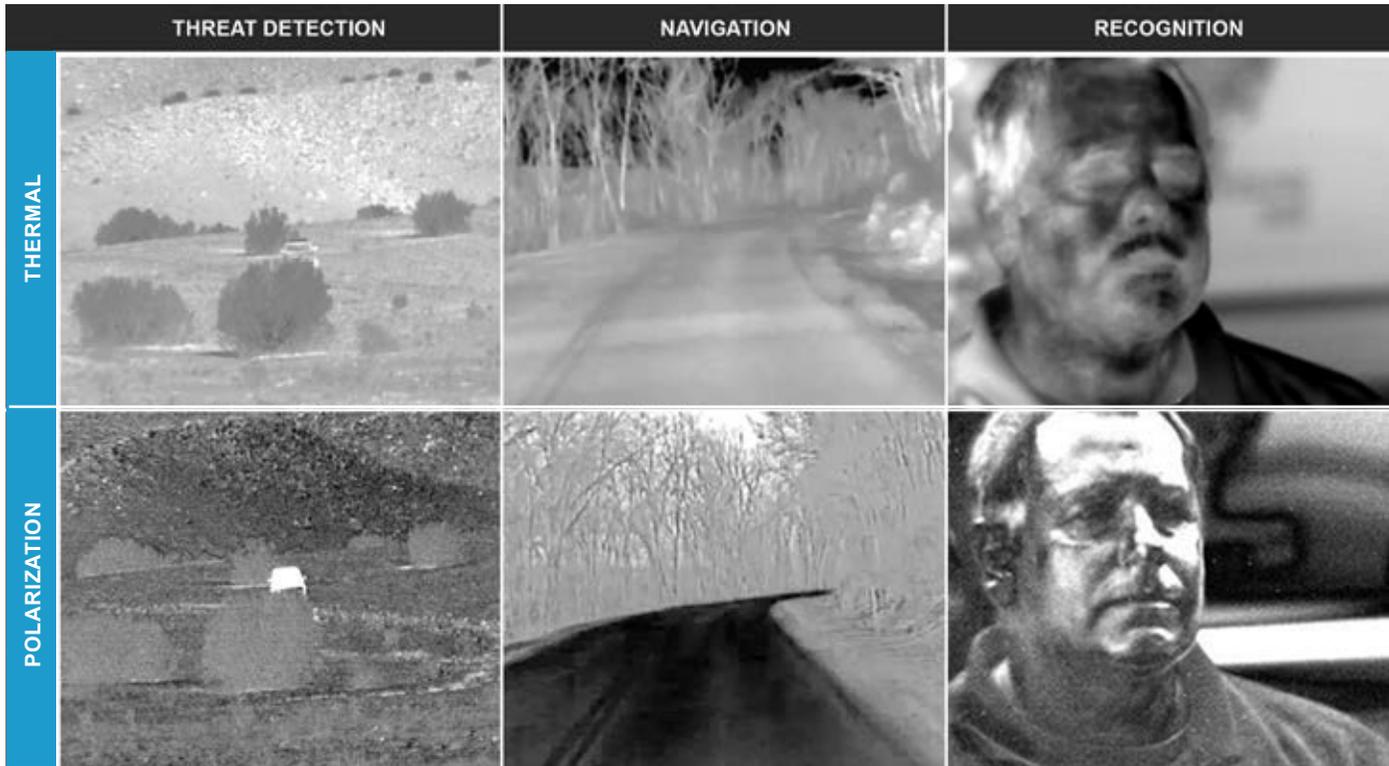
Testing and Measurements

- Stokes vectors
- Flexible spectral resolution
- Radiometric measurements
- Direct/diffuse measurements
- Multiple wavebands
- Multiple modalities
- Field and flight test support
- Custom data acquisition
- Collaborative team

Algorithm Development

- Multi-object tracking
- Detection and recognition
- Low signal to noise acquisition
- Unresolved target tracking
- Collision avoidance
- Orbital debris detection
- Satellite imagery
- Multiple modality data fusion
- Custom data products

DAYLIGHT DETAIL IN THE DARK



Polaris imaging systems reveal details undetected by other imaging devices.

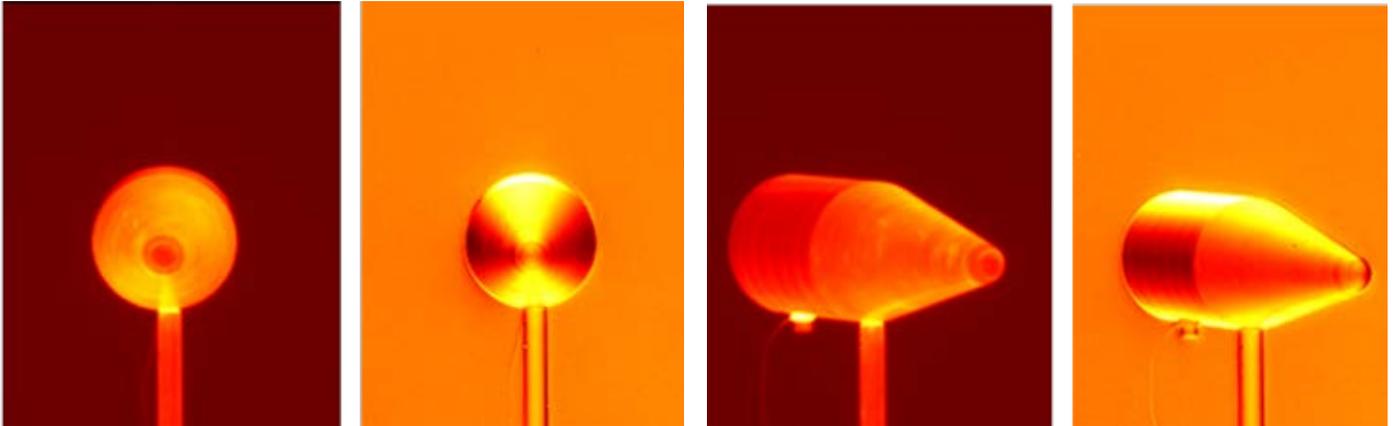
For more than a decade, Polaris Sensor Technologies, Inc. has been the industry's leading designer and developer of polarization-based imaging systems providing daylight detail in the dark and visibility in low contrast conditions. By exploiting a fundamental phenomenon of light called polarization, Polaris' imaging systems are able to reveal details undetected by other imaging devices. These systems, referred to as Polarization Enhanced Imagers, solve difficult detection and imaging issues for our military and commercial customers alike. Our systems provide vast improvements in mission critical target detection and surveillance for our military customers. Examples of commercial applications that also greatly benefit from polarization include autonomous vehicle navigation, facial recognition, and oil on water detection.

Our research has resulted in the development of novel imaging systems designed to operate in a specific waveband--from the visible to the long wave infrared--or a combination of wavebands depending on the application. Starting with only scientific concepts, we deliver highly-specialized sensors funded by the military that have evolved into laboratory instruments and small, rugged prototype systems suitable for agriculture, construction, surveillance, targeting, tracking and inspection. Polarization combined with advanced algorithms and calibration software enables our systems to operate beyond the performance of traditional imagers. That's the Power of Polarization from Polaris Sensor Technologies, Inc.

WHO WE WORK FOR



MEETING CUSTOMER NEEDS

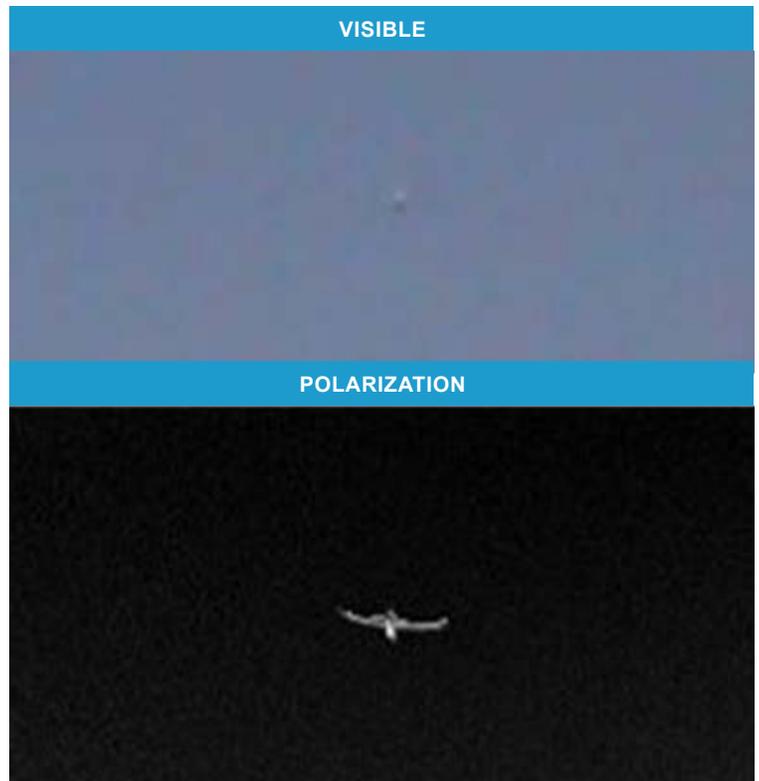


Polaris often supports our customers in a variety of data collection and analysis exercises. We can provide: a collection of calibrated laboratory data, outdoor data collections from our facilities overlooking downtown Huntsville, “around the town and on the move” data collection, or customer sponsored field tests around the globe. Polaris has supported a large number of field tests for our customers including ARL, ONR, AFRL, MDA, DOE, CERDEC, AMCOM and OSLI. Our staff can supply sensors that operate in a variety of environments in order to capture target data ranging from tanks, ships, missiles, pedestrian traffic, automobiles, oil spills, and even wildlife.



SEE MORE. KNOW MORE.

- Detect man-made objects in low contrast scenes
- Acquire and track difficult targets in real-time
- Customized data collections and field testing
- Application-specific sensors and software



The off-the-shelf drone hovering about 500 meters away in the daylight is undetectable in the visible image, but clearly shown using a Polarization Enhanced Imager.

REVEALING TARGETS IN LOW VISIBILITY



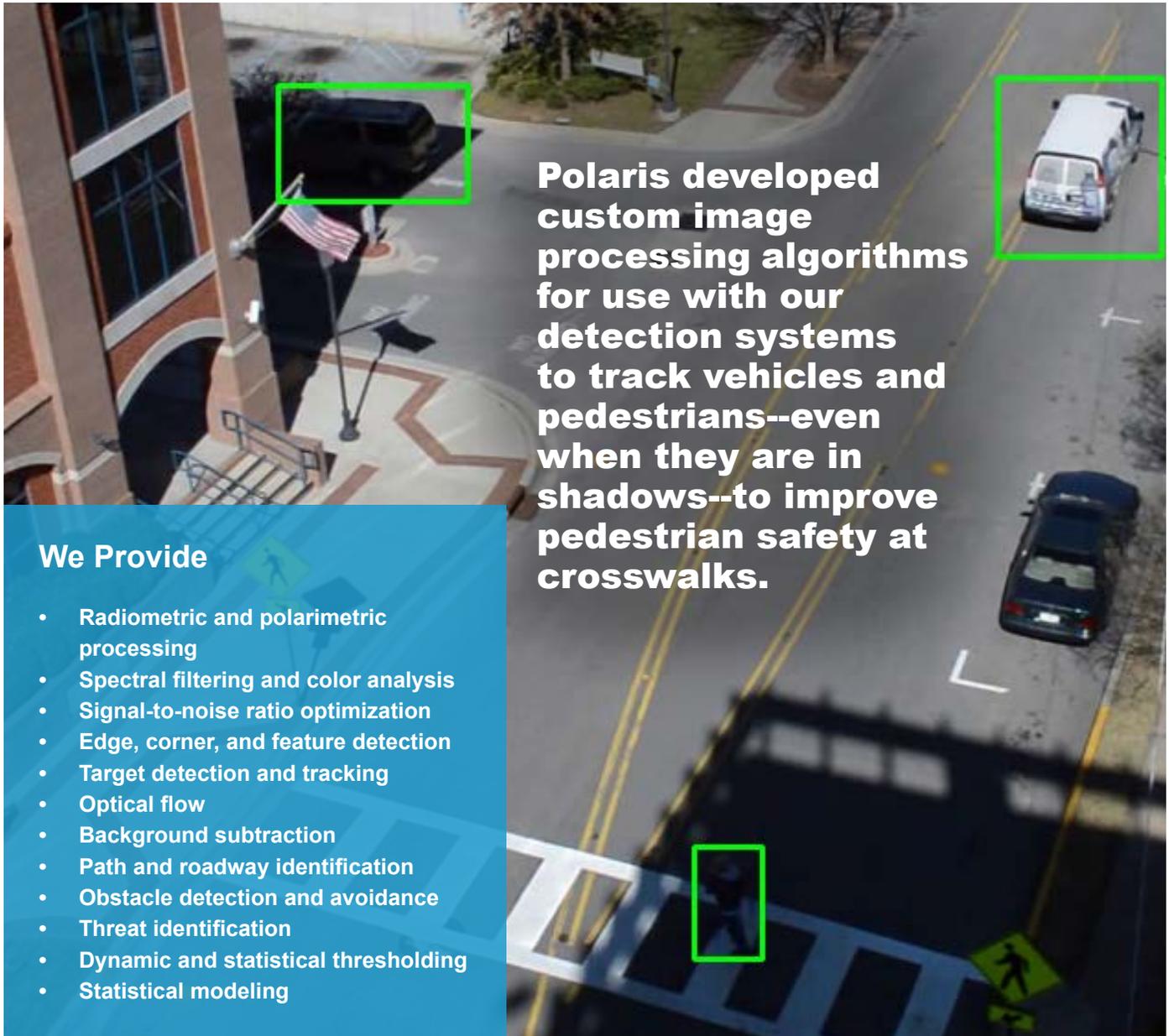
Tank (left) and ship (right) are hard to identify in natural clutter, but are easily revealed and colored using Polaris' custom sensors and software.

Our primary focus for the defense and security sector is detecting man-made threats in natural clutter at long detection ranges. These threats may be ground vehicles such as tanks and armored personnel carriers; maritime vessels including ships, submarines and go-fast boats; airborne targets such as UAVs, missiles and projectiles, and other man-made objects such as improvised devices and roadway obstacles. While detecting vehicles and missiles primarily appeals to the defense markets, man-made object detection and classification is an important capability for the commercial security sector as well.

While the goal of thermal sensing is to improve the performance of electro-optic and infrared optical sensors, polarization sensing is particularly useful to help improve target detection range by reducing surrounding clutter. We have developed eTherm®, enhanced thermal, to fully harness the improvements afforded by polarization. eTherm® allows our imagers to identify as well as colorize items of interest. Since eTherm® polarization can greatly raise the detection threshold of man-made objects against natural backgrounds, it is well-suited to detect vehicles and buildings. This technique is robust in all parts of the day/night cycle and against a variety of natural backgrounds (sky, dirt, sand, grass, bushes, trees, etc.).

By measuring and combining the polarization of light from each pixel in a scene with the thermal image, Polaris' sensors can detect objects of interest where standard imaging technologies fail. Polarization exploits a fundamental phenomenon of light to reveal detail, contrast, and other data undetected by standard thermal imaging devices. Thermal polarimetric sensing does not rely on external illumination allowing our Polarization Enhanced Imagers to work well in situations where infrastructure resources are limited or restricted. Polarization also persists across all infrared, visible, and ultraviolet bands of light.

CUSTOM IMAGE PROCESSING ALGORITHMS



Polaris developed custom image processing algorithms for use with our detection systems to track vehicles and pedestrians--even when they are in shadows--to improve pedestrian safety at crosswalks.

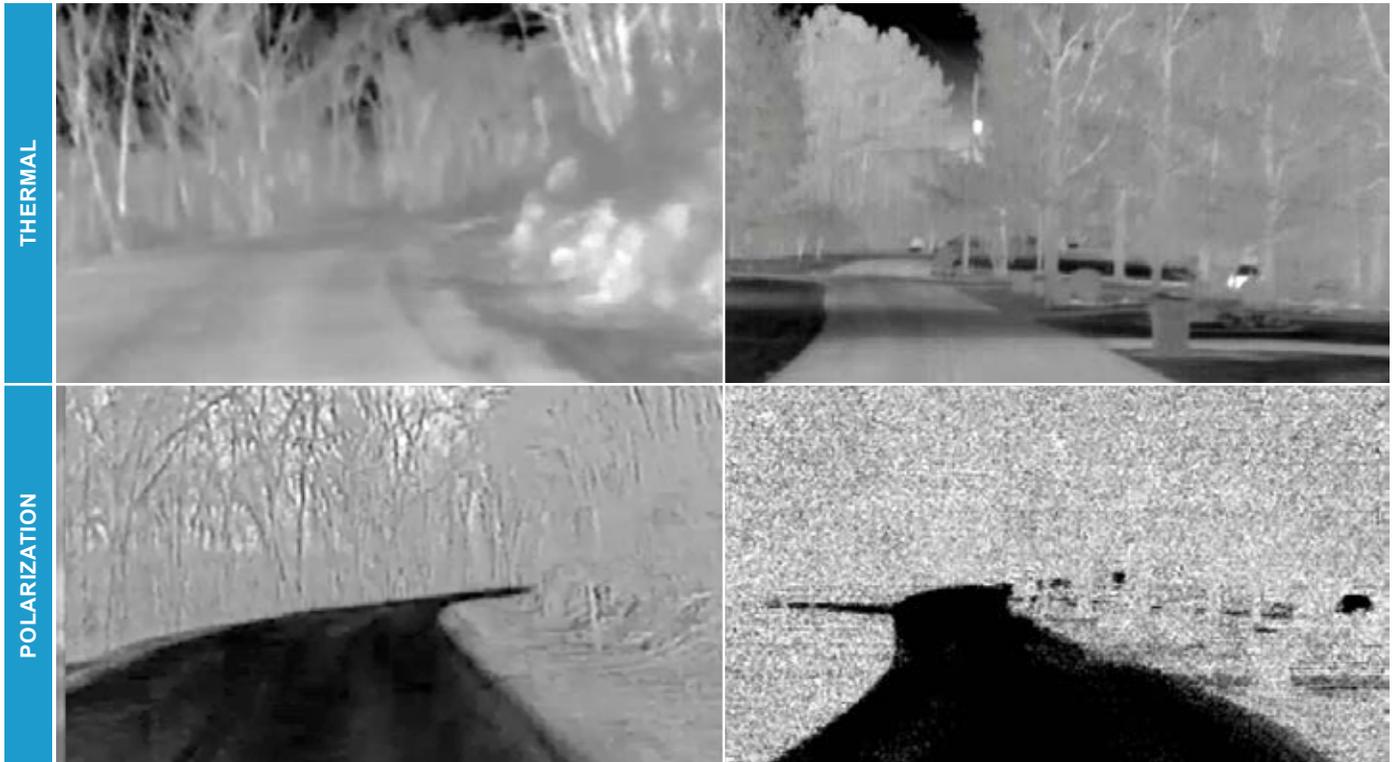
We Provide

- Radiometric and polarimetric processing
- Spectral filtering and color analysis
- Signal-to-noise ratio optimization
- Edge, corner, and feature detection
- Target detection and tracking
- Optical flow
- Background subtraction
- Path and roadway identification
- Obstacle detection and avoidance
- Threat identification
- Dynamic and statistical thresholding
- Statistical modeling

Meeting customer software needs, Polaris' image processing algorithms leverage the data generated by our novel sensor technologies to provide usable data products for an array of applications including enhanced human perception, automated target recognition, hazard detection, and false alarm rejection among others. Using Polaris for both sensor development and image processing implementation, speeds the integration of the sensor into the final system.

Our software algorithm development team solves difficult real-time image processing problems by developing novel algorithms implemented in higher order programming languages and then converting the algorithms into low-level hardware. Throughout the design and conversion the entire team is actively involved to ensure that the final product has been thoroughly tested and optimized to meet the customer's needs.

IMPROVED AUTONOMOUS NAVIGATION



A Polarization Enhanced Imager clearly defines the roadway regardless of shadow or illumination, during both night and day operation.

Autonomous vehicle navigation is an emerging technology that is forecasted to radically change the automobile market within the next 20-30 years. The ability to reliably sense and recognize roadways, pedestrians, and hazards has been a limiting factor in the adoption of new technology. Traditional visible cameras have difficulty in low light, bad weather, and shadows. Traditional thermal cameras rely on temperature difference for detection, and can fail to detect objects which are at the same temperature as the background of the scene. Polarization offers the added ability to sense reliably in a variety of operating conditions where standard visible and thermal cameras fail.

As shown above, using a Pyxis Polarization Enhanced Imager, the road is clearly defined regardless of shadow or illumination, during both night and day operation. Using Pyxis for reliable detection of the roadway provides the vehicle's vision system with strong and consistent contrast relative to the surroundings. This helps the autonomous vehicle arrive safely at its destination.

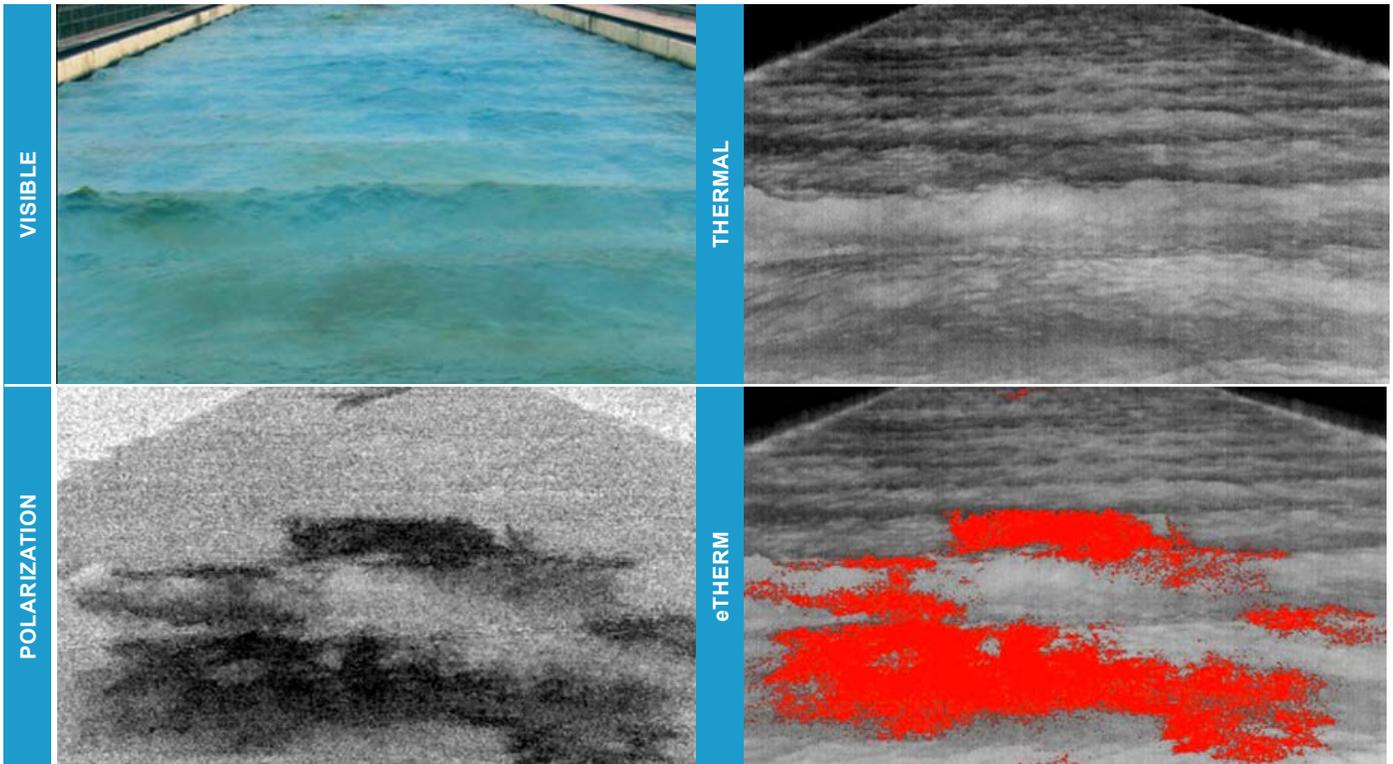
At night, headlights can be used to illuminate the road ahead, but this solution is problematic for human drivers, because it is difficult to distinguish roadway, obstacles, and other vehicles at a distance. When traveling through winding roads at speeds greater than 40mph, distance becomes important. Thermal imagery is not limited by distance, but the roadway is "washed out" and loses contrast with the surrounding trees, grass, and dirt.

The Benefits of Polarization for Seep and Leak Detection

- Up to 400% better identification of oil on water than thermal imagery with no false alarms
- Real-time display and analysis of Infrared and Polarization data
- Saves money by reducing man power needed to detect oil on water
- Suitable for automated continuous monitoring, detection, and alarm
- Distinguishes oil from sun glint, seaweed, and other debris
- Works in both daylight and night



400% GREATER DETECTION THAN THERMAL



The Pyxis Polarization Enhanced Imager detects oil and diesel on water better than standard thermal.

The oil and gas industry is plagued by the inability to accurately discriminate oil and diesel on water from vegetation, sea kelp, and sun glint on water, because thermal and infrared sensors are limited. However, the Pyxis® Polarized Enhanced Imager can distinguish oil or diesel from water up to 400% better than standard thermal from up to a kilometer away.

Pyxis is the industry's smallest lowest-cost polarization sensing thermal camera. Our software experts have developed a polarization enhancement called eTherm® to filter through the data and identify critical data. Oil on water can be distinguished from vegetation, sea kelp, and sun glint and colored for greater clarity.

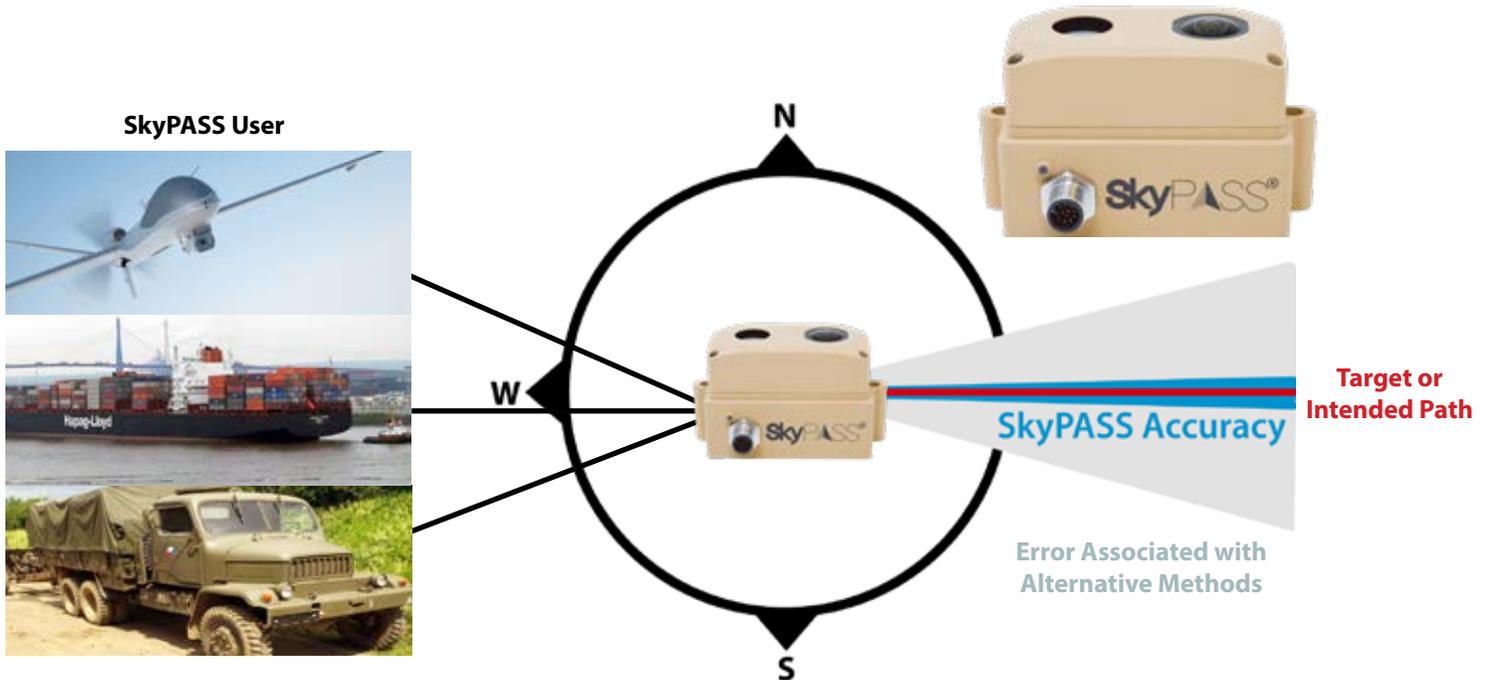
Pyxis also has a variety of platforms in real-time display to help the user receive critical information. These include detection of oil or diesel on water, wrecked watercraft recovery, downed aircraft recovery, remote monitoring of rigs or wells, and fracking oil leakage identification. In addition, Pyxis® has a software auto process to remove need for man in the loop.



PYXIS PLATFORMS
drone • handheld • oil rig

HEADING IN GPS DENIED ENVIRONMENTS

SkyPASS Provides Accurate Heading
Eliminating Large Errors Associated with Alternative Devices



SkyPASS® provides accurate heading in a GPS denied or spoofed environment, greatly reducing the heading error associated with alternative devices.

In navigation, course is the compass direction along which a vehicle is to be steered. Heading is the compass direction in which its bow or nose is pointed. Having an accurate heading measurement is critical for establishing your intended course, particularly on the battlefield where heading is also used for locating a target. When the Global Position System (GPS) is denied or spoofed, current navigational devices used to determine course or heading no longer work or become highly inaccurate. Heading estimates provided by magnetic compasses and other navigation devices used to establish heading without GPS will drift, accumulate error, and degrade the position over time.

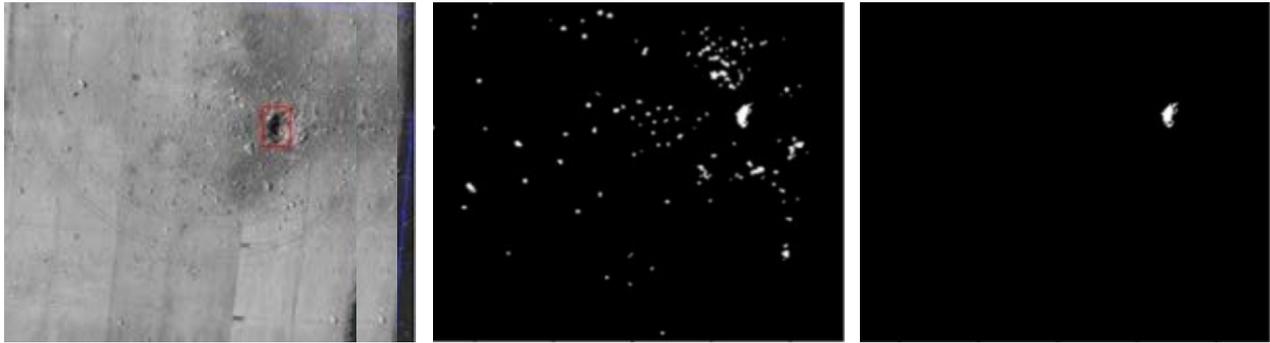
Using advanced algorithms and optics, SkyPASS® is able to detect and decipher the polarization map of the sky to compute highly accurate heading without GPS. The sky polarization map is an upper atmosphere phenomenon observable from any point on earth or from any aerial platform. So from sunrise to sunset, SkyPASS® provides accurate heading for any military or commercial application. In addition to its accuracy, key benefits of the SkyPASS® include its compact size, low power consumption and immediate time to startup, providing accurate heading within seconds at a price point that makes it attractive to all users.



SkyPASS® PLATFORMS

drones • vehicles • personnel • far target locators • watercraft • aircraft

DETECT AND ASSESS AIRFIELD DAMAGE



Runway (Left), Change Image (Center), Crater Detected (Right).

Change detection coupled with Artificial Intelligence (AI) detects runway damage via drone.



These tags and labels are automatically generated via advanced algorithms to reprocess the data, eliminate data of no interest and queue the operator from 20' altitude.

Rapid Airfield Damage Assessment System (RADAS) supports post-attack actions by rapidly addressing airfield damage by identifying Minimum Operating Surface (MOS)/Minimum Airfield Operating Surface (MOAS) candidates for repair actions.

Polaris Sensor Technologies, Inc. is developing UAV sensor technologies (cameras and algorithms) to detect and assess airfield risk/damage and provide a simple classification to warn and queue repairs; the detected risks were either debris, camouflaget, or a crater. The team used multiple Unmanned Aerial Vehicles (UAVs) operated from a Home Base where the UAVs are housed and maintained. The UAVs were dispatched from Home Base and carry one of two sensor payloads. The first sensor payload enables scouting tasks so that the UAV can quickly fly over the airfield and provide the information back to Home Base (via radio) where craters and debris are classified using advanced image processing algorithms. The UAV equipped with this payload is referred to as a "Scout". Multiple Scout UAVs are anticipated per airfield with the specific number determined by the airfield size and layout. The goal of the Scout/Home Base is to simply locate (lat/long) the suspect debris field and any suspected craters.



POLARIMETRIC ENHANCED IMAGERS

LWIR



Pyxis®



Ursa MCT



Corvus



Ursa(VOx)

MWIR



Indus Pyxis® MSIP



Indus

SWIR



Corvus



Pyxis®

VIS



Lyra



Ursa



Ursa High Res



Ursa High Speed

Multispectral



Corvus VIS/NIR



Ursa MWIR/LWIR



Corvus SWIR/MWIR

Hyperspectral



Indus



Corvus

Rapid Concept to Prototype Development

- Custom sensor solutions
- Advanced electro-optics
- R&D, algorithms and measurements
- Commercial and governmental

MANAGEMENT TEAM

Michele Ruggiero Banish **Chief Executive Officer**

CEO and Co-Founder of Polaris Sensor Technologies, Ms. Banish formed the company as a Principal Investigator of Small Business Innovation Research contracts focused on artificial intelligence. She located Polaris inside an incubator program at the University of Alabama. She developed accounting and contracting systems that won the approval of the Defense Contracting and Auditing Agency. After incubating one year, she relocated Polaris to a facility in downtown Huntsville with large laboratory spaces and an outdoor test platform to facilitate collection of sky polarization signatures and other experiments. She has developed software, hardware and optical systems to support research. Under her direction, Polaris has an established and growing patent portfolio and is licensing technology to market leaders. Two spin-off subsidiaries, Knowflame and Knowmore, have been formed around novel products. Prior to founding Polaris, Ms. Banish worked at a number of research firms and founded another company, MEMSOPTICAL, that was funded by Venture Capital and eventually sold to a multinational company. Ms. Banish received her B.S. in Electrical Engineering in 1987 with a minor in Engineering Management. She received her M.S. in Electrical Engineering from the University of Alabama in Huntsville in 1994. She has a specialty in Applied Optics.

Dr. David Chenault **President**

Dr. Chenault leads a team of 20 scientists and engineers in developing advanced sensors, algorithms, and optical instrumentation for military and commercial customers. Under his leadership, Polaris has a long history in developing optical systems in the visible to the long wave infrared optical bands that exploit the polarization properties of light. As a result of his contributions to this technology, Chenault was selected to be a Fellow of the Society of Photo Instrumentation Engineers(SPIE) and has been Chair or Co-Chair of twelve SPIE conferences in Polarization, and has co-authored special sections on Polarization in Applied Optics and Optical Engineering. Chenault received his B.S. in physics from Vanderbilt University in 1986, his M.S. in physics from the University of Alabama in Huntsville in 1989 and completed his Ph.D. in physics at the University of Alabama in Huntsville in 1992.

Dr. Larry Pezzaniti **Chief Technology Officer**

Dr. Pezzaniti initiates, directs, and manages a large portion of Polaris' new technology development. He is a subject matter expert in polarization imaging, micro and macro optical system development, and physical aerodynamic optical effects. His breadth of knowledge includes not only optical disciplines, but also mechanical, electrical, electronic, processing, and analytical specialties that directly lead to the success and customer satisfaction of Polaris R&D and product development efforts. While he routinely develops novel and innovative optical system concepts, lens designs, components, integrated assemblies, he is able to manage and lead multidiscipline teams to implement and complete projects. Dr. Pezzaniti has over 75 journal publications and holds 23 patents and is a collaborative member of research teams at leading universities as well as Army, Air Force and Navy Research Laboratories. Dr. Pezzaniti graduated from the University of Florida and in 1993 completed his Ph.D. at the University of Alabama in Huntsville (UAH) under renowned polarization expert Dr. Russell Chipman.

John Harchanko **Director of Engineering**

Mr. Harchanko has over 25 years of leadership, management, and engineering/research experience in designing and developing optical systems across the UV, visible, SWIR, MWIR, and LWIR wavebands. He is a subject matter expert in optical systems for space, counter-IED for the dismounted soldier, and disturbed earth detection using optical sensors. In addition to new business development and managing multiple ongoing contracts, he also performs an extensive amount of algorithm development using conventional and neural network approaches. His forte is optical systems engineering to achieve the optimal balance of sensor hardware and algorithms in order to maximize system performance. The application of these skills launched KnowFlame, a spin-off subsidiary. He is the primary or sole inventor of 7 patents and received his B.S. of Optical Science at the University of Alabama in Huntsville in 1992.



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Internationally Renowned Experts

Polaris Sensor Technologies, Inc. is a small, non-traditional prime government supplier providing innovative designs, unique products, and state-of-the-art analyses of optical systems. We have a team of optical experts with extensive experience in designing high-performance systems. Our portfolio includes polarization-based imaging systems, sensors, seekers, light scattering modeling, and measurement services.

Located in Huntsville, Alabama, our engineering facility features an extensive laboratory. Holding many national and international patents, Polaris creates custom hardware and unique software solutions providing our customers with the ability to meet mission objectives. What can we do for you?

See More. Know More.®