Managing Light for Next Generation Applications

Viavi OSP 2017
A Look Ahead at Upcoming Trends
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Introduction

Growing demand for a more intuitive, personalized and secure world requires a staggering number of sensors and highly sophisticated optics in order to work. With nearly 70 years of expertise, Viavi’s Optical Security and Performance Products (OSP) business is experiencing an inflection point as the world transforms to optical. Advanced optics from Viavi very precisely guide, filter and direct light that carries data about our environment, enabling new and innovative products to perform a wide variety of tasks on our behalf.

A big driver for advanced optics is The Internet of Things (IOT) and increasing reliance on connected devices to automate routine activities and provide faster access to specific data that improves the quality of our lives. Gartner predicts there will be more than 20 billion devices online by 2020. Viavi’s extensive optics experience, combined with innovative and high-volume manufacturing capabilities, has enabled it to support growth across a number of areas.

Optical Sensing

High-performance optical solutions from Viavi are being used across a wide range of smart electronics such as mobile phones, robotics and drones, giving them the ability to ‘see’ in three dimensions and respond accordingly, just like their human counterparts. For industrial applications, Viavi has moved near infrared (NIR) spectroscopy from the laboratory into much smaller, portable devices so that the measurement of materials can be performed at the ‘point of use’. As technology merges between the industrial and consumer worlds, Viavi is developing a new multispectral sensing filter that can help perform measurements from a mobile device. While in early stages of development, this new technology will enable many exciting consumer applications.

Government

Custom-designed optical filters from Viavi have been ensuring the high performance of many government applications for over 60 years. They are used in satellites that explore the universe and in guidance systems that detect targets with great accuracy, protecting allied forces in times of battle. Increasingly intelligent filters are now helping soldiers to ‘own the environment,’ giving them the ability to see under a wider range of challenging conditions.

Automotive

As cars become more autonomous, Viavi’s high-performance filter capabilities are being deployed in sensing systems to recognize and adapt to driver and passenger comfort.
preferences, and in LiDAR technology systems to safely monitor and react to conditions outside of the car. As car buyers with more disposable income look to differentiate their vehicles by paying extra for special-option car colors that include pigments from Viavi, OEMs also benefit by increasing revenue and profit in an increasingly competitive market.

**Anti-counterfeiting**

Protecting currency is a key market for Viavi, and its optical pigments are on approximately 80 percent of the world’s banknote value. The technology provides striking visual effects that allow banks and consumers to easily recognize if a note is real, while making it difficult for counterfeiters to make illegal copies. Other Viavi pigment technologies are being used on major consumer brands to protect them from the escalating and costly problem of counterfeiting.

Read more to learn about major trends happening across each of these core markets.

**Optical Sensing**

**Optics for Photonic and 3D Sensing Applications**

**The Sensing World Around Us**

As electronics become more intelligent, they’re recognizing our personal identities and subtly adjusting the environment around us as we move throughout our day. The photonics industry is expected to hit $766 billion by 2020, driven by demand for many types of smarter, more efficient electronics that let us seamlessly interact in the physical and virtual worlds.

Recent advances in optical sensor coating technology from Viavi help sensors recognize ambient light conditions around electronics and optimize their display brightness and color balance. Viavi coatings are also used for range-finding capabilities in cell phones, enabling them to appropriately turn on and off the touchscreen display and automatically focus the camera. It will soon even be possible for phone cameras to generate a 3D model of the user or the environment, opening up opportunities for new applications.

In the future, hundreds of thousands of sensors embedded in smart homes, cars, wearable devices and offices will automatically adapt according to our environment and preferences, in more customized ways than ever before.

**Verifying Your Genetic Digital Signature with 3D Sensing**

Use of multimodal biometrics is also on the rise, as passwords are expected to become obsolete by 2020. Fingerprint sensing currently leads the biometrics market, with iris and facial recognition not far behind. By 2021, analysts predict that more than two thirds of smartphones will include one or more biometric capabilities, tying multiple elements together to better protect us from a criminal’s ability to steal our personal data.

Viavi was first to market with 3D sensing filter solutions more than seven years ago, when it deployed its first-generation optical filter capability to support the popular Microsoft Kinect gaming system. It was the first deployment of technology where gestures of players could be recognized in 3D and incorporated into a virtual game on a TV screen.

Next-generation sensing systems with Viavi filters are now being used for iris and facial recognition to detect a person’s unique identity and unlock various levels of access on a device or within an application. A key ingredient of 3D sensing is Viavi’s sophisticated optical-filter technology that separates specific wavelengths of light from a 3D image from ambient light that could interfere and confuse the system.
In the future, multimodal biometric access could eventually replace IDs like driver’s licenses or passports, and provide levels of access to public venues and facilities. Even your self-driving car will instantly recognize you, unlock the car, adjust your comfort levels, start the engine, and, if necessary, ensure you stay awake and attentive.

Viavi Differentiators
Viavi has invested more than seven years of research and development into its 3D depth-sensing filter technology, and has been awarded several related patents and IP. The specialized coating design on its filters provides less wavelength angle shift compared to traditional coatings, enabling significantly better overall performance of the system. The filters provide a deep suppression of unwanted ambient light, so that they can be used under a wide variety of extreme light conditions. High precision manufacturing at a very large scale (in the hundreds of millions) with excellent quality and customer relationships has made Viavi an industry leader in this space.

Optics for Multi-Spectral Sensing
Bringing Scientific-Level Measurement to the Masses
Every material in the universe has its own unique optical spectral signature. When you shine light at it, the light reflected back includes information about its material composition. Analyzing that reflected light involves dispersing the spectrum into its component parts, which can be done in many wavelength ranges and in many ways. The wavelength region closest to the visible spectrum, the short-wave NIR (SW-NIR), is especially interesting because optical detectors in this range are common and inexpensive. Viavi has recently developed a novel method of filtering SW-NIR light, called Binary Multispectral (BMS) filters, that is both compact and low cost. This innovation provides the opportunity for the sophisticated optical analysis of materials to be made from consumer mobile devices, revealing invisible insights that previously weren’t available.

Recent media coverage indicates that integrating spectrometers into smartphones will be a major technology disrupter. People will be able to perform a variety of measurements on their own, using their phone to test the ingredients of a food product, or to monitor their blood glucose or hydration levels. While BMS technology is in early stages of development, it is likely to be a key enabler for this emerging market.

Viavi OSP Differentiators
No other technologies today meet the size, cost and performance capabilities of Viavi BMS for shortwave near-IR capabilities. Based on decades of optical expertise, BMS provides superior spectral behavior, better bandpass form, and unmatched out-of-band blocking that covers a wide range of wavelengths. Viavi’s innovative and highly-efficient manufacturing methods dramatically reduce the technology’s size and price point, while delivering the advanced performance demanded by mobile devices.

Optics for Near IR Spectroscopy
It’s Not Just About the Sensor
Various industries have been using near IR spectroscopy for many decades to measure the molecular fingerprint of many common materials. Launched in 2012, MicroNIR™ paved the way for dramatically smaller, portable uses of this capability. Unlike BMS filters, which operate in the 0.4 – 1.1 micron wavelength range, MicroNIR operates in the 0.9-1.65um wavelength range to provide more spectral detail than is available in the SW-NIR range.

Today, versions of the product come in various compact forms, from the size of a hairdryer all the way down to the size of a golf ball, making them suitable for several important applications, including:

Safe Drug Manufacturing
The pharmaceutical world uses Viavi’s MicroNIR during the batch production of drugs, to aid in the inspection of raw materials. The near IR capability verifies the ingredients and uniformity of each mixture to ensure they are appropriately blended before the drug gets pressed into tablets. The industry is now moving from batch production to the continuous manufacturing of drugs, where smart factories will enable a process line to manufacture products continuously. This will require a wide range of sensors across the manufacturing line to constantly monitor critical quality processes, including to verify the composition of drugs.
Managing Light for Next Generation Applications

High-Quality Dairy and Grain Production

The agricultural industry uses MicroNIR to test the nutritional value and water content of animal feed, so they know when to add key nutrients to the animal’s diet. Balanced nutrition makes dairy cows less susceptible to disease or illness and helps to ensure a high-quality milk product. Most of the daily products that we buy in the store have been improved in some way by a near IR spectrometer measurement.

Detection Of Illicit Substances

Law enforcement and security personnel also use MicroNIR to identify whether or not a substance is illegal. For example, it can determine whether a white substance is heroin or sugar, or whether the strength of THC (the active ingredient in Cannabis or marijuana) is within permitted limits.

Viavi Differentiators

Spectroscopy requires sophisticated optics in order to collect and synthesize very precise information. MicroNIR provides an end-to-end solution for industrial applications that includes a spectrometer, innovative collection optics, easy-to-use sample interfaces, and software for the complete and real-time analysis of materials. Viavi combines a long legacy of optical thin-film coating expertise and high-volume manufacturing capabilities, so that the solution can be deployed in high volumes.

Viavi’s MicroNIR Suite of Sensors and Accessories

**Government**

**Modernizing the Military with Precision Sensing**

Modernization is a top priority for the U.S. government and its military agencies in order to be ready for both asymmetrical warfare (terrorism) and traditional threats at a moment’s notice. To fast track innovation, the government is tapping into the technological strength of Silicon Valley, California and advances made by large consumer electronics companies. What both areas already have in common is that they use infrared (IR) technology to see what’s happening in the dark, or in varying levels of light. In consumer electronics, IR is already being used for security, gaming and other applications that employ 3D sensing technology. The military is keen to leverage this technology to support the next generation of defense solutions.

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**Bringing the Battlefield into Focus**

The challenge with current military night-vision capabilities is that they still require some level of light in order to work. There is an increasing need for high-end defense cameras that provide a more detailed view of the surrounding environment. Optical filter technology from Viavi is evolving for IR sensing applications, to leverage both near and mid-wave infrared spectral bands (also known as ‘dual band’ or ‘multispectral band’). These new IR capabilities can see in difficult environmental conditions such as heavy rain, strong heat, dense fog and deep undergrowth. Soldiers stand to benefit, as this ‘super vision’ could help them detect movements of enemy infantry or muzzle flashes from weapons even in the most difficult of battlefield conditions.

**Innovation on Land, at Sea and in the Air**

The proliferation of unmanned devices like drones and robots, on land and at sea, are also increasing the need for more advanced cameras and sensing capabilities. In addition, satellite systems used for weather, surveillance and reconnaissance are using highly specialized filters from Viavi, including multispectral and hyperspectral filters. These filters allow several different wavelengths of data to be superimposed over one another for a richer, more in-depth view of the environment.

Similar types of sensing capabilities from Viavi are already being used in mobile devices. The smaller size, lower power and improved cost of these mobile features could provide big advantages to soldiers out in the field. Imagine a soldier being able to flip back and forth between...
the visual and IR worlds, or simultaneously combining the two, via a mobile device or through a small display attached to the front of his helmet.

Evading the Enemy with Special Effects

Special features of optical filtering technology are also fast-forwarding futuristic concepts of combat tactics into the present. Missiles can leverage a laser beam directed towards a targeted position and a Viavi optical filter mounted in front of a sensor to ensure the missile hits its target with minimum collateral damage. Conversely, military vehicles can also use Viavi filters to help manipulate laser light in ways that provide effective countermeasures to an enemy’s attempts to target them. New developments in Viavi optical pigment technology also provide ‘signature management’ capabilities. This cloaking device lets soldiers control their infrared signature out in the environment, hiding them entirely from enemy view or even reducing their risk of falling victim to accidental ‘friendly fire.’

Viavi Differentiators

Viavi has mastered the design challenges associated with creating highly sophisticated IR filter technology, enabling systems that can detect multiple bands of light simultaneously and accurately provide information to the warfighter. Viavi manufactures at scale and on larger-sized substrates required for equipment such as satellites. In addition, the company manufactures these products solely in the U.S. to comply with International Trade Arms Regulations and has various levels of security clearance to work on special projects. As the military continues to innovate, Viavi is one of the few optical providers that has mastered a unique set of challenges to provide high performance filters to both the consumer and government markets.

Automotive

3D Sensing in LiDAR Systems

The Next Supercomputer is Your Car

IOT has made a dramatic impact on the automotive industry. Cars have become supercomputers on wheels with transportation-as-a-service and varying degrees of connected and autonomous vehicles hitting city streets worldwide. Automakers, ride sharing services and other industry players are forming partnerships for connected car services to make driving more comfortable, convenient and safe. It’s an industry expected to explode from $13.6 billion today to $42 billion by 2022.6

The Path to Autonomous Driving

New improvements are being added to cars every year with more types of sensors and diverse capabilities. Tech companies are fully invested, building whole cars or important features inside a car. While widespread use of fully autonomous cars is still years away, increasing levels of ‘driver assist’ features have been added such as voice and gesture recognition, automated emergency braking, and parking assistance, moving us closer to fully-autonomous cars.

Ride sharing, combined with full automation, promises big benefits. Eventually, we will cease to own our own car, as improved safety of driverless cars will decrease accident risks below that of human drivers. Ride-sharing without personal car ownership will also dramatically reduce the need for parking spaces, ease traffic congestion, and alleviate pollution. It conveniently aligns to millennials’ preference to own less and share more, with IOT technologies underpinning this behavior.

Sensing for Self-Aware Vehicles

As car automation technology continues to evolve with more multi-sensory capabilities, vehicles will better understand what’s happening under a wider variety of situations in order to respond appropriately.

LiDAR sensing is an emerging car technology that has long been used for applications in space, agriculture and geographical mapping -- think radar + light. It’s now being used for semi and fully autonomous driving and employs Viavi filter technology, enabling cars to have full awareness of their environment for the best decision making. A laser light shines out from the car, bounces off an external object, and the returning light is sent through a Viavi filter before hitting a sensor, which in turn feeds data to the car and the driver.

Driver monitoring inside the car also employs similar 3D depth-sensing technology using Viavi filters, but at a shorter range to recognize and adapt to conditions of the driver. Soon, cars will automatically recognize the driver with biometrics and set pre-programmed comfort levels. Most importantly for semi-autonomous driving, it will scan the driver to see if they are alert and ready to react, and will immediately

Inspection of Large Scale Optic
take over if a driver is compromised or if there is imminent danger ahead.

By the time millennials have grandchildren of their own, fully autonomous cars could be ubiquitous in cities, speeding across smart superhighways at 100 mph and 2 inches away from each other. Advanced filtering technologies that are successfully guiding semi-autonomous cars today will continue evolving for the safety and performance required for autonomous car networks of the future.

Viavi Differentiators

Advanced optical filtering technology from Viavi used in LiDAR systems suppresses stray light very precisely under a wide variety of light conditions. This patented Viavi low-angle shift filtering technology is also known as “narrow band” functionality. It only allows a very narrow stream of light in to inform the car and driver, while suppressing any ambient light that would otherwise confuse the sensor. It is ideal for extreme light conditions, such as darkness or full sunlight, and can view the changing environment from the widest possible range.

Custom Color Solutions

Gaining a Competitive Edge with Custom Car Colors

As disposable income increases across many parts of the world, car buyers are adorning automobiles with special-option paint colors that include special-effect pigments from Viavi, to express their individual style and flair.

ChromaFlair® and SpectraFlair® pigments provide striking color-shift effects as light hits a car’s exterior at different angles, and are compatible with other key features such as a high gloss or matte finishes.

In the future, these paint features could also give ride sharing services a boost, enabling them to brand different tiers of self-driving car services to their passengers.

Auto Wraps for a Unique and Temporary Effect

Wraps have been a big hit in Asia and are starting to take hold in the US and Europe. For car owners looking for that striking paint effect, special films have been designed that can be applied as an aftermarket add-on. This customization is less invasive and cheaper than fully repainting a car. Auto wraps are typically backed by a multi-year warranty and leased cars can easily be reverted to their original state before being returned after expiration of the lease.

Autonomous Cars and Cooler Dark Colors

The physics behind color-shifting pigments lends itself well to making cars more visible to near infrared light. For autonomous vehicles, new pigment technology is being explored that will improve the infrared reflection of black cars, allowing autonomous vehicles with LiDAR systems to better sense them in various environmental conditions. Since 50 percent of solar radiation is in the infrared range, the same technology can be applied to dark car colors so that they better reflect heat, reducing the amount of energy required to cool the cabin and leading to better mileage for electric vehicles.

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Anti-Counterfeiting

Keeping the Counterfeiters Away

If you live in a first world urban area, it’s easy to think the world is going completely cashless, as more e-payment applications move into mobile devices and retail countertops. The reality is that the majority of the world is not ready for a cashless society. Banknote circulation is in fact currently forecasted to increase steadily, at approximately a 5 percent compound annual growth rate.

The challenge with electronic payments is that fraudulent transactions happen much more frequently and easily. Devices such as PCs or smartphones were originally designed for convenience and not for the security required to conduct financial transactions. If e-payment infrastructures are standardized to facilitate cashless transactions on a much larger scale, then how will hackers be prevented from more easily infiltrating the system and compromising millions of accounts?

Easy to Authenticate, Tough to Replicate

For the near future, physical cash will continue to dominate, especially in less urban areas and in developing parts of the world. To prevent counterfeit activity, central banks have relied on sophisticated pigment technology from Viavi for several decades.

The pigments go into inks on bank notes and provide special effects that are easy for people to identify but difficult for counterfeiters to replicate. These are known as ‘overt’ features. The feature explains itself, and once you see it, you know what to look for on the next bill to verify its authenticity. For example, on the number showing the note’s denomination, all Euro bills have a bright green bar that moves through a darker background when tilted. People must be able to verify a banknote in the blink of an eye, while putting it in a cash register or a wallet. It shouldn’t require a lot of extra light or time to validate.

Moving Downstream

Initially, overt features were only used on high denomination bills that attracted criminal activity. But once counterfeiters were thwarted from copying larger notes, they moved downstream and started illegally replicating smaller bills. Now, overt features are being used all the way down to the lowest denomination notes. For example, the European Union uses overt features from Viavi on every single banknote and other countries aren’t far behind.

While electronic transactions will grow, particularly in developed countries, cash remains the main source of currency around the world. Viavi is committed to providing innovative technology that safeguards the well-being of consumers, retailers and governments against the negative repercussions of counterfeit banknote activity.

Finally, major worldwide brands including electronics, clothing, food and beverage and pharmaceuticals also see the value of protecting their brand equity using overt features on their products. Viavi supports these companies through their range of customized brand security labels.

Viavi Differentiators

As the leader in overt anti-counterfeiting technology, Viavi has several decades of experience providing pigment technology to central banks and is on more than 80 percent of the total banknote value across the world.
Sources


Acknowledgements

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To learn more about Viavi Optical Security and Performance Products, please visit: www.viavisolutions.com/osp.