

VISION

focus

Delivering the latest news from the Imaging and Machine Vision markets

Multispectral sensor tested on US spy drone



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Photo: Northrop Grumman.

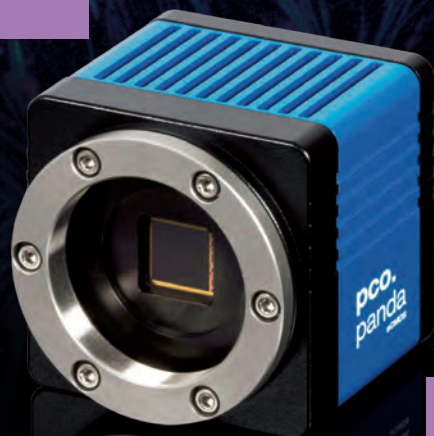
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All-seeing eyes

Welcome to the latest issue of **VISION Focus**, the quarterly digital magazine that covers all aspects of vision and imaging, produced by the team that brings you optics.org. The editorial focus of this issue is centered on SPIE's Defense + Commercial Sensing 2017, the leading global technical conference and exhibition about sensing, imaging, and photonics technologies for defense, security, health care, and the environment.



For the first time DCS is located in Anaheim, California, having moved west from Baltimore. Attendees will get to hear the latest technical advances in sensors, infrared technology, laser systems, spectral imaging, radar, LIDAR, and more. The Southern Californian technology environment has evolved from aerospace and defense centers to become one of the largest photonics-related technology hubs in the world.

Following is a taste of some of the major developments across the vision industry, including some exclusive features for Vision Focus. Industry news in this issue includes the following:

US defense contractor Northrop Grumman has confirmed that the "MS-177" multispectral optical sensor payload has for the first time flown on board the US military's longest-range unmanned aircraft, or drone (p. 4).

A new smartphone-based inspection application developed at the Fraunhofer Institute for Factory Operation and Automation in Magdeburg, Germany, can look inside objects and display particular constituents (p. 5).

imec, the research and innovation hub in nano-electronics and digital technologies, introduced several a range of market-ready imaging and camera systems, including the Snapshot image sensor with integrated color (RGB) and narrow-band near-infrared (NIR) filters (p. 8).

Following its March 7 launch, the European Union's "Sentinel-2B" satellite – the latest addition to the Copernicus environmental monitoring program – pinged back its first images of Earth, demonstrating the payload's multispectral capabilities with high-res views of the Italian and Albanian coastlines (p. 12).

The University of Würzburg, Germany, in partnership with carmaker Volkswagen, assesses manufacturing geometries to optimize change of model design. Deploying a 3D scanning system through the production line enables detailed analysis of what changes will be necessary when switching production to a new vehicle design (p. 18).

Each issue of VISION Focus magazine is promoted to more than 25,000 industry professionals. We also publish printed copies at major events and exhibitions, so if you're visiting the AIA Vision show, make sure to grab a copy of the latest issue.

Matthew Peach, Contributing Editor
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This Issue

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Fraunhofer smartphone app looks inside objects

Cognex sales top \$500M in record year

Imec launches TDI, multispectral and hyperspectral sensors

Qioptiq wins \$100m surveillance contract from UK Ministry of Defence

Sentinel-2B pings first images

Navitar Purchases Canadian Camera Manufacturer PixeLINK®

\$15M equity round for phone camera startup Corephotonics

Subsea lidar to map ocean floor with centimeter resolution

All change: 3D scanning speeds production line retrofits

plus the latest product launches from within the industry

Publication and Editorial Schedule 2017/18

June/July Issue 2017

- Bonus Distribution: **Laser World of Photonics** - Germany
- **Editorial Focus:** optical components, academic research, software applications.
- Published in advance of Laser World of Photonics - Germany, 26th – 29th June 2017

September/October Issue 2017

- Bonus Distribution: **Electronica**
- **Editorial Focus:** opto-electronic systems, applications in sensing and manufacturing.
- Published in advance of Electronica, 8th – 11th November 2017

January/February Issue 2018

- Bonus Distribution **SPIE BiOS + Photonics West**
- **Editorial Focus:** industrial applications, sensing, biomedical analysis and treatments.
- Published in advance of BiOS, 29th Jan – 1st Feb 2018 and Photonics West, 30th Jan – 1st Feb 2018

Multispectral sensor tested on US spy drone

Northrop Grumman claims success with first flight on board autonomous high-altitude endurance aircraft.

US defense contractor Northrop Grumman has confirmed that the "MS-177" multispectral optical sensor payload has for the first time flown on board the US military's longest-range unmanned aircraft, or drone.

The inaugural flight on one of Northrop's "RQ-4 Global Hawk" high-altitude surveillance planes demonstrated that the drone's capability can be extended to

provide capabilities to not only 'find' targets using broad area search and different sensing technologies, but to also fix, track, and assess targets through its agility and multiple sensing modalities."

Multispectral benchmark

The MS-177 is a multispectral camera operating across a wide range of the optical and infrared regions that was

set to continue through the first half of this year. It has also been testing an optical bar camera capable of generating panoramic imagery on board the same platform.

"The MS-177 is the new benchmark in imaging ISR sensors and its integration into the Global Hawk platform expands the mission capability we can provide," said Mick Jagers, VP and program manager of the Global Hawk program at Northrop Grumman.

Jagers also told the aviation web site Flight Global in December last year: "We will operationalize the MS-177 so that the United States Air Force can declare initial operational capability for that sensor system by the end of 2017.

"In this particular test we'll test how the air vehicle accommodates for new weight and new center of gravities, and then we'll start demonstrating the recording and dissemination of the ISR information."

Endurance record

According to the US Air Force, the remotely piloted RQ-4 Global Hawk is able to provide global, 24-hour, all-weather ISR, and the drones have been fielded in the skies above Iraq and Libya, as well as during humanitarian relief operations over Japan following the devastating earthquake and tsunami of March 2011.

The UAVs carry electro-optic, infrared and synthetic radar sensors that can also be controlled remotely, while data collection plans can be updated "on the fly". In 2014 one of the RQ-4s set a new endurance record for the US military when it flew for more than 34 hours without refueling.

Mike Hatcher, Contributing Editor

<http://optics.org/news/8/3/7>



Photo: Northrop Grumman.

Northrop Grumman has begun flight testing of the MS-177 multispectral sensor payload with a successful inaugural flight on an RQ-4 Global Hawk high-altitude, long endurance autonomous aircraft system.

a wider range of intelligence, surveillance and reconnaissance (ISR) missions, the company claimed.

"The flight tests mark the first time the sensor has been flown on a high-altitude long-range autonomous aircraft and extend the mission capabilities of the system," reported Northrop.

"The MS-177 sensor is designed to

developed by the United Technologies subsidiary UTC Aerospace.

According to UTC it offers the longest-range combat identification imaging capability in the US military's airborne ISR inventory, and is able to operate at high altitudes for 30 hours.

Northrop says that following the initial flight tests in California its checks are

Fraunhofer smartphone app looks inside objects

Prism-free HawkSpex system can verify constituents of fruit, consumer products and more for quality control.

A new smartphone-based inspection app developed at the Fraunhofer Institute for Factory Operation and Automation (IFF) in Magdeburg, Germany, can look inside objects and display particular constituents. It has numerous uses, say the developers, for instance, fruit can be scanned for pesticide residues.

The so-called HawkSpex will also enable consumers to quickly discover whether a car has been in an accident and resprayed. The IFF says that the mobile app could significantly enhance user's knowledge of previously unverifiable information.

Although phone-based systems that perform such scans already exist, users usually have to clamp additional parts such as a prism onto the front of the integrated camera. This is costly and impractical and can interfere with a smartphone's design. Prof. Udo Seiffert, Expert Group Manager at the Fraunhofer IFF commented, "What makes our app special is that users don't need anything for a scan other than the camera already integrated in their smartphones."

No hyperspectral camera needed

So how did the development engineers manage to get by without a prism? Project manager Dr. Andreas Herzog explained, "Such scanning techniques usually require a special hyperspectral camera: it adjusts to different colored light with each scan and ascertains how much of a particular wavelength is reflected by an object, thus generating a complete spectral fingerprint of the object."

The IFF development engineers instead are using a mathematical model to extract a variety of data points from an object, such as its constituent elements / molecules, from the spectral fingerprint. "Since hyperspectral cameras aren't integrated

in smartphones, we simply reversed this analytical principle," said Prof. Seiffert.

"The smartphone camera provides a broadband three-channel sensor, which illuminates an object with different wavelength and scans every wavelength



It will soon be possible to use smartphones to scan apples for pesticide.

and." This means that, instead of the camera measuring luminous intensity in different colors, the display successively illuminates the object with a series of different colors for fractions of a second.

Thus, if the display casts only red light on the object, the object can only reflect red light – and the camera can only measure red light. Intelligent analysis algorithms enable the app to compensate for a smartphone's limited computing performance as well as the typically limited performance of the camera and display.

The first laboratory version of the app is now finished, IFF reported earlier this month. The engineers are now developing a variety of initial applications before it can be released to private users. The system first has to be installed with reference scans to be able to analyze, for example, whether

apples contain pesticides. Seiffert said he hopes that the HawkSpex app will be launched on the market around the end of 2017.

Reference scans are not always needed, though. Some problems only require measuring different distributions of substances or materials rather than specifying individual constituents. Purchasing a car is one example: In this case, the app compares paint to determine

whether it is exactly the same color everywhere or has been touched up.

Seiffert added, "There are so many conceivable uses that the market will surely overrun us. That is why we will be relying on a user-generated approach modeled on the approach employed by Wikipedia."

He believes that the app has "extremely interesting commercial potential" and could be used to develop sectors that wouldn't really benefit from high-precision scanners: quality control of foods, effectiveness of cosmetic products or even agriculture, for example. "Farmers, for instance, could easily obtain information on whether their crops are sufficiently supplied with nutrients or fertilizer is needed," Seiffert concluded.

<http://optics.org/news/8/2/11>

Cognex sales top \$500M in record year

Machine vision firm piles up cash during highly profitable period as investment in factory automation grows.

A series of acquisitions coupled with strong demand for its machine vision technology has propelled Massachusetts-headquartered Cognex to record sales and profits in 2016.

Topping half a billion dollars for the first time, the company's sales revenues rose 16 per cent on the 2015 figure to reach \$520.8 million – while annual net income surged to \$149.8 million.

Company chairman Robert Shillman – who founded Cognex back in 1981 – said in response: "We reported the highest annual revenue, net income and earnings per share from continuing operations in our company's 36-year history."

Cash pile

Remarkably, Cognex was able to post the results in what it considered to be a "sluggish" year for spending in the industrial sector. Its CEO Robert Willett added: "While there's uncertainty in the world today, we're encouraged by the level of demand that we experienced in the second half of the year."

The ongoing high profitability has seen Cognex's balance sheet swell to nearly \$750 million in cash and investments – plenty to finance any more acquisitions to build on the four that it completed during 2016.

Those recent deals have seen Cognex snap up three companies specializing in 3D

vision: Jena, Germany, based EnShape, the Spanish company AQSense, plus Colorado-headquartered outfit Chiaro Technologies. Cognex has also acquired Webscan, another Colorado company that specializes in barcode verification.

Key to the rapid sales growth is the trend towards factory automation, which Cognex reports as a standalone business unit. Willett reported that divisional sales jumped 34 per cent year-on-year in the closing quarter of 2016, led by automotive, consumer electronics manufacturers and logistics companies in Europe and China.

Europe strong

Willett said that Europe had been particularly strong in the final three months of 2016, particularly as a result of spending by automotive firms, and added that the emerging 3D vision sub-sector was growing quickly.

"Our 3D products are gaining a lot of traction," he told an investor conference call. "We grew well in excess of 100 per cent [in] that business last year." The CEO said that Cognex was still a small player in the 3D market, currently taking around a 10 per cent share of a market estimated at around \$200 million now, but growing fast.

The Cognex CEO also explained that the Chiaro acquisition brings the company a complementary 3D sensor technology that is suited to applications requiring speed and a wide field of view but not micron-level accuracy. "These include applications such as measuring the dimensions and integrity of a box travelling on a high-speed conveyor in a warehouse," he noted.

Looking to the future, Willett said that 2017 had so far got off to a better start than had been expected, with large orders from consumer electronics customers again expected to pull through during the middle of the year.

The CEO added that the roll-out of new displays technologies in particular should yield strong demand for machine vision products as production lines are brought up to speed for volume manufacturing.

"Korea is a great market for machine vision," Willett noted, adding that Cognex was gaining strong traction in both the consumer electronics and automotive industries in the country. He also said that in India, where the traditional manufacturing sector is relatively unsophisticated and still relies on large numbers of laborers, investments by large domestic automotive



Photo: Messe Stuttgart.

Cognex machine vision technology, shown in action at the Vision show held in Stuttgart, Germany, in late 2016. Growing investment in factory automation pushed the Massachusetts company to record sales and profitability last year.

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Cognex sales top \$500M in record year

and electronics producers should offer an opportunity in the longer term.

Barriers to entry

Asked about the possibility of new competitors looking to muscle in on what has become a highly profitable niche for Cognex, founder Shillman said:

“The barriers to entry in this business are substantial. The first barrier to entry is the incredible amount of technology that one needs to have. And it first starts with the knowledge of machine vision. I think at this point we probably have over 30 or 40 PhDs, guys who got their PhDs not just in computer science, but their thesis was specifically in machine vision.”

Willett pointed out that Cognex currently employs around 400 engineers, many of whom have worked at the company for a long time, and added that when other companies have previously tried to enter machine vision, they have tended to burn



Investors in Cognex have enjoyed a massive return over the past decade, with the US company commanding a very strong competitive position in what has become a fast-growing niche thanks to investment in factory automation. As of February 17, 2017, the company was worth in excess of \$6.5 billion.

through a lot of cash before realizing how tough the technical challenges really is.

On top of that, Cognex has built up an extensive portfolio of intellectual property over the 26 years since Shillman started up the firm, further raising the barrier to entry.

Not surprisingly, all that has translated to a high market valuation of the firm that would make it an expensive acquisition.

Like many others in the optics and photonics space, Cognex’s stock price is currently trading at all-time highs, and after rising another 8.5 per cent following the latest results and outlook the firm commands a market capitalization of around \$6.5 billion.

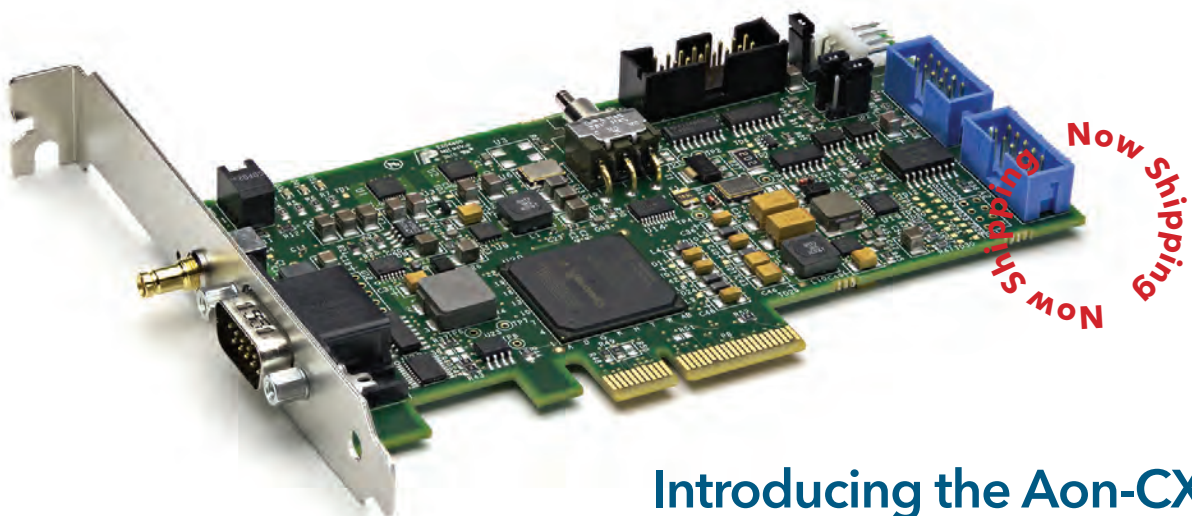
By Mike Hatcher, Contributing Editor

<http://optics.org/news/8/2/22>

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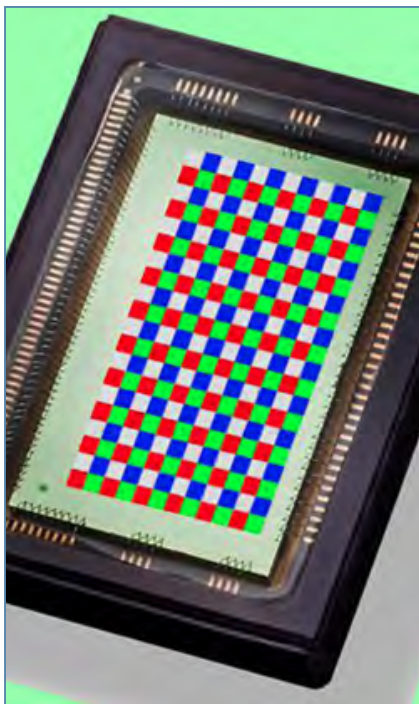


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Imec launches TDI, multispectral and hyperspectral sensors

Products combine color and NIR imaging; fusing benefits of snapshot and linescan technologies, writes Matthew Peach

At SPIE Photonics West 2017 in San Francisco, imec, the research and innovation hub in nano-electronics and digital technologies, introduced a range of market-ready imaging and camera systems, including the Snapshot image sensor with integrated color (RGB) and narrow-band near-infrared (NIR) filters.



Snapshot mosaic RGB + NIR multi-spectral image sensor.

Snapshot sensor

imec says this "breakthrough" in optical filter integration and sensing enables different applications, ranging from medical, industrial, security surveillance and automotive to virtual and augmented reality, where near-infrared signals need to be extracted and overlaid on top of color images.

"Our RGB-NIR multispectral platform demonstrates for the first time the possibility of integrating standard RGB color filters, the NIR-cut filter, NIR narrow band-pass filters and on-chip microlens technology, down to small pixels as small as 5µm," the company commented. The NIR band-pass filter and design pattern implementation can be tuned to match requirements of specific applications, such as the wavelength of a particular laser or LED light.

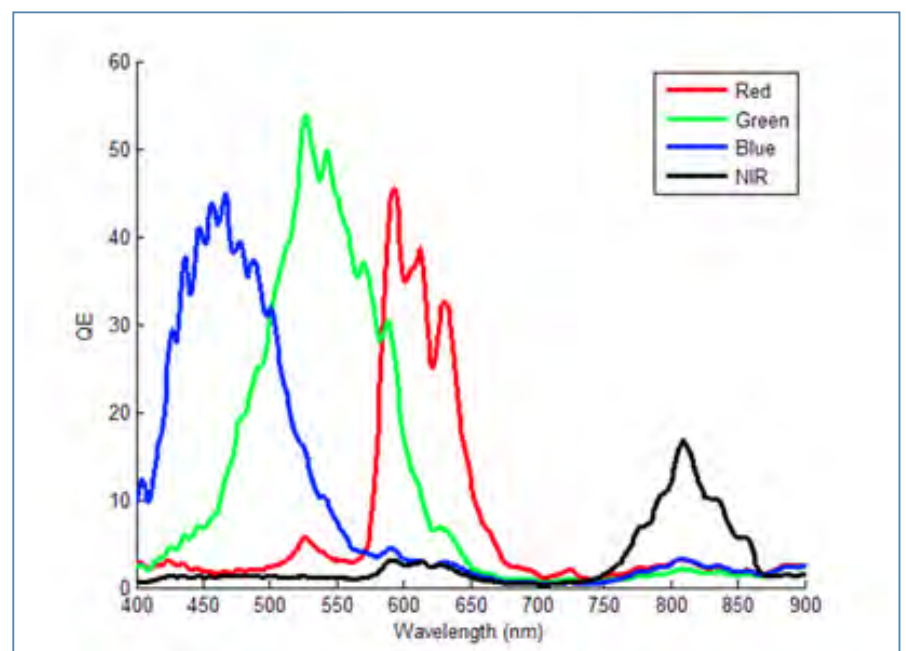
Andy Lambrechts, program manager for imec's integrated imaging activities, said, "An affordable, high resolution and high-speed solution for integrating true RGB color combined with narrow-band NIR detection was essential to develop for future applications that need to detect or track near infra-red signals that should not be visible to human eyes.

"This capability to integrate a color view with one or several near-infrared narrowbands will be a key enabler for next-generation 3D, virtual reality and augmented reality imaging platforms. As well as in machine vision, medical, automotive and security surveillance applications."

Multispectral TDI sensor based on CCD in CMOS

At Photonics West, imec also presented a prototype of a high-performance multispectral time-delay-integration imager based on CCD-in-CMOS technology. Due to its high sensitivity and record high speed (up to 300kHz), this next-generation TDI (time delay integration) imager targets applications such as remote sensing, life sciences and machine vision.

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Measured QE responses of RGB + NIR spectral channels.

urce:imec.

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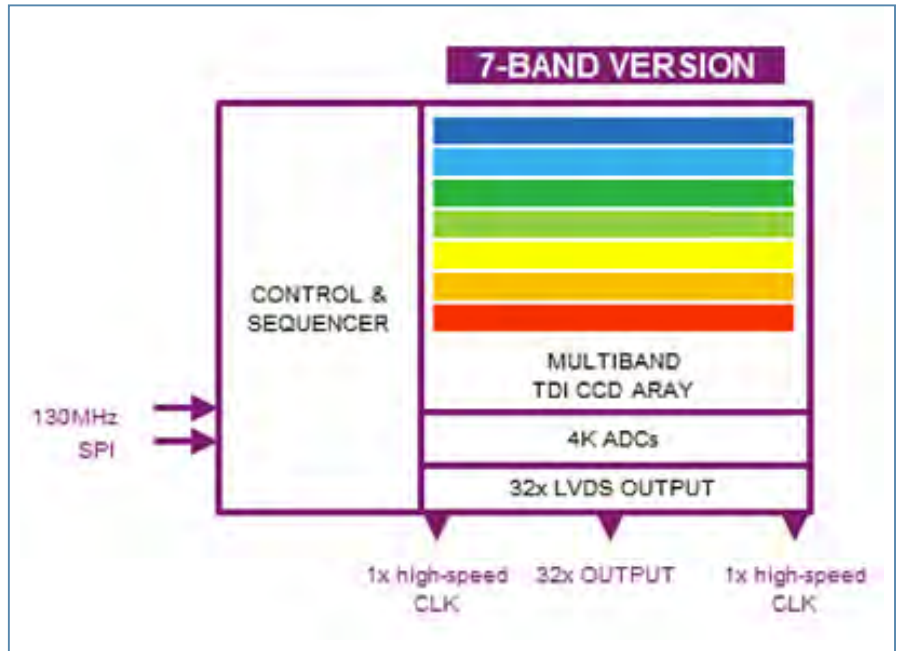
Imec launches TDI, multispectral and hyperspectral sensors

TDI imaging technology relies on the collection of charges that are generated from multiple exposures of an object moving linearly with respect to the imager. Traditionally, this is done through CCD technology where the charge transfer in the CCD pixels results in a noiseless integration and transfer synchronized with the moving scene.

imec produced the sensors in one CMOS-compatible flow. Using backside-illumination technology, the area that is exposed to light is maximized, increasing the sensor's light sensitivity. To enhance the TDI imaging performance, the TDI CCD-in-CMOS technology was combined with multispectral or RGB color filters, which can be processed at wafer level.

The prototype TDI sensors use a format with 4,096 columns and 256 stages per CCD array. A version with one CCD array is no available, as well as a 7-band version, allowing to add 7 spectral filters. The prototypes integrate CMOS drivers and readout circuitry.

Jonathan Borremans, program manager at imec, commented, "This



Schematic of a multispectral TDI image sensor with 7 bands.

low-power TDI technology excels in speed and sensitivity. The availability of multispectral filters allows the extraction of significantly more features of the moving scene than with a traditional TDI solution. This makes the technology attractive for applications, such as remote sensing, medical imaging and industrial machine vision."

Snapscan hyperspectral imaging camera

Thirdly, imec's Snapscan camera combines a "good" signal to noise ratio with spatial and spectral resolution

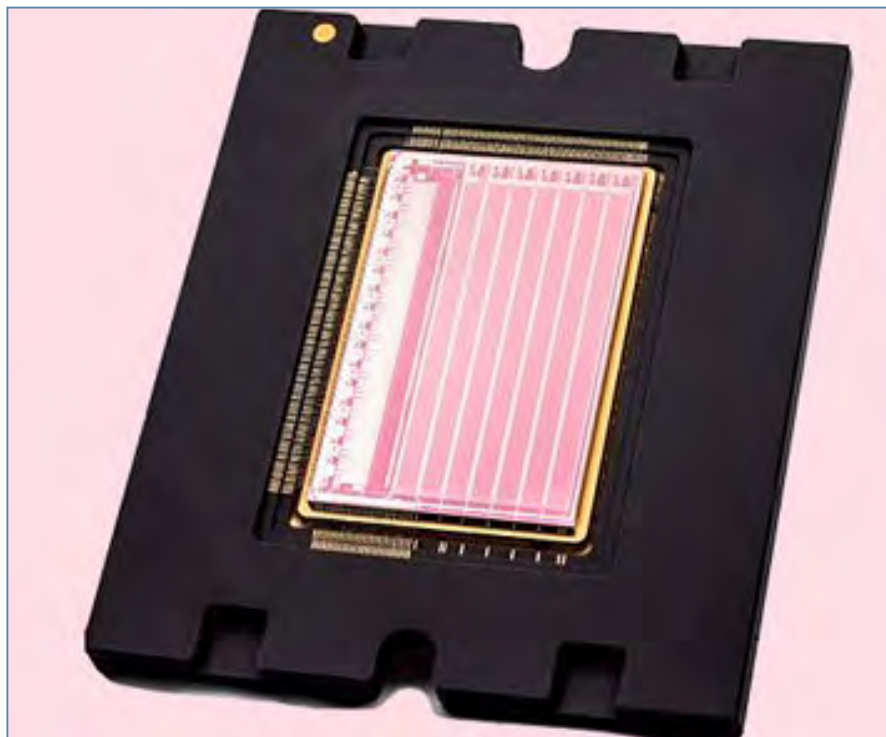
advantages of linescan hyperspectral imaging technology and the ability to acquire data-sets as easily as with a snapshot camera, the developer says.

imec commented, "scanning is handled internally, using a miniaturized scanning stage. Full hyperspectral images can be acquired in a matter of seconds."

Currently, the maximal RAW spatial resolution that is possible to achieve is 3650x2048px (7Mpx) per image, with a spectral resolution of 150+ spectral bands within the 470-900nm range. Flat signal-to-noise ratios, as high as 200 over the full spectral range, have already been demonstrated thanks to software features that optimize the reconstruction and correction of hyperspectral data cubes.

Jerome Baron, business development manager for imec's integrated imaging and vision system teams, said, "Our Snapscan camera technology will open up the market for hyperspectral imaging research and development, thanks to its simplicity to create high quality datasets, essential for application validation and building spectral libraries.

"We see many additional opportunities beyond the R&D market, especially in applications such as digital microscopy for pathology and cytogenetics, medical imaging for endoscopy, wound diagnostics and guided surgery, as well as in precision agriculture for unmanned ground vehicles and robotics".



Packaged prototype of a multispectral TDI image sensor with 7 bands.

<http://optics.org/news/8/2/8>

Radiant Vision Systems

Photometers with Hi-Res CCDs

ProMetric® Y series imaging photometers are available in 2-, 16, and 29-megapixel models, all of which feature cooled interline CCD sensors with up to 73.4 dB dynamic range. The cameras are available with 35 mm, 50 mm, and 100 mm macro lenses and feature USB 2.0, USB 3.0, and Ethernet interfaces.

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JAI A/S

New JAI 2.35 megapixel GO camera with USB3 Vision interface

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It features USB3 Vision interface and the low noise and high image quality of the Sony Pregius™ IMX174 CMOS sensor. With 80G shock ratings, 10G vibration, MTBF greater than 200,000 hours – they have much greater reliability than other small "entry-level" cameras.

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Iridian Spectral Technologies

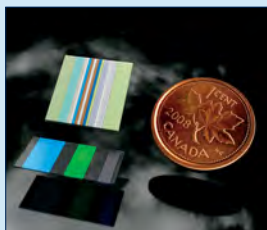
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Iridian also offers single wavelength filters tailored to meet specific customer needs.



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Qioptiq wins \$100m surveillance contract from UK Ministry of Defence

Excelitas Technology division will provide equipment and know-how for MOD's surveillance and target acquisition support needs.



Photo: Qioptiq

Sure shot: Qioptiq's Kite weapon-mounted night sight.

Qioptiq, a developer of diverse photonic products and solutions has won a \$100 million contract from the UK's Ministry of Defence for the supply of surveillance and target acquisition support (STAS).

Qioptiq is a division of Excelitas Technologies, which designs and manufactures photonics and other high-technology

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Qioptiq wins \$100m surveillance contract from UK Ministry of Defence

systems for a wide range of markets and applications in defense and aerospace, medical and life sciences, industrial manufacturing and research and development.

The contract win was announced during the International Defence Exhibition & Conference (IDEX 2017), in Abu Dhabi, UAE, last month. UK Minister Harriett Baldwin confirmed the award of the \$100 million STAS contract to Qioptiq.

The company stated that this award will allow its St Asaph, North Wales, site "to provide support for surveillance and targeting equipment to the UK Armed Forces over the next six years, and will

ensure vital night vision equipment is available to UK Armed Force personnel around the globe".

\$84m expansion possibility

The contract has options for an additional five years of support, which would increase the contract value by a further \$84 million. The Welsh Government will also continue to play a pivotal role in supporting Qioptiq by investing £2.5m in a new purpose designed facility for the STAS contract adjacent to the main company site in North Wales.

Peter White, Managing Director of St Asaph and VP Land Business, commented, "We are delighted that we have received this major contract from UK MOD to support equipment vital to the safety of our soldiers in front line operations. The support from Welsh Government and the hard work, capability and commitment of our employees were the key factors in our success."

Doug Benner, Excelitas Executive VP Defense and Aerospace, said "We appreciate the confidence the UK MoD has placed in us. This selection will allow us to continue the mission of ensuring STA equipment is available to the end user when needed. Excelitas' Defense & Aerospace mission is to keep our troops safe with the best technologies and services."

The contract covers equipment used across the UK Armed Forces delivering capability to all three front line commands. Chief Executive Officer of the MoD's Defense Equipment and Support organization, Tony Douglas said: "Crucially, the STAS contract, will deliver improved support to Her Majesty's Armed Forces."

In 2013, Qioptiq was acquired by Excelitas Technologies, a global technology company focused on delivering customized solutions to meet the lighting, detection and other technology needs of OEM customers. The group employs approximately 5,500 employees in North America, Europe and Asia.

By Matthew Peach, Contributing Editor

<http://optics.org/news/8/3/36>

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GO your own way...

Model	Resolution	Frame Rate
GO-2400	2.35 MP • IMX 174	
GO-2400-PGE		48.8 fps
GO-2400-USB		159 fps
GO-2400-PMCL		165.5 fps
GO-2401	2.35 MP • IMX 249	
GO-2401-PGE		41 fps
GO-5000	5.0 MP • Lince5M	
GO-5000-PGE		22 fps
GO-5000-USB		62 fps
GO-5000-PMCL		107 fps
GO-5100	5.1 MP • IMX 250	
GO-5100-PGE		22.7 fps
GO-5100-USB		74 fps
GO-5101	5.1 MP • IMX 264	
GO-5101-PGE		22.7 fps
GO-5101-PMCL		35.6 fps

When you need low cost, high performance and ultra-reliability in a machine vision system, there's a JAI Go Series camera to help you reach your destination. Choose the perfect combination of imager, resolution, pixel size and interface to fit your exact requirements. From our most affordable 2.35 megapixel GO-2401-PGE, to our newest 5.1-megapixel GO-5100-USB model, these cameras combine small size, light weight (only 46 grams), and MTBF ratings equal to more than 20 years of continuous 24 x 7 operation. Ready to make your system Go? Find your best route at www.jai.com/go

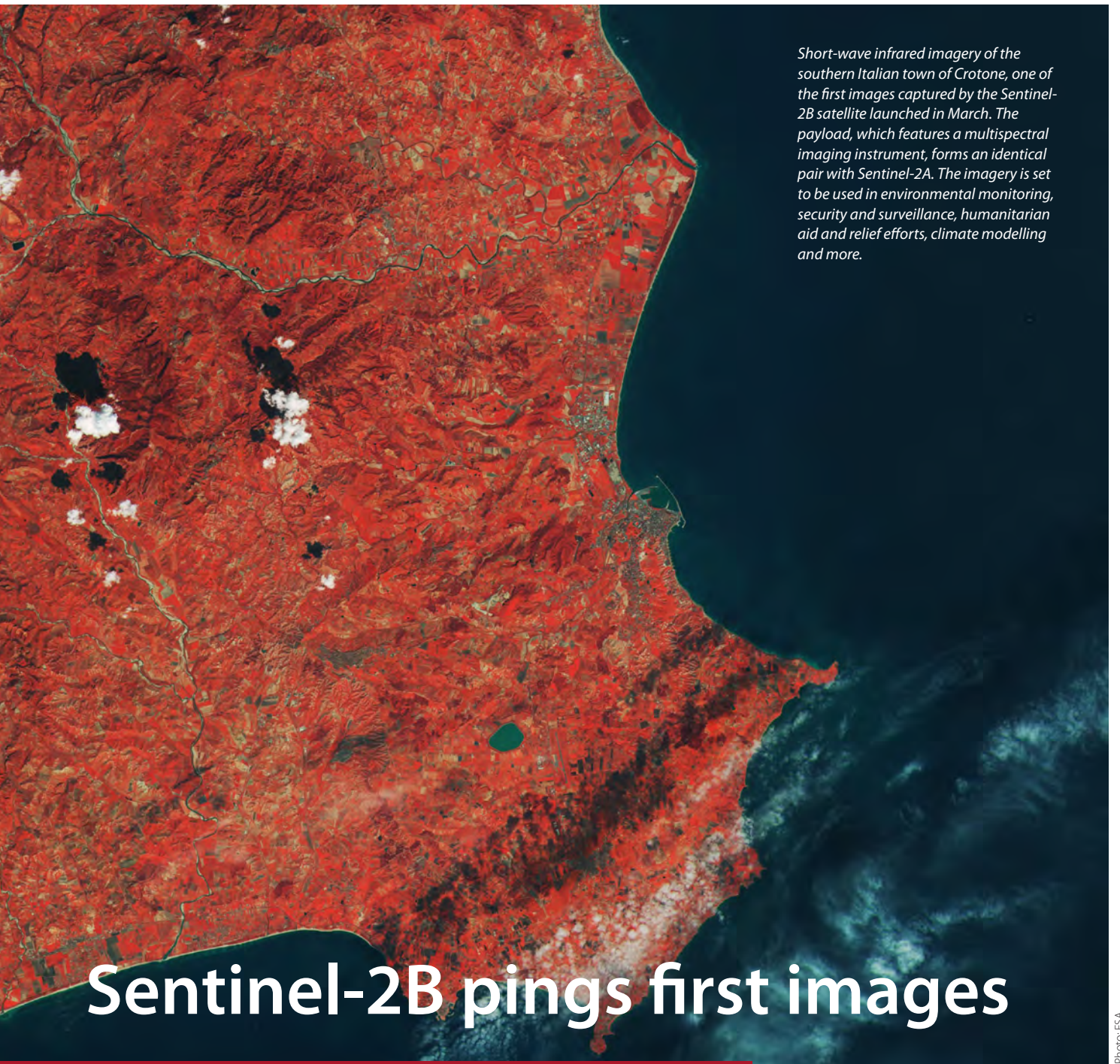
The GO Series...

Small and affordable industrial cameras

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Short-wave infrared imagery of the southern Italian town of Crotona, one of the first images captured by the Sentinel-2B satellite launched in March. The payload, which features a multispectral imaging instrument, forms an identical pair with Sentinel-2A. The imagery is set to be used in environmental monitoring, security and surveillance, humanitarian aid and relief efforts, climate modelling and more.

Sentinel-2B pings first images

Satellite's early views of Italy and Albania demonstrate payload's multispectral capability.

Barely a week after its March 7 launch, the European Union's "Sentinel-2B" satellite – the latest addition to the Copernicus environmental monitoring program – pinged back its first images of Earth, demonstrating the payload's multispectral capabilities with high-res views of the Italian and Albanian coastlines.

With a swath width of 290 kilometers, Sentinel-2B's first acquisitions came from a strip of observations as it traversed eastern Europe, starting over the Baltic Sea and ending in northern Libya.

Each pixel from the images represents a ground resolution of 10 meters, with the data relayed in real time using a laser link via the European Data Relay System (EDRS) and a radio-frequency downlink to the European

Space Agency (ESA) ground station in Matera, Italy, for processing.

Clear skies over southern Italy allowed the first demonstration of the instrument's multispectral capabilities - including a striking infrared image of the southern Italian town of Crotona in Calabria, and a crystal-clear view over the port city of Brindisi.

The multispectral imager is currently

being calibrated, as part of a three-month commissioning phase before it joins the existing Sentinels in the wider Earth observation mission. Sentinel-2A was launched in June 2015, and with both payloads now in orbit, the "twins" will be able to provide repeat coverage every five days.

Josef Aschbacher, the director of ESA's Earth Observation Programmes, said: "Sentinel-2B will be one of the workhorses of Copernicus, as it will enable a whole range of applications with a focus on land. With the second Sentinel-2 satellite in orbit, we now have much better coverage - which is especially important for monitoring areas frequently covered by clouds."

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Photo: ESA.

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Sentinel-2B pings first images

The key function of the Copernicus constellation and the various Sentinels is environmental mapping and monitoring, providing vital information on the state of agricultural land and coastlines, sea-ice coverage, oil-spill detection, ship surveillance, support for humanitarian aid efforts, climate studies and much more besides.

The latest launch is just one element of the wider Copernicus mission, described by the ESA as “Europe’s eyes on Earth”, and which comprises six sets of satellites. While Sentinels 1A and 1B provide radar coverage, the Sentinel-2 payloads offer multispectral imaging across 13 wavelength bands stretching from 443 nm in the blue spectrum to 2190 nm in the infrared. Their 10-meter spatial resolution is achieved with the visible and near-infrared range, dropping to 20 meters further into the infrared and to 60 meters in three atmospheric correction bands.

The twin Sentinel-3 satellites – one of which launched in February 2016, with the second scheduled for blast-off within months – offer



Photo: ESA.

Acquired March 15, another of the initial set of images relayed from Sentinel-2B features the southern Italian port city of Brindisi.

a combination of visible and near-IR imagery, combined with surface temperature and microwave radiometry. Future Sentinel-4, 5 and 6 missions will add ultraviolet and thermal infrared capability and high-resolution ocean topography, among other things.

Philippe Brunet, director for space policy at the European Commission, said that the launch of Sentinel-2B would improve the quality of the Copernicus data, helping

to protect the environment and natural resources, as well as improving civil security.

Although launched separately, the Sentinel-2 satellites are actually in the same orbit, flying 180 degrees apart so that they are constantly on opposite sides of Earth. Every five days, the satellites will jointly cover all land surfaces, large islands, and inland and coastal waters between latitudes of 84 degrees south and north.

Immediately after the Sentinel-2B launch, Aschbacher said: “I have personally been involved in Copernicus since its very first day and helped shape it along its way. It is therefore extremely satisfying to see the constellation of satellites delivering data for the services we have always dreamt of.”

Built by Airbus Defence and Space in France, the multispectral instruments on board the Sentinel-2 satellites use a three-anastigmat telescope design optimized to achieve state-of-the-art imaging quality across its very wide field of view, and feature silicon carbide mirrors to keep thermal deformations to a minimum.

Its two focal planes are based on CMOS and mercury-cadmium-tellurium detectors, with two arrays of 12 detectors mounted on each. A shutter mechanism prevents the instrument from direct solar illumination, and is also used as a calibration device by collecting sunlight after reflection by a diffuser.

The rapidly growing data sets from the Copernicus mission are available, via a selection of software tools and applications at the dedicated web site <https://spacedata.copernicus.eu/>



Photo: ESA.

The Karavasta Lagoon in Albania, as seen by the Sentinel-2B multispectral imager.

Mike Hatcher, Contributing Editor



Navitar purchases Canadian camera manufacturer PixeLINK®

Acquisition expands Navitar's integrated imaging solutions business

Date Announced: 31 Jan 2017

Rochester, NY – January 30th, 2017 – Navitar Canada, Inc. (Navitar), an innovative manufacturer of precision optical solutions, announced today the purchase of PixeLINK®, a leading developer of digital cameras for use in industrial, life science, and other advanced imaging applications. This acquisition allows Navitar, Inc to offer fully integrated end-to-end lens and camera imaging solutions to customers worldwide.

Based in Ottawa, ON, Canada, PixeLINK manufactures, optimizes and integrates industrial cameras for machine vision applications and microscope cameras for life science and digital microscopy applications. Product offerings include CMOS and CCD sensors, coupled with state-of-the-art high speed digital technologies such as USB 3.0, FireWire (IEEE 1394), USB 2.0 and Gigabit Ethernet (GigE). PixeLINK's latest camera models are equipped with the 12.3 MPixel Sony Pregius IMX253 (1.1") and 8.9MPixel IMX255 (1") sensors which support 4K Ultra HD video.

"The addition of the PixeLINK business enables us to provide our Navitar core dealers and OEM customers in machine vision and life science a large range of visible spectrum camera solutions," explains Navitar President Michael Thomas. "Navitar recently added active alignment, assembly and testing of 4K OEM lens camera modules to our repertoire of services - combining Navitar large format,

athermal, HDR lenses with Sony IMX CMOS sensors. Now our customers developing VR cameras, autonomous vehicles, drones and persistent surveillance systems will achieve unprecedented image quality with a Navitar lens, and they will benefit from decades of sensor integration expertise and industry-leading CMOS camera technology from PixeLINK."

PixeLINK is recognized around the world for its quality hardware, imaging software and unmatched customer service. Their USB 3.0 high speed cameras provide superb image quality and have consistently been rated as the most reliable industrial cameras in the market. Paul Saunders, President of PixeLINK, comments, "We are excited to add our cameras to Navitar's large selection of imaging products. Current and new customers will benefit greatly from our integrated solution offerings."

Julian Goldstein and Jeremy Goldstein, owners of Navitar, comment, "We welcome the PixeLINK employees and customers to the Navitar network of companies and look forward to developing ground-breaking integrated camera and lens solutions optimized for the sharpest, cleanest images available in the industry."

Navitar plans to announce the acquisition of PixeLINK at Photonics West in San Francisco on January 31. In addition, are introducing a new high performance zoom lens series, the Resolv4K, with a live demonstration using a PixeLINK camera (IMX255 sensor).

About PixeLINK

PixeLINK designs and manufactures consistently reliable industrial and life science cameras for machine vision, medical imaging, biometrics, and microscopy applications. Since 1992, PixeLINK has designed, manufactured, and supported the imaging requirements of customers around the world. PixeLINK offers unmatched customer support and service, while providing the finest off-the-shelf, OEM and custom industrial imaging solutions to their customers.

www.Pixelink.com

About Navitar, Inc.

Navitar, Inc. designs, develops, and manufactures innovative optical solutions for customers and enterprises across the globe. Solutions include complete optomechanical and electro-optical assemblies and sub-assembly systems. Navitar components and systems are used in a wide variety of industries including life science, medical, defense and security, industrial, entertainment and projection. Applications include machine vision, electronics, semiconductor process, metrology, UV lithography, non-contact measurement, IR imaging, simulation, planetarium, amusement, laser projection, autonomous vehicles, surveillance, cinematograph and VR.

www.navitar.com

<http://optics.org/press/3497>

\$15M equity round for phone camera startup Corephotonics

Israeli firm specializing in new 'dual camera' and folding optics technology wins backing from Samsung and Foxconn.

Corephotonics, an Israeli startup company developing camera technology that it says will raise the performance of camera phones to professional standards, has landed \$15 million in a follow-up round of equity financing.

The latest round sees Samsung Ventures, iPhone producer Foxconn, semiconductor chip maker MediaTek and an unspecified but "top-tier" smart phone OEM investing in the company, which is headquartered in Tel Aviv and pursuing a licensing business model.

Israeli Ministry of Science and general manager of Tessera's image enhancement division, previously started up the optoelectronics firms Civcom and Eyesquad.

"We established Corephotonics in order to improve the image quality in smart phones, and to provide consumers with a unique user experience, after we identified this need of device manufacturers," said Mendlovic in a release from the company.

"We successfully predicted the use of dual cameras, and we currently see such cameras

Targeting drones, auto, surveillance

The latest funding round, which takes total investment in Corephotonics to \$50 million, was led by VC firm MizMaa Ventures and Beijing Singularity Power Investment Management Co., Ltd, while previous backers have included Li Ka-shing – reputedly the richest man in Hong Kong.

According to the company, its dual-camera technology enables imaging capabilities that until now have only been available in professional cameras to be incorporated into a smart phone. "The technology is based on the combination of two cameras, which enables stills photography with optical zoom of up to 3x and up to 8x zoom in video, even in low light conditions," it claims.

The approach also enables the so-called "bokeh" effect, where blurring a photograph's background helps the main subject in the image to stand out better. That typically requires a digital single-lens reflex (SLR) camera, although high-end phones including Apple's new iPhone 7 Plus now offer this feature.

As well as its patented dual-camera optics, the Corephotonics team has developed a zoom function that is slim enough to be incorporated into a phone, and a new design based on folded optics that is said to capture five times as much light as a standard camera.

They say that the latest investment round will go towards developing next-generation cameras for smart phones, and to help the company expand beyond phone handsets and into the automotive, drone, surveillance, and action camera markets.

To do that, Corephotonics plans to add to its current 50-strong workforce by recruiting dozens of engineers in Tel Aviv, along with support staff and integration engineers in China and South Korea. "In addition, the company is exploring opportunities to acquire complementary technologies," says the firm.

By Mike Hatcher, Contributing Editor

<http://optics.org/news/8/1/21>



Photo: Corephotonics.

The Corephotonics folded optics uses a prism and a lens barrel oriented such that it is parallel to the phone surface. This results in a high focal lens camera, combined with a form factor said to be a "thinner than a pencil".

Dual camera tech

According to Corephotonics, Apple and others have already incorporated similar dual-camera technology into their latest phones. "During the Consumer Electronics Show (CES), more than half of the advanced smart phones announced were using dual main cameras," noted the firm. It was set up in 2012 by CEO David Mendlovic, also a professor of electro-optics at Tel Aviv University, alongside imaging guru Gal Shabtay and entrepreneur Eran Kali.

Mendlovic, whose impressive resumé includes stints as the chief scientist of the

being integrated into a broad range of smart phones by all leading manufacturers. We are pleased that top-tier investors have expressed confidence in our capabilities, allowing us to develop next-generation camera technologies, which will reach the market within the next few years."

Gonzalo Martinez de Azagra, who heads up the Samsung Ventures operation in Israel, added: "Samsung Ventures is determined to invest in ever-more compelling solutions for mobile devices, using the best-of-breed technologies, and Corephotonics is a world-renowned leader in the mobile imaging space."

Subsea lidar to map ocean floor with centimeter resolution

Laser-based system already used by Monterey Bay aquarium to investigate at depths of nearly 3 km. By Mike Hatcher.

The Monterey Bay Aquarium Research Institute (MBARI) is working with Boulder-based company 3D at Depth, which develops subsea optical mapping equipment, on a next-generation lidar system capable of centimeter-scale resolution.

Ultimately intended for sea-floor mapping with autonomous ROVs (remotely operated underwater vehicles), the advanced mapping system is wanted for surveying oceanic changes and is

expected to lead to new understandings of processes occurring at the ocean floor.

Centimeter resolution

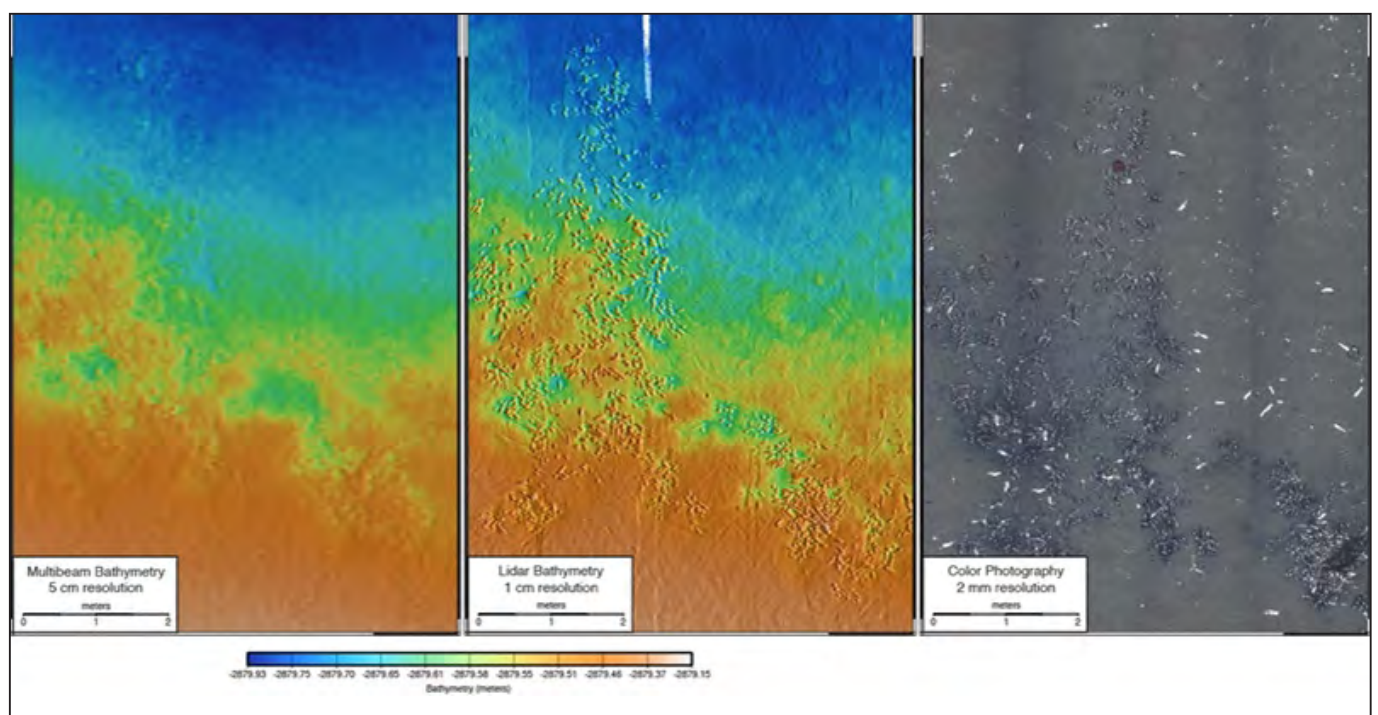
The two partners have already been collaborating for a while, with MBARI first testing the company's "SL1" lidar technology back in 2013. They incorporated the laser-based sensor into an ROV-mounted, low-altitude survey system that also included stereo cameras, strobe lights, multibeam sonar,

Doppler velocity log sonar, and an inertial navigation system.

That system was able to deliver 1-centimeter resolution topography alongside color photographic imagery over 80 m by 80 m areas in single ROV dives, says the firm.

Early tests also included investigation of clams nearly 3 kilometers below the ocean surface in Monterey Canyon,

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A comparison of multibeam bathymetry (5-cm resolution), LiDAR bathymetry (1-cm resolution) and a photomosaic (2-mm resolution) of a clam community in Monterey Canyon, as mapped by MBARI's "Doc Ricketts" ROV from a 3-meter altitude. The lidar bathymetry is able to resolve individual clams and the trails left by their movement.

Image: MBARI/3D at Depth.

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Subsea lidar to map ocean floor with centimeter resolution

demonstrating that the bathymetric lidar – using blue-green wavelengths to penetrate water - could resolve individual animals and the trails left by their movements.

More recently, low-altitude surveys have been used to map sponges on the summit of Sur Ridge, and to monitor fine-scale changes to the seafloor in Monterey Canyon as part of a wider study of sediment transport down the active canyon.

Following tests with a prototype, MBARI and 3D at Depth say they have now defined the requirements for efficient 1 cm-scale swath mapping in the deep ocean, and will proceed with the development of a subsea lidar system that is able to meet the requirements.

Initial testing of the new lidar equipment will be as part of the ROV-mounted survey system, but ultimately MBARI is intending to field the low-altitude survey capability on autonomous platforms.

New perceptions

David Caress, the principal investigator for MBARI's Ocean Imaging project, said in a joint statement:

"Our desire to achieve 1 cm-scale surveys of areas with complex and rugged terrain requires generating precise bathymetry over ranges from 2 m to 20 m, while our need for efficient use of expensive platforms requires a scan rate and a field of view comparable to other swath mapping sensors."

He added that achieving such performance with a lidar scanner will lead to "fundamentally new" observations in the deep ocean.

Carl Embry, the CEO of 3D at Depth, added: "The project is truly a win-win for both organizations as it provides MBARI with a tool to meet their scientific goals and this helps us accelerate the development of our next-generation subsea lidar systems for moving autonomous underwater vehicles (AUVs) and ROVs."



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#MBARI's researchers are conducting seafloor surveys in #MontereyCanyon as part of a large-scale experiment
ow.ly/9ccz309InVF

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In its latest technology roadmap, MBARI states that every technological advance that has increased the resolution of sub-sea depth measurements has produced "startling" new perceptions of the sea floor and the processes shaping it.

Ultimately, MBARI wants to combine centimeter-scale bathymetric data with optical imagery, saying: "This new level of resolution is necessary to elucidate geological processes as well as to provide a clear physical framework to observe and understand the distribution, movement, and relationships of benthic (i.e. sea-bed) fauna."

News of the collaboration comes just a few months after 3D at Depth showed the power of subsea lidar for the energy industry, when its scans were used in conjunction with additive manufacturing techniques to fix a well head in deep water off the coast of Australia.

MEMS sensors

Bathymetric lidar - which uses blue-green rather than the more traditional infrared lidar wavelengths to penetrate through water much more effectively - is a relatively old idea, but has tended

to rely on bulky lasers that have meant systems weighed up to 300 kilos.

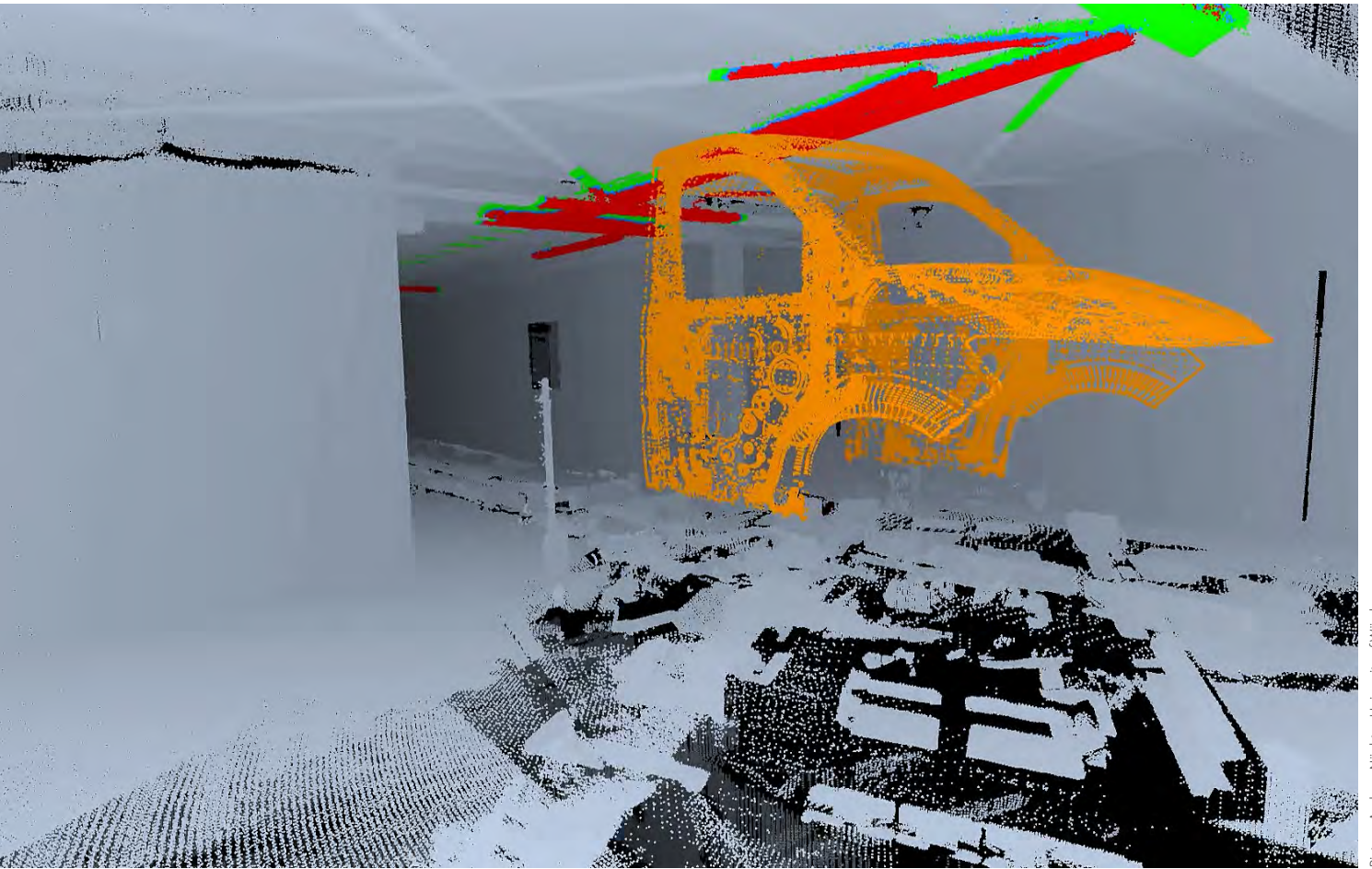
According to the US Geological Society the technology remains highly specialized, with only a handful of systems in existence, most of which are only used in shallow coastal waters.

Other bathymetric system providers include Leica Geosystems, whose "HawkEye III" airborne platform is able to collect sea-floor data from the air, but only to a depth of 50 meters.

3D at Depth says that its SL1 sensor hardware integrates a unique optical design with a sub-nanosecond pulsed solid-state laser to generate the underwater imagery. The systems include an embedded MEMS motion sensor used to calibrate for pitch and roll, meaning that it can be "levelled" despite the motion of the ocean.

SL1 weighs nearly 41 kilos out of the water but is able to operate at depths of up to 3 km, while the newer SL2 version of the equipment is significantly lighter but only operates to 1.5 km depths.

<http://optics.org/news/8/3/26>



Picture: Andreas Nüchter, University of Würzburg

Mind your head: Section of an automotive production line and a simulated model as a 3D cloud of dots. The places where collisions would occur after a change of model are highlighted in red.

All change: 3D scanning speeds production line retrofits

Academic partnership with VW assesses manufacturing geometry to optimize change of model production.

by Matthew Peach

How does an assembly line for production of complex mechanical products such as automobiles, but also including aerospace or industrial parts, need to be retrofitted for a change of design or model? An effective solution to this challenge is to deploy a 3D scanning system through the entire production line (as a work piece would travel) to analyze in great detail what happens with the existing manufacturing approach – and what sort of changes will be necessary.

The variety of vehicle models has increased significantly over recent decades. Consider Volkswagen: in 1950, the automaker produced just two model ranges – the Beetle and the Transporter. This number had increased to ten models by 1990, and today around 20 different VW car designs are rolling off assembly lines. Counting all 12 brands within the wider Volkswagen Group, the number of different designs reaches at least 300 models – including trucks, buses, motorbikes and other vehicle types.

Long gone are the times when one factory fabricated the same car for years on end. There is a trend towards more frequent model changes and smaller volumes. A car factory with just one production line suitable for manufacturing multiple models is what the future will look like, believes Professor Andreas Nüchter of the Institute of Computer Science at the Julius-Maximilians-Universität (JMU) in Würzburg, Germany, who is a specialist for this type of job.

“Such an evolution of the manufacturing environment would require increased flexibility in production, more robots and a higher level of digitization,” Professor Nüchter commented.

3D models

Professor Nüchter is working to achieve to this goal. His team – Dorit Bormann, Florian Leutert, and Johannes Schauer – supports the group known as Virtual Technologies of Corporate Research, which is based at Volkswagen AG. Their aim is to achieve digitization of production lines in preparation for a change of model.

For this purpose, the computer scientists send a 3D “FARO Focus3D” scanning

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All change: 3D scanning speeds production line retrofits

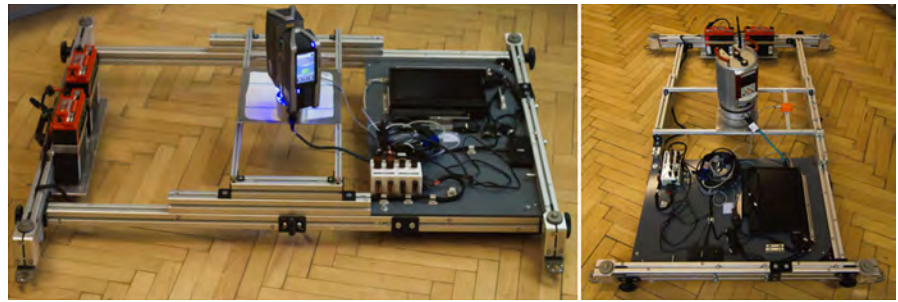
system mounted on a "skid" through the production line during live operation and then use the data to generate virtual three-dimensional images of the production facility. Subsequently, they simulate how the production line has to be converted to manufacture the new model.

Scanning and evaluating the data takes about a month. But why is this job apparently so complex when there are already construction plans of the production plant available? Professor Nüchter explained, "The fabrication plans are invariably never up to date, because minor adjustments are being made to the manufacturing system all the time during live production." Hence the need for a live assessment.

"Previously, polystyrene models of the new car or product types would be sent through the production line to determine bottlenecks and other obstacles," he added.

The solution developed by the Würzburg scientists is certainly more up to date. The 3D scanner moreover allows them to cover areas that are difficult to access, such as the tunnels where the vehicles' paintwork is dried.

"We were commissioned by Volkswagen to go through this process for the new launches of the models Tiguan and Crafter," Professor Nüchter explained. The new scanning procedure in those cases revealed, for example, that the ceilings of the production spaces needed to be converted to prevent collisions in the case of Crafter production.



Pictures: Andreas Nüchter, University of Würzburg.

Left: Sensor skid, the workpiece holding fixture, fitted with a FARO Focus 3D laser scanner. Right: Skid with a Riegler VZ-400 laser scanner. Both skids are also equipped with a low-cost MEMS IMU (x sens MTI).

Automated data evaluation

What is challenging about this application is not so much the scanning of the production environment, but the evaluation of the collected scanning data. "This is why we are seeking to automate as much of this particular step as possible," Nüchter said. Presently, his team is also working on further developing the corresponding software.

These specific analytical activities for Volkswagen are just a by-product of Nüchter's research. His actual expertise is in the area of mobile robots that scan their surroundings using 3D scanning systems. "Ultimately, it makes no big difference whether we operate a scanner on a mobile robot or let it pass through an automotive assembly line on a skid," the professor states.

The technique is also readily transferable to other sorts of production besides automotive: "Of course, our production line scanning method is also applicable to aircraft production, for example. It is applicable everywhere where you have such manufacturing environments."

Future plans

In a related development, the Würzburg team has also founded a startup called "Measurement in Motion", which is intended to take these capabilities into market. The new company's website can

be found at <http://mimgermany.com/> (due be online in early-mid 2017).

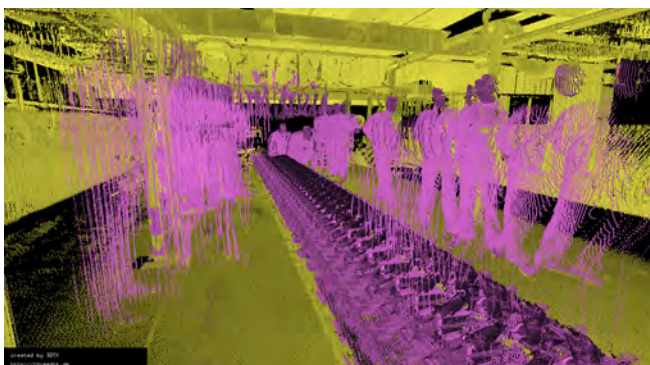
Professor Nüchter concluded, "We wish to expand our method to terrestrial laser scans. First trials have already shown promising results. To further eliminate points that are incorrectly marked as dynamic, a post filter could be applied that makes sure that dynamic point groups must be bigger than the given voxel size; we expect all moving objects like humans or other car bodies to be large enough for this heuristic."

A measure to decrease the problems from reflecting surfaces would be to keep a count of how often a voxel is marked as free. If the scanner is moving, then it is unlikely that reflections in the mirror will remain the same and thus one could only remove voxels that were seen as free more often than just once.

Other extensions to the algorithm would be to cater for outdoor situations. With an open sky, there exist no points to shoot rays to in many directions. In these cases it would be useful to add enough dummy rays to still be able to detect moving objects even if they have no background.

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Author Matthew Peach is a contributing editor to optics.org



Moving image: A scene from a Volkswagen consumer car factory with workers standing alongside or on the production line. (a) The original scan partitioned into static (yellow) and dynamic (pink) points. (b) The original scan without dynamic points.

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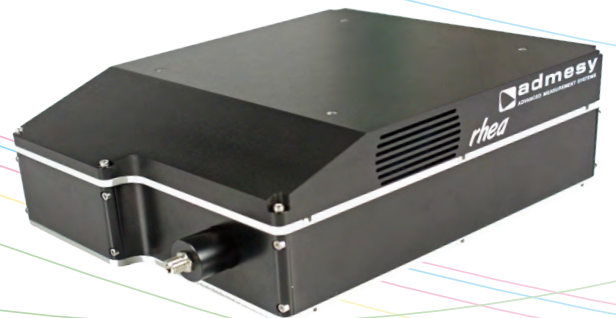
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