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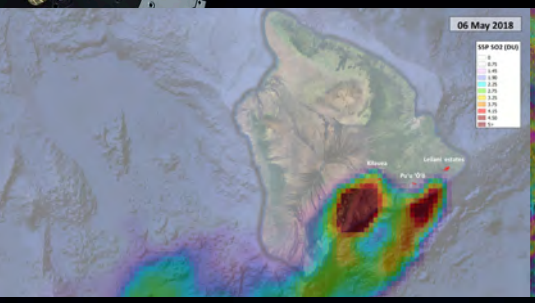
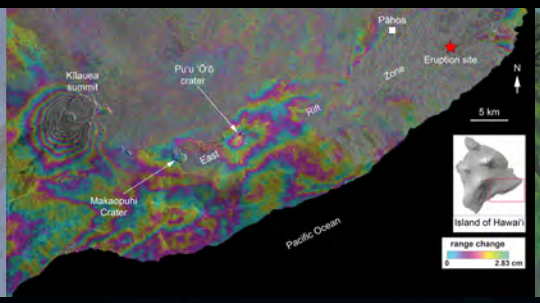
July/August 2018

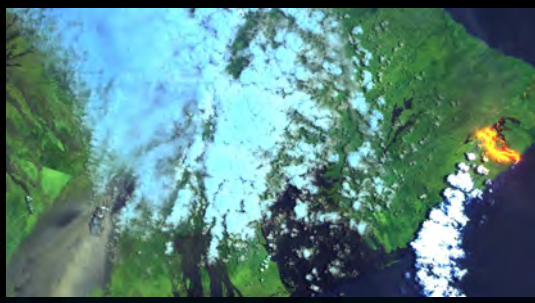
VISION focus

Delivering the latest news from the Imaging and Machine Vision markets

Latest Sentinel returns first images







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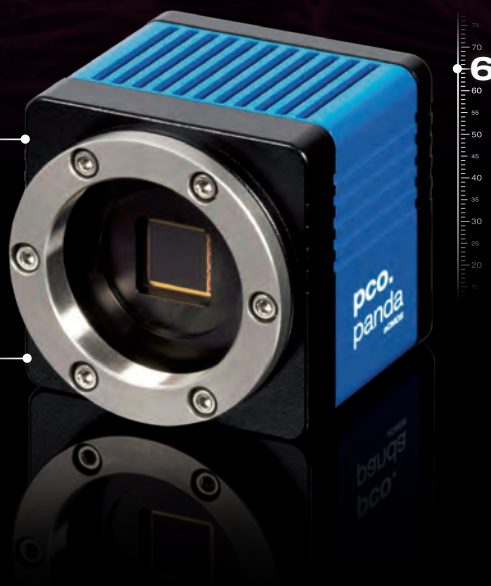

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High visibility

Welcome to the latest issue of VISION Focus, the quarterly magazine *(and free download from optics.org)* 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 the photonics-related conference: SPIE's Optics + Photonics expo, 19th – 23rd August in San Diego, California.

Optics + Photonics is the premier, annual event for optical engineering and applications, nanotechnology, quantum science, and organic photonics. Expect fascinating plenary talks on innovative technologies helping industry, academia, and governments to meet a wide range of objectives.

Issue highlights

The European Space Agency has announced that its latest Earth observation satellite, the Copernicus Sentinel-3B, has relayed its first images back to ground stations (see also on the cover).

Vision systems giant Cognex is now eyeing logistics and 3D vision markets – as the OLED boom softens. With global investment in organic LED production in something of a slump so far in 2018, MV specialist Cognex aims to maintain its rapid recent expansion with a fresh approach to logistics and 3D vision applications.

In order to separate chemical mixtures into their single components, industry operators commonly carry out energy-intensive distillation, such as in crude oil refineries. Now researchers at the Technical University of Kaiserslautern, Germany, are developing a camera-based system to monitor this process.

In Israel, Jabil Optics is expanding its R&D resources with the opening of a 2000 square meter Optics Technology Innovation Center in Haifa.

FLIR has been fined $30M (under ITAR rules) to settle US government allegations that it violated International Traffic in Arms Regulations. Half of the fine is suspended pending remedial compliance measures related to historic exports of thermal cameras.

We also report on the 55th edition of Display Week, LA's screen-fest, which celebrated the half-century of liquid crystal displays. Our coverage of other recent vision-related expos includes: Defense & Commercial Sensing 2018, where a Hyperspectral imaging technique by HinaLea demonstrated early diagnosis of plant diseases; and at SPIE's Photonics Europe, a Harvard student won the AR/VR design challenge – Zhujun Shi was awarded top score for her presentation on a novel metrmaterial-based waveguide display. See inside for news of further winners!

Enjoy the show – and enjoy Vision Focus!

Matthew Peach, Contributing Editor
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This Issue

Publication and Editorial Schedule 2018/19

October/November Issue 2018

- Bonus Distribution: **Vision**
- **Editorial Focus:** opto-electronic systems, applications in sensing and manufacturing.
- Published in advance of Vision, 6th – 8th November 2018

January/February Issue 2019

- Bonus Distribution **SPIE BiOS, Photonics West, SPIE Medical Imaging**
- **Editorial Focus:** industrial applications, sensing, biomedical analysis and treatments.
- Published in advance of Photonics West, 2nd - 7th Feb, Lase, 2nd - 7th Feb, SPIE Medical Imaging, 16th – 21st February 2019

April/May Issue 2019

- Bonus Distribution **SPIE Defense+Commercial Sensing**
- **Editorial Focus:** aerospace and defense applications, associated research and development
- Published in advance of DCS *(Defence & Commercial Sensing)*, 14th – 18th April 2019.

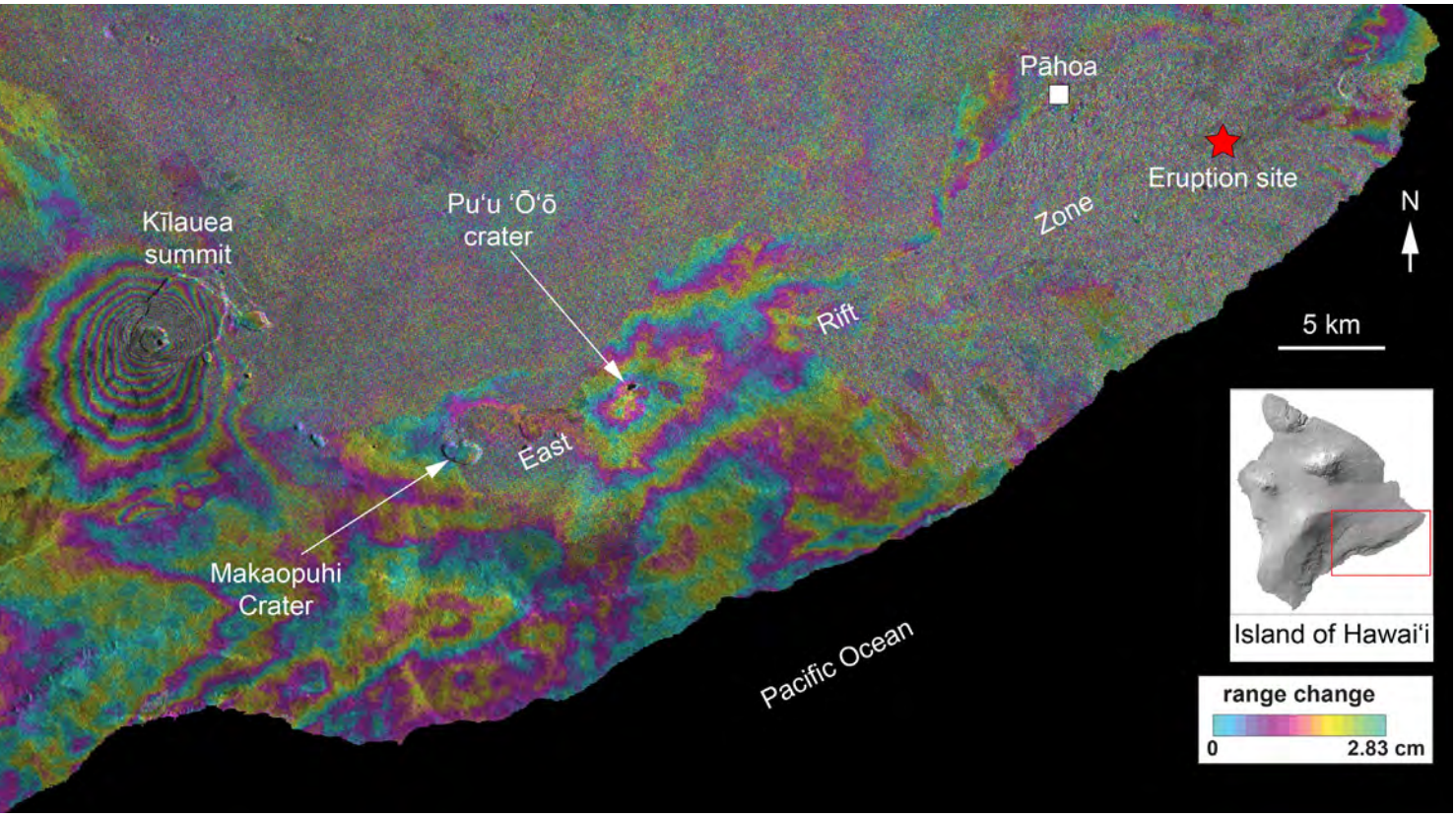

Image: ESA/USGS.

Captured by Sentinel-1 satellites, this radar interferogram over the Kilauea volcano on Hawaii's Big Island shows how recent seismic activity has deformed the local land.

Latest Sentinel returns first images

'3B' satellite completes first batch of orbiting Earth observation units launched by the European Space Agency.

The European Space Agency (ESA) says that its latest Earth observation satellite, the Copernicus Sentinel-3B, has relayed its first images back to ground stations.

Launched from Russia in late April, the latest payload is the seventh in the Copernicus constellation, and joins its Sentinel-3A "twin" in a low-Earth orbit, to measure sea surface topography, sea and land surface temperature, and ocean and land surface color with high accuracy.

ESA chiefs say that Sentinel-3B completes the first "batch" of payloads in the Copernicus mission, the European Union's ambitious project to provide round-the-clock, high-resolution imagery for a variety of scientific, land management, and humanitarian applications.

Instrumentation

Like the 3A satellite, which was launched in early 2016, the 3B carries four main instruments for observation – including a high-resolution multispectral imager, and a sea and land surface temperature radiometer (SLSTR).

Over oceans, the equipment measures the temperature, color and height of the sea's surface, as well as the thickness of sea ice. These measurements can then be used to monitor changes in Earth's climate, and for what the ESA describes as a more "hands-on" applications including monitoring marine pollution.

When orbiting over land, the Sentinel-3B is able to monitor wildfires, map the way that land is used, check the health of vegetation, and measure the height of rivers and lakes with a laser retro-reflector instrument.

Elzbieta Bienkowska, the European Commissioner responsible for industry, entrepreneurship and SMEs, highlighted the commercial potential of the data and imagery received, saying in an ESA release: "This new satellite will deliver valuable images of how our oceans and land are changing. This will not only speed up the response to natural disasters, but also create new business opportunities.

"Earth observation is a larger market than you would think - a driver for research discoveries, a provider of highly skilled jobs, and a developer of innovative services and applications."

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Latest Sentinel returns first images

Image: ESA/USGS.

Image: ESA/EUMETSAT.

One of the Copernicus Sentinel-3B's first images captured post-launch, this shows sea ice swirled into eddies caused by the wind and ocean currents near Greenland. The image was taken by the satellite's multispectral ocean and land color instrument (OCLI).

Enabling technology

In part, those commercial opportunities are enabled by the state-of-the-art photonics technology on board. That includes the multi-spectral Ocean and Land Colour Instrument (OCLI), which collects images across 21 different wavelength bands in the visible-near infrared spectrum, between 400 and 1020 nm.

Tuned to specific ocean color, vegetation, and atmospheric correction measurement requirements, OCLI has a spatial resolution of 300 m for all measurements and features a swath width of 1270 km, overlapping the SLSTR instrument's swath.

"OLCI's new eyes on Earth will allow ocean ecosystems to be monitored, support crop management and agriculture and provide estimates of atmospheric aerosol and clouds – all of which bring significant societal benefits through more informed decision-making," states ESA.

Based on the opto-mechanical and imaging design of the MERIS instrument deployed on board Europe's earlier Envisat payload, the OLCI kit includes a push-broom imaging spectrometer with five camera modules arranged in the form of a fan, to share the field of view.

Although the 3B satellite has already sent back initial imagery showing sunset over Antarctica, sea ice in the Arctic Ocean, and a clear view of northern Europe, its instruments will not be handed over to routine operations until a five-month period of commissioning and calibration is completed.

Monitoring Kilauea eruption

In recent days, the earlier Sentinel launches have shown their value by helping to monitor the eruption of the Kilauea volcano on Hawaii's Big Island.

Both the Sentinel-1A and Sentinel-1B satellites have generated interferometric radar imagery indicating how the local land has been displaced by seismic activity associated with the eruption, and have used laser terminals to return large data sets to ground stations much more rapidly than was possible previously.

"The pattern of fringes near the summit of the volcano indicate withdrawal of magma from the subsurface to feed the eruption, which is occurring about 40 km away along the volcano's lower East Rift Zone," explained the Copernicus team.

Additional high-resolution imagery has been provided by Sentinel-2 satellites, showing the temperature of the Kilauea crater. In a Copernicus release, the US Geological Survey (USGS) geophysicist Michael Poland was quoted saying:

"Sentinel-1 data have proven invaluable for tracking the highly dynamic current volcanic and earthquake activity at Kīlauea Volcano in Hawaii. That the data are accessible very soon after acquisition and cover the entire island have allowed for rapidly available and synoptic views of surface deformation that might not otherwise be available."

Subsequent Sentinel payloads are set to include optical instrumentation for monitoring aerosols and air quality, and to provide more detailed information for climate and weather modeling.

Mike Hatcher is Editor in Chief of optics.org

http://optics.org/news/9/5/12

Cognex eyes logistics and 3D vision as OLED boom softens

Photo: Messe Stuttgart.

Cognex equipment on the tradeshow floor at Messe Stuttgart's Vision Show. The machine vision company has recently re-evaluated its target markets to be worth a collective $3.5 billion per year, with the upgraded logistics and 3D vision sub-sectors thought to be growing particularly rapidly.

With global investment in organic LED (OLED) production in something of a slump so far this year, machine vision specialist Cognex is looking to maintain its rapid recent expansion by turning its attention to growing opportunities in logistics and 3D vision applications.

Although the Natick, Massachusetts, firm posted another strong set of financial results for the opening quarter of 2018 - sales were up 22 per cent year-on-year - its CEO Robert Willett warned that the strong upturn that has characterized the past couple of years will hit a pause.

"Following a record year in 2017, we face tough comparisons this year, particularly in the second half, due to anticipated lower demand from consumer electronics - our largest industry vertical," Wilett said. "Because of that, we believe that Cognex revenue over the next nine months will be relatively flat in total with the comparable period in 2017."

Willett and company founder and chairman "Dr Bob" Shillman still expect Cognex sales to grow at an average rate of 20 per cent per year over the long term, but right now the firm is subject to the sudden swings in capital investment and capacity digestion that characterize the OLED sector.

Speaking at a J.P. Morgan investor conference in mid-May, Willett said that the "super-cycle" boom year of 2017 - when Cognex's annual sales soared 44 per cent – was largely the result of massive investment in production lines for new smart phone models. One of the major releases, Apple's iPhone X with OLED display, is currently in something of a production hiatus, pending an anticipated re-start when Apple and its key OLED supplier Samsung Display reach an agreement.

"It's a cycle rather than a trend," Willett said, adding that OLED manufacturing would still need plenty more machine vision equipment in the future as processes that are still relatively immature, complex, and wasteful are honed by key protagonists Samsung and LG Display, as well as emerging rivals in China.

In the meantime, the Cognex team is turning its focus on emerging applications in logistics. According to the firm's internal estimates for its served markets, this is a sector already worth $500 million, and growing fast. "We're

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Cognex eyes logistics and 3D vision as OLED boom softens

very bullish, and seeing huge demand," said the CEO, with the likes of Amazon driving business as it increasingly looks to automate "picking" processes with vision-enhanced robots.

Other key tasks include correctly identifying boxes for shipment of sensitive equipment by symbols on their packaging - one example being lithium ion batteries. "Vision is the enabling technology in these sales," said Willett, emphasizing that Cognex specialized in difficult applications that have enabled the company to differentiate itself and build up an enviable profit margin in the process.

Despite that focus on high-margin activity, another key trend is the falling cost of the technology, something that is helping to democratize the sector as forward-thinking customers in sectors such as food and drink, pharmaceuticals, and consumer goods begin adopting machine vision equipment.

The Cognex executives' recent re-evaluation of the company's served markets included a significant upgrade for the "3D vision" sub-sector, now seen to be worth an annual $400 million and an area where Willett is aiming for year-on-year sales growth of 50 per cent – albeit from a low base.

"The technology is driving growth, especially at the high end of the market," said Willett, noting the firm's 2016 acquisitions of Germany's EnShape and Spanish software firm AQSense as key elements in the 3D vision portfolio at Cognex.

With the logistics and 3D vision sectors now respectively contributing 10 per cent and 5 per cent of Cognex's sales revenues, both have been targeted to grow at a compound annual rate of 50 per cent. If that proves achievable, it should go a long way towards reducing the company's exposure to the more mercurial elements of the consumer electronics market.

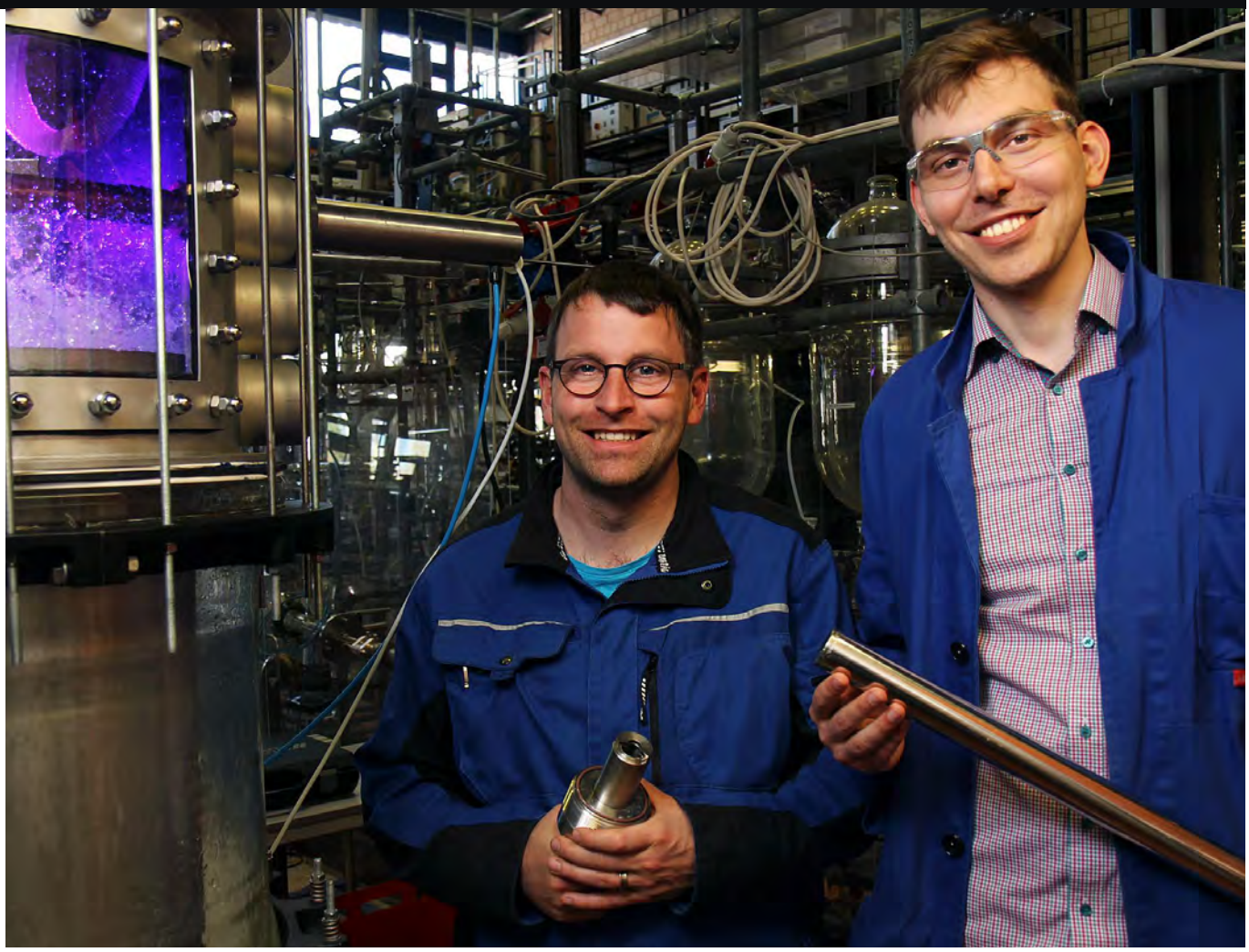
The other key sector being targeted is what the Cognex team identifies as mobile terminals, in other words handheld scanner units that are used to read barcodes and other symbols. Willett describes that particular part of the machine vision business as "ripe for disruption", and with its high-performance technology capable of performing scans from as far away as 30 feet, Cognex is planning to be the one doing the disrupting.

Also reckoned to be worth an annual $500 million as an individual target market, it contributes significantly to what Willett and Shillman have calculated to be an aggregate addressable market now worth some $3.5 billion per year. Having posted annual sales of $748 million in a "spectacular" 2017 - along with a pre-tax profit of $267 million - it looks like the company has plenty of headroom to grow, even if 2018 does prove to represent something of a pause year.

Mike Hatcher is Editor in Chief of optics.org

Camera system monitors distillation and cuts energy demands

Scientists at the Technical University of Kaiserslautern are developing a camera-based system to observe the fundamental process of chemical engineering with greater precision. *By Matthew Peach.*



Credit: TUK/Thomas Koziel (12)

Markus Lichti (left) and Jonas Schulz are developing the camera system to observe distillation.

In order to separate chemical mixtures into their single components, industry operators commonly carry out energy-intensive distillation, such as in crude oil refineries. Researchers at the Technische Universität Kaiserslautern (TUK) are developing a camera system that monitors this process.

The system measures whether there is a "high degree of droplet formation", which can negatively affect the separation of components. In the future, this technology could take countermeasures whenever the relevant measurement data change – and can also save energy.

The developers first presented the technology to attendees at ACHEMA, the exhibition on process technology in Frankfurt, Germany, on the research stand of the state of Rhineland-Palatinate (in mid- June, 2018).

During distillation, liquids are evaporated and then separated into their

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Camera system monitors distillation and cuts energy demands

constituents following the subsequent condensation of the vapour. A notable example can be found in the refining of crude oil, where the crude oil is separated into high-boiling heavy oil, diesel and petroleum, as well as into lower-boiling kerosenes or gasolines.

"This common procedure involves a high amount of energy consumption," said Jonas Schulz, who is examining this procedure as part of his doctoral studies at the chair of separation science and technology under Professor Dr. Hans-Jörg Bart.

In the United States alone, distillation is responsible for half of the energy costs associated with thermal separation processes in the chemical industry. This incurs costs in excess of $100 billion every year, note the TUK engineers.

Optical monitoring

The TUK team are developing a technology that will improve energy efficiency in the future. Their approach is based on a camera system that monitors the process. "Distillation in the chemical industry takes place in what are known as 'fractionating columns'," said Markus Lichti, who is also involved in the project.

"These columns are cylindrical installations that contain a series of distillation plates. These can be configured in a variety of ways, depending on the application, including plates with a sieve-like surface," he added.

Separation occurs as part of a continuous process in which vapor is produced at the very beginning by adding the corresponding mixture into the middle of the column. It runs downwards through the individual plates and is heated in the lower section of the column. It then rises to the top as vapor.

Mixture is regularly fed into the system to prevent the reaction from stopping. "In turn, the vapour heats the liquid, which then begins to boil and rise as vapour," added Schultz, while explaining the principle. "It then cools again and collects in liquid form on the next highest plate."

As a result, the constituents of the liquid that have a lower boiling point evaporate again and move up to the next distillation plate in the column. This process continues over several levels, until the liquid with the lowest boiling point has accumulated on the highest plate.

"Contamination occasionally occurs during distillation, since the liquid does not separate properly into the individual components," Lichti said. This can be caused by a range of different factors, such as a distinctly increased vapour flow, excessive pressure or insufficient liquid in the system.

It is possible for the liquid and vapour to mix on the plate to such a degree that the vapour carries away some of the droplets from the liquid phase. Experts refer to this as entrainment. The droplets move up to the next plate where they remain; in the refining of crude oil, for example, some of the heavy oil can accumulate with the diesel, thereby changing its chemical properties.

The camera system developed by the researchers at Kaiserslautern may provide a solution to this in the future. The camera is integrated into a probe – a stainless-steel tube – that protects it against the hot vapor. The probe is inserted into the fractionating column through an access slot.

This access slot resembles the principle of a drawer in which the probe is fixed in place. A glass plate allows the camera to look into the interior of the column. High-contrast images are enabled by means of lighting technology housed in another access slot directly opposite.

"Our system is designed in such a manner that these access slots can be positioned at different points of the fractionating column," explained Schulz. This enables the process to be examined from the edge or in the middle, for example.

Versatile software

"Using the images, we can see how large the droplets are and how quickly they form. Our technology allows us to measure parameters that could not be observed before. The camera is controlled by a software program that also analyses the images and thus detects entrainment.

Until now, there have not been any investigations into how this process occurs precisely. The data obtained give the researchers insight, for instance, into whether the parameters have to be configured differently for the distillation process.

In the future, says the team, the industry could use the software as part of an automatic control system that initiates countermeasures whenever the measurements deviate, as well as to save heating energy and reduce operating costs. In addition, the technology can save material – for example, if it shows that certain distillation plates are not necessary or their surface is not sufficiently fine.

About the research project

The work of the Kaiserslautern researchers, from the Faculty of Mechanical Engineering and Process Technology, forms part of the TERESA project (droplet formation and reduction in material exchange apparatus), funded by Germany's Federal Ministry for Economic Affairs and Energy. Besides the researchers of the TUK, the Ruhr-University Bochum, Braunschweig University of Technology and Helmholtz-Zentrum Dresden-Rossendorf are also participating in the project.

The following partners from industry are involved: HZDR Innovation GmbH and industrial companies Envimac Engineering, Falk & Thomas Engineering, Linde AG, Munters-Euroform, DencoHappel, Raschig, RVT Process Equipment and Horst Weyer und Partner.

Matthew Peach Contributing Editor to optics.org

Jabil Optics expands R&D resources

With the opening of 2000 square meter Optics Technology Innovation Center in Haifa, Israel.

Green Point, a division of Jabil Optics, has opened its new 2,000 square meter Optics Technology Innovation Center in Haifa, Israel. This development and manufacturing center is intended to provide the Israel tech community with additional opportunities in computational cameras, projection systems and combined solutions.

Irv Stein, VP of Jabil Optics, commented, "We're actively engaged in several global automotive opportunities to industrialize and bring to market advanced LiDAR solutions for mass-market adoption. By leveraging our cost-optimized hardware, global manufacturing expertise, and strategic partnerships, we can meet our customers' needs for dependable, high-quality products."

"We recognized the growing demand for premium optoelectronic solutions more than a decade ago, and sought to address it with the acquisition of the Carl Zeiss projections systems group. Our support for optoelectronics customers has been on a steady, upward trajectory since. Today, our services help to drive the market for mobile devices, AR/VR, automotive solutions and medical devices."

The new Jabil Optics facility – located in Matam Park, Haifa – meets the growing demands of Jabil customers looking for resources for complex assembly and integration of optoelectronic systems. Capabilities include optical design; development and manufacturing capabilities for camera modules; and projection systems.

These solutions are important assets for smartphones, tablets, e-readers and laptops as they prepare to serve mobile, virtual, augmented and extended reality products seeing rapid growth and adoption. The Center will also create leading-edge automotive products and solutions including advanced driver-assistance components, DMS systems, head-up display units and LiDAR systems.

Image: Paul Orlive / Jabil Optics.

Irv Stein, VP of Jabil Optics, in the new R&D facility in Halfa.

Automotive markets

"Jabil's advanced manufacturing and technology capabilities are enabling the automotive industry to develop increasingly complex electronics that improve safety, efficiency, intelligence and connectivity of all types of vehicles," said Chad Morley, VP, Jabil Automotive & Transportation.

"We're actively engaged in several global automotive opportunities to industrialize and bring to market advanced LiDAR solutions for mass-market adoption. By leveraging our cost-optimized hardware, global manufacturing expertise, and strategic partnerships, we can meet our customers' needs for dependable, high-quality products."

Jabil employs more than 600 people in Israel and expects this number to continue to grow in the future. One of the compelling incentives for Jabil Optics to locate its Innovation Center in Haifa was to access the strong stream of technology resources and talent in the surrounding area.

Evolution

Jabil's optics footprint initially began in the Optics Valley of Jena, Germany with the Carl Zeiss acquisition and expanded to include process development and materials science expertise located in Silicon Valley in the United States. Optics expertise was further bolstered by the acquisition of Kasalis, an active alignment automation leader located outside of Boston, Ma.

The company's strategy includes the participation of numerous ecosystem partners in Israel. As recently as July of 2017, Jabil entered into a strategic partnership with Israel-based eyeSight Technologies, to bring vision-based Driver Monitoring Systems (DMS) to market.

Gideon Shmuel, CEO of EyeSight, commented, "The Jabil/eyeSight partnership offers a complete 'design to manufacturing' platform solution, enabling Automakers and Tier 1's to accelerate time to market. EyeSight's award-winning software requires less processing power, allowing it to run on lower-cost, industry standard processors, and be easily integrated into existing ARM architectures. This complements Jabil's miniaturized optics and hardware solutions, which can be seamlessly integrated into any cockpit electronics or vehicle interior."

Matthew Peach Contributing Editor to optics.org

http://optics.org/news/9/5/28

Sponsored Editorial

New pco.panda 4.2 bi camera from sCMOS pioneer PCO, meets the highest standards

PCO sets new standards with the pco.panda 4.2 bi, the world's first back-illuminated sCMOS camera in an ultra-compact housing. This camera joins the successful line of scientific cameras manufactured by the Kelheim, Germany-based camera innovator that created the pco.panda 4.2 and pco.edge camera family.

PCO is one of the pioneers in sCMOS camera technology. The term sCMOS stands for scientific Complementary Metal Oxide Semiconductor. PCO has been co-developing sCMOS sensors with chip manufacturers for more than 10 years. In 2009, the company launched its first sCMOS camera. The latest highlight of this development is the pco.panda 4.2 bi. The abbreviation, bi, stands for back illuminated.

The "front" of the sensor is where the CMOS circuitry is located. Because this circuitry partially covers the surface of each pixel, a large portion of the pixel is blocked from collecting light. With bi technology, the light from the object passes through the lens and strikes the back side of the senor. Therefore, the light encounters no obstacles, so the full pixel area can be used for light collection. Exposure through the backside of the pco.panda 4.2 bi sensor results in a very high quantum efficiency of 95 %. This makes it particularly well-suited for low light microscopy applications.

(Copyright: PCO AG)

pco.panda 4.2 bi: PCO's high resolution back illuminated sCMOS camera.

The pco.panda 4.2 bi breaks with the notion that only an actively cooled sensor meets the highest standards of quantum efficiency and readout noise. In practical use, there are few differences between the two. This is proven by conducting tests in demanding microscopy applications where comparatively short exposure times are sufficient to provide excellent images.

Due to the omission of cooling it is also extremely compact, measuring only 65 x 65 x 65 mm^3. This makes the pco.panda 4.2 bi ideal for users who are looking for an uncomplicated and compact camera but want to avoid spending a fortune.

(Copyright: PCO AG)

pco.panda 4.2: revolutionary sCMOS technology in a compact design.

pco.panda 4.2 bi key features:

Resolution	2048 x 2048 pixel
Sensor format	13.3 x 13.3 mm^2
Pixel size	6.5 μm^2
Dynamic range	30000:1
Exposure time	10 µs – 5 s
Frame rate	max. 40/s @ full resolution
Interface	USB 3.1 with power supply via USB cable
Dimension	65 x 65 x 65 mm^3

The pco.panda 4.2 bi supplements the standard pco.panda 4.2 with its front-illuminated sensor, launched in 2017. The standard pco.panda 4.2 is less expensive than the bi, and suitable for many scientific applications where very high quantum efficiency is not required. The sharpness of the image is equal in both cameras. The pco.panda 4.2 bi and pco.panda 4.2 are mainly used in structured illumination microscopy (SIM), localization microscopy (PALM, STORM, dSTORM, GSD ...) and a wide range of other microscopy and life science applications.

(Copyright: PCO AG)

Dr. Gerhard Holst, Head of Research at PCO.

We spoke to Dr. Gerhard Holst, Head of Research at PCO, on the new pco.panda 4.2 bi:

Last year, PCO introduced the pco.panda 4.2 with front-illuminated sensor. Now the back-illuminated version follows: the pco.panda 4.2 bi. What are the noticeable differences between the two in application?

"The bi-variant with back exposure has a higher quantum efficiency of more than 95 %, because more usable area is available on the pixels from the back. It is intended for users with high demands, for example in microscopy with low light quantities. For sensitive applications in daily lab routine, however, the variant with a front-illuminated sensor is sufficient."

The camera system has no cooling. Does the image quality suffer?

"Differences exist mainly in the data sheets. The pco.panda 4.2 bi has a readout noise of 1.8 electrons, which would be 1.4 if cooled. This only affects very long exposure times. We investigated this with users and they did not notice any difference to cooled chip recordings. There is also a trend to achieve good results with simple means. The pco.panda 4.2 bi puts the cherry on the cake."

So there will be no cooled pco.panda 4.2 bi?

"We have further variants with the imaging sensor of pco.panda 4.2 bi in the works, which are also intended for absolute high-end applications. Just wait and see!"

Corporate profile

PCO is a leading specialist and Pioneer in Cameras and Optoelectronics with more than 30 years of expert knowledge and experience developing and manufacturing high-end imaging systems. The company's cutting edge sCMOS and high-speed cameras are used in scientific and industrial research, automotive testing, quality control, metrology and a large variety of other applications worldwide.

Further info can be found on the official website at **www.pco.de**.

FLIR fined $30M under ITAR rules

Half of fine suspended pending remedial compliance measures related to historic exports of thermal cameras.

Infrared imaging company FLIR Systems has been fined $30 million to settle US government allegations that it violated International Traffic in Arms Regulation (ITAR) rules.

While half the fine has been suspended in exchange for continued remedial measures by the company, FLIR will pay an initial $1 million within ten days, plus an annual $3.5 million in each of the next four years.

The fine comes more than three years after FLIR first contacted the US Department of State office that deals with ITAR regulations about the potential violations.

Fully aligned

Revealing FLIR's agreement with the US government department, CEO Jim Cannon told an investor conference call discussing the firm's latest financial quarter:

"This agreement is the result of a long review process, where we co-operated fully and have devoted considerable time and expense to improve our compliance processes. The bigger picture here is that we're fully aligned with the US government in achieving its policy objectives, including the most important one - and that is protecting the lives of the US war fighter."

According to the Department of State's Directorate of Defense Trade Controls (DDTC) statement on the matter, the allegations relate to the transfer of ITAR-restricted equipment to dual national employees of Iran, Iraq, Lebanon and Cuba - all of which are banned from receiving US arms exports under ITAR rules.

Photo: FLIR Systems.

FLIR CEO James Cannon has just signed a contract extension with the infrared imaging firm that ties him to the company through April 2022.

As per details in the DDTC's proposed charging letter, the alleged violations relate to unauthorized exports to employees at 22 of the company's non-US facilities, including FLIR AB in Sweden, that were subsequently re-exported.

One example of the hardware involved was FLIR's "THV-3000" multi-sensor thermal imaging system, with the period under investigation extending back a decade.

Asked about the ITAR agreement in the investor call, the CEO re-iterated that the company had exactly the same policy as the State Department when it comes to protecting the US military, adding that there would be two external audits carried out over the next four years, overseen by a special compliance official.

Happy 40th

Despite those revelations, Cannon said he was happy with the start to 2018, with solid growth across the company's product portfolio and improved profitability as FLIR marked its 40th anniversary in March.

Cannon, who has just signed a contract extension to remain CEO through April 2022, attributed that in part to his decision to focus the company around three business units – industrial, government and defense, and commercial. Those replaced six previous application-focused segments.

"With these record first quarter results, we are off to a great start to 2018," Cannon said. "Our top line grew 13 per cent organically while our adjusted earnings per share grew 33 per cent. All three of our business units had double-digit organic revenue growth and we saw significant operating leverage with this growth."

The Point Grey Research machine vision business, acquired by FLIR in late 2016 for around $250 million, appears to be performing particularly well.

"The business grew organically at a rapid clip through the year last year," said Cannon. "We built strong backlog [and] the business continues to improve. We're very enthusiastic about the machine vision space."

FLIR's executives are looking to double the unit's production rates in time, partly by applying the company's "FLIR Method" approaches to productivity improvements.

With sales rising to $440 million in the quarter, the FLIR team has decided to raise its expectations for full-year sales slightly. Cannon and colleagues have now pencilled in a revenue target of between $1.76 billion-$1.79 billion.

- *FLIR's stock price suffered no ill effects relating to the DDTC consent agreement, trading slightly higher following the results announcement to just over $52 on the Nasdaq exchange – equivalent to a market capitalization of around $7.3 billion.*

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http://optics.org/news/9/4/44

Display Week showcases AR breakthroughs and more

55th edition of LA's screen-fest also celebrates the half-century of liquid crystal displays.

The 55th edition of Display week was presented by the Society for Information Display (SID), at the Los Angeles Convention Center in California.

Image: SID.

Display Week is the world's leading event focused on emerging electronic display technologies.

Display Week is the world's leading event focused on emerging electronic display technologies, attracting attendees from the entire ecosystem of R&D, engineering, design, manufacturing, as well as commercial and consumer end-user markets.

Here, optics.org reports on certain highlights from some of the show's larger exhibitors.

Schott's RealView glass wafers 'bring AR to life'

Schott is unveiling its RealView system, which it describes as "a breakthrough in high-index glass wafers". The glass development enables more immersive augmented reality applications, claims the specialist glass-making giant.

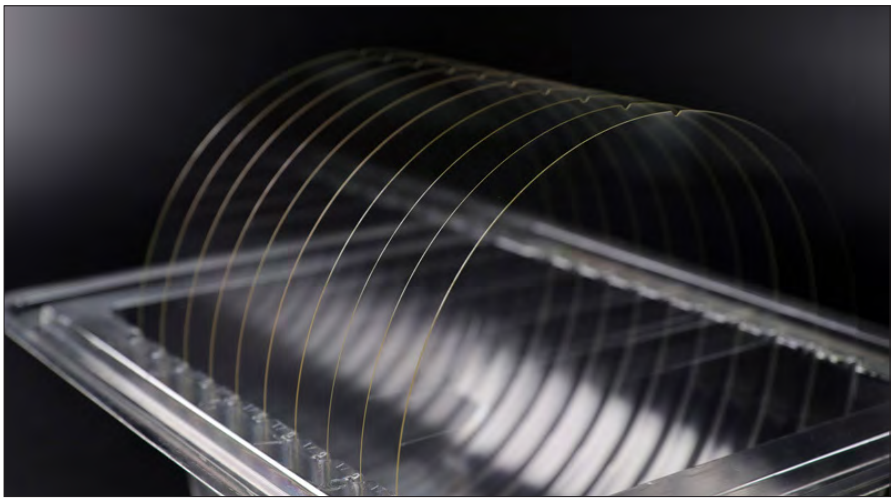

Image: Schott.

Schott's RealView development enables more immersive augmented reality applications.

The new wafers are made from optical glass with a high refractive index, enabling a wider field of view in AR devices. The geometrical precision of the wafer surface enables what Schott calls "superior picture quality with the best contrast and highest definition, enhancing the user experience."

RealView doubles the total internal reflection angle compared to conventional glass wafers. Schott says this development gives AR device manufacturers the first opportunity to expand the FOV almost to the limit of human peripheral vision.

The company produces the raw glass in its high-tech melting facilities in Germany, and the wafer manufacturing and optical coating takes place in China, where Schott recently announced a joint venture investment together with Zhejiang Crystal-Optech.

"Augmented reality should still look like reality," said Dr. Rüdiger Sprengard, VP and Head of Augmented Reality. "To raise the bar and meet the requirements of this rapidly expanding market, manufacturers need superior optical wafers with qualities a full order of magnitude greater than what has previously appeared on the market."

Corning's advanced glasses

Another big name in glass-making, Corning is exhibiting its advanced glass portfolio at Display Week. Applications include large-size LCD TVs, OLED illuminated mobile phones, and yet more immersive augmented reality devices.

"We are leveraging Corning's core technologies and our manufacturing and engineering expertise to drive the next wave of display innovations," said Chris Hudson, international division VP and commercial director. "Today, the

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Display Week showcases AR breakthroughs and more

display industry is witnessing a shift to the next generation of devices, and Corning is excited to be at the forefront of this continued evolution." Some of the technologies displayed by Corning included:

- Lotus NXT Glass: enhances the design and manufacture of high-performance displays, and is optimized for the expanding LTPS-LCD and LTPS-OLED industries.
- Gorilla Glass: the cover glass of choice for more than 40 major OEMs, which is featured on billions of consumer electronic devices.
- Augmented Reality Solutions: enabling cutting-edge augmented reality/mixed reality devices. Corning offers a reliable supply of high-index glasses, polymers, automated laser glass-cutting, and characterization tools.
- Iris Glass: is a glass light-guide plate for edge-lit LCD TVs and monitors. Due to its intrinsic rigidity and dimensional stability, it allows manufacturers to reduce thickness, increase brightness, and design sets with slimmer bezels.

Also during Display Week, experts from Corning were set to make presentations at the 2018 SID/DSCC Business Conference, the Display Week Symposium, and SID's LCD 50th Anniversary Celebration (see below).

DigiLens presents 2-layer AR display for HUDs

Hot on the heels of a $25 million Series C fundraising round, AR-VR solutions developer DigiLens is introducing a new waveguide eyeglass display for AR apps. The system is constructed from only two inkjet coated grating layers. The company states, "It's thinner, lighter, brighter, and significantly lower in cost."

Image: Corning.

Gorilla Glass: the cover glass of choice for more than 40 major OEMs.

The DigiLens MonoHUD is intended for smart helmet applications now being developed across the industry. The MonoHUD provides motorcycle and bike riders with distraction-free content directly in their line of sight, so they can keep their eyes focused on the road ahead.

It enables variables such as speed, gear change, fuel and oil level status to be monitored, along with maps, real-time accident warnings, music and other non-distractive smartphone applications—all without riders needing to take their eyes off the road. In addition to the new two-layer display that replaces the previous three-layer design, DigiLens has started using a new inkjet coating manufacturing process with significantly increased throughput.

"The increased quality of the two-layer display and the reduction in manufacturing complexity is crucial for our customers," said DigiLens CEO Chris Pickett. "It lowers the production costs and allows them to get product to market quicker. We are already seeing several innovative use cases like motorcycle HUDs and are seeking developers to show us what's next."

Young Optics, a leading display manufacturer, is one of the first to license the DigiLens MonoHUD, and will soon be supplying it at high volume. Sena, an industry leader in Bluetooth communications for motorcycle and action sports, is working with Young Optics to integrate the DigiLens display and its communication system into helmets to allow riders to view their phone and dash information through the display.

50 years of LCD displays

Display Week organizer Society for Information Display announced that this year's event would have a special event celebrating 50 years of the liquid crystal display. A SID release stated, "LCDs are currently a US$100-plus billion industry, ubiquitous in everyday products such as TVs, smartphones and computer monitors, and being designed into indoor signage and AR/VR systems – to name a few."

On Tuesday afternoon, May 22nd, SID hosted an exclusive event entitled "Pioneering the Trail to Today: 50 Years of LCD Innovations", featuring brief talks from industry leaders illuminating the past, present and exciting future of LCD technology.

Matthew Peach Contributing Editor to optics.org

http://optics.org/news/9/5/26

Image: DigiLens.

DigiLens' MonoHUD waveguide eyeglass display for AR applications. The new DigiLens MonoHUD waveguide eyeglass display for AR applications is constructed from only two inkjet coated grating layers. It's now thinner, lighter, brighter, and significantly lower in cost.

DCS 2018:

Hyperspectral imaging offers early diagnosis of plant diseases

HSI developer HinaLea reports success in maximising agricultural yields with handheld camera. *By Matthew Peach in Orlando*

Hyperspectral imaging systems offer the agricultural sector the ability not only to monitor plant health, but also to detect potential plant pathogens. The impact of chemical contaminants and fungal, viral, and bacterial pathogens ranges from moderate to severe but can result in complete crop losses for major commodities such as corn, wheat, and soybeans world-wide.

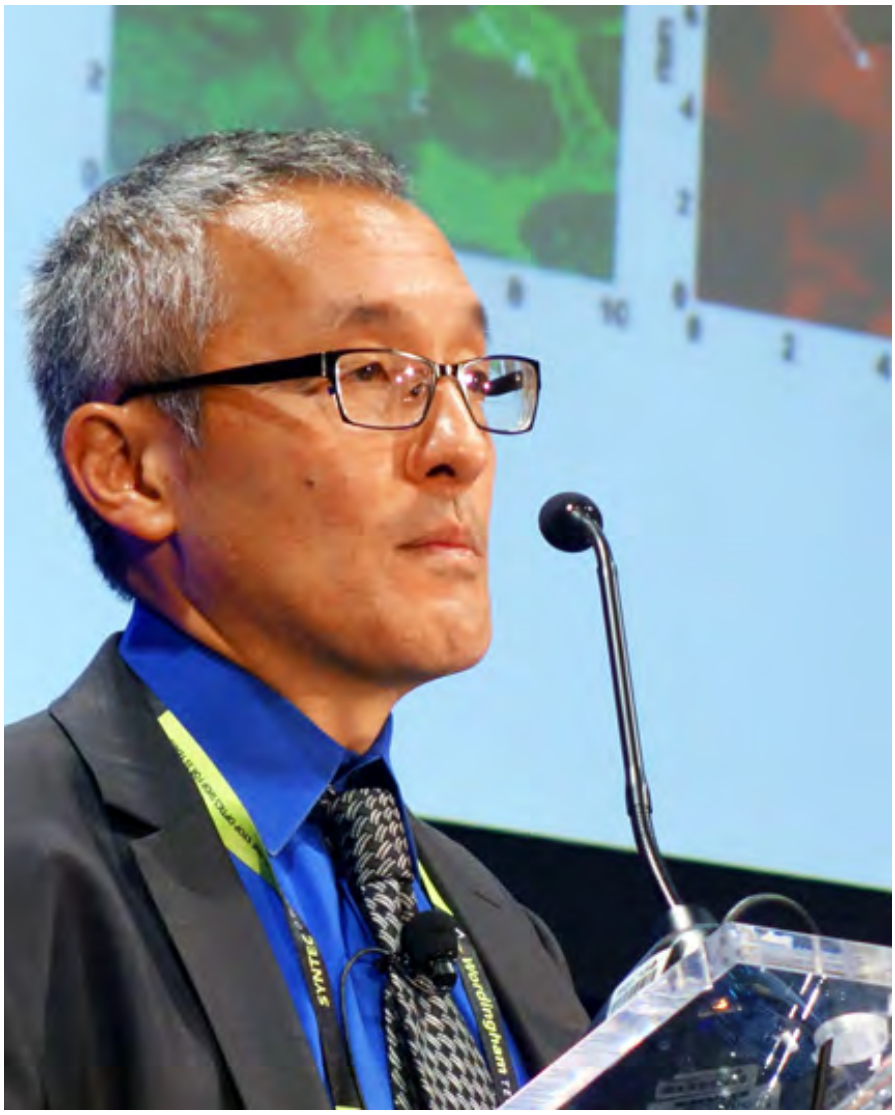

Photo: Matthew Peach, optics.org

Alexandre Fong, Director of Hyperspectral Imaging, at HinaLea Imaging.

In an industry presentation session during SPIE's Defense + Commercial Sensing, Alexandre Fong, Director of Hyperspectral Imaging, at the company HinaLea Imaging, explained how his company's systems use spectral imaging to achieve precision agricultural management.

Only one month ago, as reported by optics.org, TruTag Technologies, a developer of product authentication and brand security solutions, announced the launch of its HinaLea Imaging business unit.

Fong told the audience, "Our new, dynamically adjustable hyperspectral imaging technique allows early identification and prevention of spread of a range of diseases to enable early treatment and cut crop losses."

'Higher resolution'

"Hyperspectral imaging offers a higher spectral resolution than multispectral imaging, which captures both spectral and spatial information of the imaged object. In hyperspectral, each individual pixel captures a high-res spectrum."

"It works by imaging narrow spectral

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DCS 2018: Hyperspectral imaging offers early diagnosis of plant diseases

bands over a continuous spectral range, and produces the spectra of all pixels in the scene. Hyperspectral sensors collect information as a set of images, which are then processed to form a hyperspectral data cube for processing and analysis."

Image: HinaLea

Don't leave me this way: HinaLea's 4100H hyperspectral camera.

HinaLea's HSI system was originally developed to image and read the company's proprietary microscopic edible optical barcodes. It is powered by a patented tunable Fabry-Perot technology. Fong told the conference, "These tunable filters can achieve nanometer-range alignment in a rapid and cost-effective system in a handheld, battery-operated camera arrangement."

HSI camera shown at D+CS

He went on to describe how HinaLea's hyperspectral approach has been effective in assessing real-world plant diseases such as: Soybean Frogeye Leaf Spot, a fungal infection affecting southern states of the USA, which has caused crop losses as high 30% annually; and Maize Streak Virus, an insect-borne disease that causes crop losses as high as 100% in sub-Saharan Africa and Asia. "HSI can also identify and distinguish herbicide drift exposure, which can otherwise be mistaken for disease," he added.

HinaLea presented its fully autonomous high-resolution Model 4100H hyperspectral camera at this expo. The model has a built-in illumination source that captures high-resolution snap-shot images, yielding a spectrum at each pixel for the visible-to-NIR (400 – 1000 nm) wavelength range in up to 550 bands.

Matthew Peach Contributing Editor to optics.org

http://optics.org/news/9/4/30

SPIE Photonics Europe:
Harvard student tops AR/VR design challenge

Zhujun Shi awarded top score for her presentation on metamaterial-based waveguide displays.

Students Zhujun Shi from Harvard University, David Dunn from the University of North Carolina, Chapel Hill, and Ori Avayu of Tel Aviv University, have won first prizes and €5000 each at the inaugural SPIE Optical Design Competition, held April 25 during the SPIE Photonics Europe event in Strasbourg, France.

In all, nine students walked away with prizes from the event, dedicated to optical developments for augmented, virtual, and mixed reality (AR/VR/MR) applications. Shi, a member of Federico Capasso's research group at Harvard, claimed the top score in the competition, for her presentation on the potential for metamaterials to improve the AR/VR experience.

Metamaterial advantage

Entitled "Wide field-of-view waveguide displays enabled by polarization-dependent metagratings", Shi's presentation showed how components based on the new class of optical materials can deliver high-quality images - alongside possibilities for additional degrees of freedom in polarization manipulation, and a smaller form factor than traditional liquid crystal lenses.

The competition is the brainchild of Microsoft's chief optical architect, Bernard Kress, and was judged by representatives from a "who's who" of the AR/VR sector – including, among others, Google, Huawei, Facebook-owned Oculus, Nvidia, Zeiss, and Jenoptik.

Describing the competition as an "amazing experience", Kress added. "Its success was due to the quality of the student designs entries aimed at solving practical industrial problems in the exciting fields of VR and AR, and also to the commitment of the industrial sponsors."

He also praised SPIE's role in the event's organization, particularly for finding a way to bring students and pioneering industrial technology companies together, to solve real problems with cutting-edge optics.

"I was very glad to see student entries from all over the world, including Europe, China, the Middle East, US and Russia," Kress continued. "Also, the impressive number of female optical engineers participating in the challenge - with the first prize going to a female researcher - was very uplifting, and shows that new exciting research fields such as VR and AR have the power to attract a very diverse, inclusive and excelling group of optical engineering students.

"Eventually, such exciting new initiatives have the power to transform the gender representation and revolutionize the traditional field of optics and photonics."

Conference debut

The competition formed part of the "Digital Optics for Immersive Displays" conference. Held for the first time at SPIE Photonics Europe this year, it proved to be one of the best-attended conference strands at the event.

Intended to help students to bridge the gap between traditional optical design and tangible industry expectations for contemporary immersive display products, it featured two rapid-fire "pitch" sessions to the judging panel.

Second prizes of €2500 went to Miaomiao Xu from the University of Arizona, Shuaishuai Zhu from China's Harbin Institute of Technology, and Simon Thiele from the University of Stuttgart.

Third-place winners Bharathwaj Narasimhan from VR optics developer Limbak, Stan Larroque,from mixed reality firm SL Process, and Austin Wilson from the University of Arizona each won Nvidia Titan X Graphics cards.

The prizes, together worth more than €50,000, were contributed by heavy-hitting "Big Tech" sponsors including Google, Microsoft, Facebook/Oculus, Huawei Technologies, Leia, and Amazon, alongside optics industry firms Jenoptik, LightTrans, Zeiss, and Zemax, and semiconductor industry giants Synopsys, Applied Materials, Lambda, and Nvidia.

Prizes were awarded by a group of local Strasbourg dignitaries representing the "Eurometropolis" cross-border co-operative group, and the French Tech Alsace technology transfer organization.

Photo: SPIE/Philippe Stirnweiss.

Top marks in the inaugural SPIE Optical Design Competition: VR, AR, MR, part of this week's Photonics Europe event, went to Harvard University's Zhujun Shi - pictured here third from the left, in the front row. Nine students won €50,000 worth of prizes at the event, which was sponsored by some of the biggest names in Silicon Valley and the optics industry.

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http://optics.org/news/9/4/46

DCS 2018:
Lockheed Martin develops dual-band IR camera core

Defense giant's Santa Barbara facility claims "industry's first" mid- and short-wave IR camera in footprint of single-band sensor. *By Matthew Peach in Orlando*

Making its debut at SPIE's Defense + Commercial Sensing, Lockheed Martin's new µLAD SW/MW IR camera core is specified "to bring big-sensor cooled performance to tiny platforms".

Driven by LM Santa Barbara Focalplane's large format, small-pixel nBn detector technology, the µLAD runs at high operating temperatures (140K compared with the 77K typical of these cooled devices), resulting in a compact, portable package, which could be integrated in portable devices or fitted onto a UAV.

Applications include: "pilotage (navigation), threat warning and targeting. This camera brings big-platform sensor performance to tiny platforms," says Lockheed Martin's launch statement.

Simultaneous collection

Brendan McCay, the camera's developer and Program Manager at LM's Santa Barbara Focalplane facility, told optics.org: "The camera's sensor toggles between the mid-infrared and a combination of visible through shortwave-infrared at a rapid frame rate of 360Hz. So it achieves simultaneous collection."

"The typical use of this camera would be in night vision and in degraded environments such as fog. It can also pick up the short wave ID tags used by military personnel in the field."

Photo: Paul Sudlow, Lockheed Martin.

Seeing double: Lockheed Martin's Brendan McCay with camera and dual images.

The camera is designed for military applications that demand reliable performance in a low size, weight, power and cost configuration. These range from missile seekers, weapon sights and remote weapon stations to small gimbal or gimbal-less platforms and tactical air and land sensor systems for OEM and military unmanned aerial vehicles. Other applications include hand-held, man-portable missions, missile warning and threat detection systems and electro-optical payloads.

McCay is confident that this device will also perform well commercially. "There's only one other manufacturer of a dual-band mid-range and visible-to-SWIR camera and that is analog rather than digital. Also our high frame rate of 360Hz allows some cool capabilities such as bullet tracking, to identify the origin of hostile fire."

Camera system specifications

This dual-band µLAD camera core delivers high-definition SW/MW IR imagery at 1280-by-1024 pixels (1.3 megapixels) with the same high-speed digital output as a single-band MWIR offering. Other key specifications include:

- ROIC: 13-bit digital high speed up to 10 Gbps
- Detector: High operating temperature, full MWIR nBn, high MTF, 100% fill factor
- Resolution: 1280 × 1024 pixels (1.3 megapixels); can window to smaller regions
- Pixel pitch: 8 µm
- Integration time: <0.1 µs to 200s
- F#: 2.3
- Command and control: RS-422 serial interface over camera link
- Cooler: Stirling split linear closed-cycle
- Input voltage: 5V and 12V, 12W steady state

Matthew Peach Contributing Editor to optics.org

http://optics.org/news/9/4/32

Images: Lockheed Martin.

Stepping up to the plate: Lockheed Martin's new µLAD dual-band IR camera core offers two high-speed, high-resolution sensors in one compact package. Short-wave IR imagery (left) is suitable for laser indicators and pilotage in maritime environments, while mid-wave IR imagery (right) readily supports such functions as night pilotage.

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