

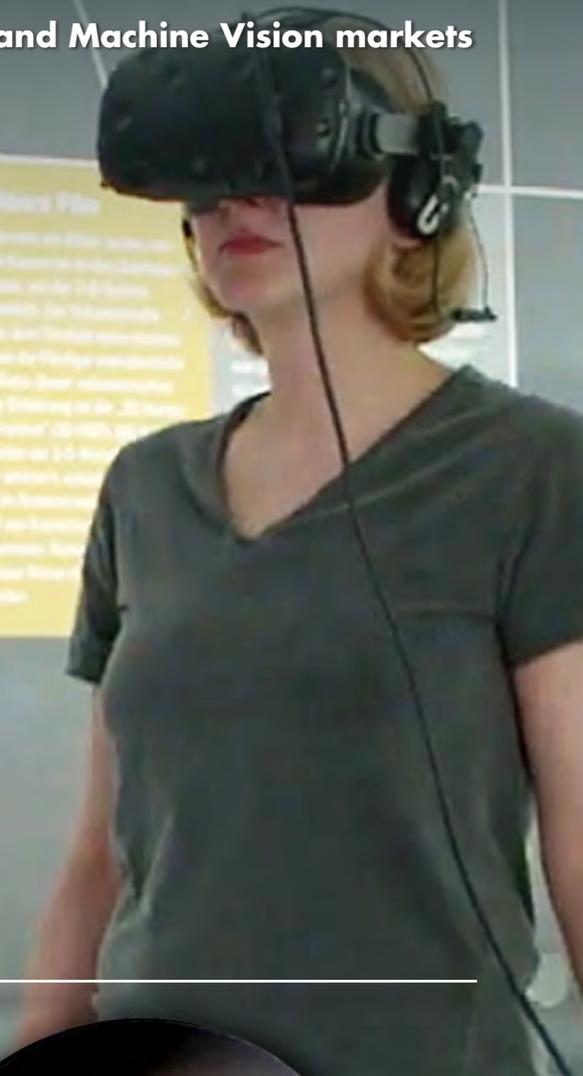
VISION

focus

Delivering the latest news from the Imaging and Machine Vision markets



Der beliebteste Film
In den vergangenen 24 Stunden wurde
das American Idol Finale über 1,2 Billionen
Mal angeschaut. Und das ist nur ein
Beispiel für die Macht der Virtualität.
Forscher aus dem Bereich der künstlichen
Intelligenz haben die Möglichkeit entwickelt,
Tiefenprofile von 3D-Objekten zu erstellen.
Diese können dann in 3D-Modellen
umgewandelt werden. Die Forscher haben
ein Computer-System entwickelt, das
Schichten in 3D-Modellen erkennt und
sie in 3D-Modellen umwandelt. Das
System ist in der Lage, die 3D-Modelle
in 3D-Modellen umzuwandeln.



**Realistic people for
virtual worlds**

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A LASER for everything and everybody

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 **LASER World of Photonics 2019** ("LASER"), Europe's largest laser exhibition and technical conference.

Following is a taster of some of this issue's key features.

Virtual worlds as depicted in the latest AR-VR systems can already seem very realistic. But often the simulated human figures moving in them not so much. Now a team from the Fraunhofer Institute for Telecommunications, HHI, Berlin, have developed a new technology enabling more lifelike people to be integrated into virtual worlds. For this achievement, they have been awarded this year's Joseph von Fraunhofer Prize (page 4).

Infineon Technologies' REAL3 time-of-flight image sensors were among the winners at the latest Embedded Vision Summit, claiming the prize for "best sensor" at the annual event in California (page 6).

Stemmer Imaging is expanding with acquisition of Spain's Infaimon machine vision firm. The US firm, which is paying tens of millions of euros for this acquisition, is now represented in all European markets (page 8).

A new market survey has revealed that the North American machine market grew by 10% in 2018. The analysis by AIA reveals record sales of \$2.87 billion, last year, an increase of 9.2 percent over 2017 and a new record for the market. (page 9).

Cognex is forecasting a sales dip amid consumer electronics slowdown. The machine vision equipment specialist is expecting full-year sales in 2019 to decline on last year's result, largely because of a slowdown in demand from the consumer electronics sector.

SRI International has joined a University of Washington project to improve scanning and ease of use in investigating eye diseases in children and infants. Exact positioning of such instruments is needed and some form of hand-held OCT is essential (page 13).

An orbiting telescope has spied the first Earth-sized exoplanet. Now NASA's Transiting Exoplanet Survey Satellite (TESS), launched almost exactly a year ago, has for the first time spotted an Earth-sized world orbiting a distant star (page 16).

Plus we showcase the latest product launches from across the industry, many of which you will be able to see in Munich. We extend an invitation to all visitors to LASER to come and meet the optics.org team in Hall B2 on Booth 118 (*SPIE and optics.org combined*).

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 - Hyperspectral imaging and metasurfaces combined for novel biosensing platform
- plus the latest product launches from within the industry*

Publication and Editorial Schedule 2019/20

Autumn Issue 2019

- Bonus Distribution: **EMVA Embedded Vision Forum Europe**,
- **Editorial Focus:** opto-electronic systems, applications in sensing and manufacturing.
- Published in advance of EMVA Embedded Vision Europe, 24th – 25th October 2019

Winter Issue 2020

- Bonus Distribution: **SPIE BiOS, Photonics West, SPIE Medical Imaging**
- **Editorial Focus:** industrial applications, sensing, biomedical analysis and treatments.
- Published in advance of BiOS, 2nd - 3rd Feb, Photonics West, 4th Feb - 6th Feb, SPIE Medical Imaging, February 2020

Spring Issue 2020

- Bonus Distribution: **SPIE Defense+Commercial Sensing, CONTROL, Stuttgart**
- **Editorial Focus:** aerospace and defense applications, associated research and development
- Published in advance of DCS 2020 (*Defence & Commercial Sensing*), 28th – 30th April 2020

Summer Issue 2020

- Bonus Distribution: **Astronomical Telescopes + Instrumentation**
- **Editorial Focus:** optical components, academic research, software applications.
- Published in advance of Astronomical Telescopes + Instrumentation, 14th – 19th June 2020

Realistic people for virtual worlds

Fraunhofer HHI creates prizewinning 'movie as a true experience' 3D Human Body Reconstruction technology for integration into VR AR projections. *By Matthew Peach*

Virtual worlds as often pictured in AR-VR systems can already seem very realistic. But often the simulated human figures moving in them not so much. Ingo Feldmann, Dr. Oliver Schreer and Peter Kauff from the Fraunhofer Institute for Telecommunications, Heinrich Hertz Institute HHI, in Berlin, Germany, have now been recognized for developing a new technology with which lifelike people can be integrated into virtual worlds. For this achievement, they have been awarded this year's Joseph von Fraunhofer Prize, announced in May, 2019.



© Fraunhofer / Piotr Banczerowski

Winning team of the Fraunhofer Institute for Telecommunications, Heinrich Hertz Institute, HHI (f.l.t.r): Dr. Oliver Schreer, Peter Kauff and Ingo Feldmann.

In conventional movies, the movement of the camera is predetermined: while watching, the viewer is following the camera. This, however, is different in a

film that a viewer can step into. In this case, the viewer is completely immersed in the film scene: when wearing VR glasses, viewers can let their gaze wander

as they wish, dive into the action and circle around the actors. Nevertheless, no matter how realistic the surroundings appear in the virtual world, the people, as conventionally designed and projected, still appear artificial and their movements seem unnatural. Also textures – for example, the way the fabric of a sweater is woven, beard stubbles or birthmarks on the skin – are still far from realistic. Until this latest development.

Feldmann, Schreer and Kauff have together developed a novel technology that solves these issues, claims the HHI. "We are now able to integrate real people into the VR environment who then appear lifelike and move in the artificial world just as smoothly and naturally as they would in the real world," commented Ingo Feldmann, group leader at Fraunhofer HHI. "The texture also appears lifelike to the viewer."

This new capability resulted in the three developers being awarded this year's Joseph von Fraunhofer Prize for their development of the so called "3D Human Body Reconstruction" technology.

So how have they achieved this advance? The researchers film the real, human actors with 32 cameras, each camera capable of recording "ten times HD". These cameras are combined into pairs and optimally distributed in the studio, which is situated in a large circular enclosed space. The cameras record up to 30 images per second and from these data a dedicated software package calculates the corresponding depth information.

In effect, it calculates how far away each part of a body is from the camera on the respective shot. It then fuses the data of the individual camera pairs with each other. The result is a lifelike three-dimensional image of the person and their movements. Feldmann added, "This three-dimensional model is then directly integrated into the virtual world simulation, incorporating all the movements the person performs. Until now, people were scanned statically and their movements were then animated on the computer."

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Realistic people for virtual worlds

Studio Babelsberg spin-off

In October 2017, researchers from Fraunhofer HHI built its first prototype to optimally capture images of people and their movements. Then in the summer of 2018, they also set up a studio at the Babelsberg films studios in Berlin. Here, external clients can have their images

digitized and can also book additional video production services and more. The production company Volucap GmbH was founded in conjunction with Studio Babelsberg, ARRI, Interlake and UFA.

The team gives a simple explanation of why this development was needed and what it is for today: "Wherever authenticity is required."

The researchers at Fraunhofer HHI say they also want to use the technology in other areas in the future. Possible scenarios include: In the case of difficult medical operations, an expert could call



© Fraunhofer / Piotr Banczerowski

With the technology of the Fraunhofer scientists, lifelike people can be integrated into virtual worlds.

in VR, see the patient in real time and provide assistance. Also, a realistic avatar of a popular soccer player could visit a fan at home before a Champions League game. The only limitation is a potential client's imagination.

"Essentially, our technology can be used wherever authenticity is needed – for example, people from society and media, but also for training and further education," explained Kauff, who has a keen eye on the commercial exploitation of the technology. His colleague Oliver Schreer, who developed the algorithms together with Feldmann, added: "Our technology is opening a door to a huge new field of application – it remains to be seen exactly where it will go."

About the JvF Awards

Since 1978, the Fraunhofer-Gesellschaft has annually awarded prizes for outstanding scientific achievements by its employees that have the potential to significantly "help solve societal challenges and safeguard the future of Germany as a business location." To date, more than 300 researchers have won the award. This year, four prizes were awarded, each worth €50,000.

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Infineon's sensor bags award at Embedded Vision Summit

Infineon Technologies' "REAL3" time-of-flight image sensors were among the winners at last month's Embedded Vision Summit, claiming the prize for "best sensor" at the annual event in Santa Clara, California.

More specifically, the German chip firm's "IRS2381C" device – designed for consumer electronics applications and tailored for sensitivity to 940nm light – is said to be the perfect fit for miniature 3D camera designs, featuring in both rear and front smart phone camera modules.

Philipp von Schierstaedt, general manager for Infineon's RF and sensors business unit, said in response that the near-infrared detector delivered a "new level" of 3D camera capabilities for mobile device applications. "Infineon's REAL3 3D image sensor is highly sunlight robust and supports wide measurement ranges," he added. "Thus, it enables a unique user's experience in secure face-authentication, computational photography, and seamless augmented reality applications."

Developed in tandem with partners at the fabless chip design firm pmdtechnologies, the IRS2381C is already in mass production. Infineon explains that the performance in varying light conditions results from its patented "suppression of background illumination" (SBI) circuitry, which features in every pixel that makes up the sensor.

"SBI enables a pixel-fine expansion of the dynamic range by up to a factor of 20, and as such avoiding early saturation of the pixels in strong sunlight," adds the firm of the imager, which measures less than 5 mm along each side and features a 14 micron pixel pitch.

Crucially, the time-of-flight approach directly measures both depth and amplitude information in every pixel while using only one infrared source. Modulated infrared light is directed at the entire scene, and the reflected light is captured by the imager. By measuring the phase difference between the emitted and received light, as well as the amplitude values, highly reliable distance information and a greyscale picture can be generated.

In February this year, Infineon released the fourth and latest version of the "REAL3" family at the giant Mobile World Congress event in Barcelona. The IRS2771C device adds higher resolution to the offering, with its 448 x 336 pixel output said to be four times better than

most other time-of-flight sensors currently on the market.

Among the other winners at the Embedded Vision Summit were Morpho's computational photography algorithm, Intel's "OpenVINO" developer toolkit, and "EV6x" embedded vision processors from Synopsys.

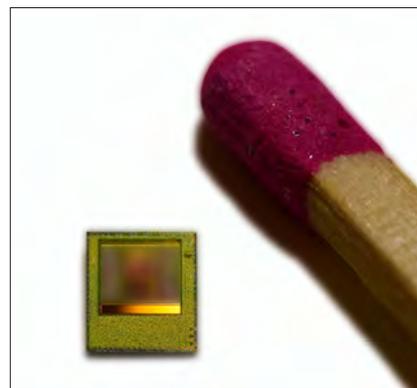


Image: Infineon Technologies.

Infineon's "REAL3" family of 3D image sensor chips are all based on time-of-flight technology. Infineon says that this enables the world's smallest camera module for integration in smart phones, with a footprint of less than 12 mm x 8 mm. The German firm won "best sensor" at the recent Embedded Vision Summit in Santa Clara.

Not surprisingly, this year's event featured plenty of talks from local chip giant Intel. Among them was a technical insight presentation by software engineering manager Ilya Krylov covering a new neural network developed specifically for embedded vision. Said to be fast and accurate, "RMNet" is designed to achieve a balance between performance and speed of operation. It is being aimed at applications in both consumer electronics and automated driving – for example pedestrian, vehicle, and bicycle detection.

Autonomous driving dominated the Santa Clara event's business insights track of presentations, with Burkhard Huhnke,

Synopsys' VP of automotive strategy, telling attendees that achieving robust designs with the very low failure rates essential for safe driving had proved more difficult than expected. His view is that collaboration between suppliers in the self-driving ecosystem will ultimately provide the necessary combination of volume, cost, performance, and reliability.

Intel was also well represented during the "enabling technologies" track, with director of marketing Gary Brown discussing the combination of artificial intelligence (AI) and machine vision using the chip firm's "Movidius" vision processor unit. "We are ushering in a new era of AI cameras to truly assist people in what we do at home and at work every day," wrote Brown in his presentation abstract, also noting potential applications in industrial automation and "visual retail cameras" for future automated shopping.

Also taking part in that session was Takeo Miyazawa, founder and CEO of the intriguing startup Magik Eye. Previously at white-light optical scanner firm CogniTens before it was acquired by Hexagon Metrology, Miyazawa discussed what is described as Magik Eye's "game-changing" depth sensing technique for machine vision.

Called "Invertible Light", the technology appears to offer a new approach to depth sensing said to enable the smallest, fastest and most power-efficient 3D sensing. "While structured light, time of flight, and stereo scoping imaging are the primary methods today, Invertible Light aims to transform 3D sensing in the coming age of robotics and machine vision for the masses," Miyazawa said.

According to the CEO, the complexity of legacy approaches using structured light suffer from high power consumption and the need for multiple optical components that are required to project a specific or random pattern to measure distances. "All of this ultimately translates into higher cost for the consumer," notes Magik Eye, adding that its approach instead projects a regular dot pattern onto an object using just one projector and an image sensor. "The result of this breakthrough in optics and mathematics is the smallest, fastest, and most power-efficient 3D sensing," claims the Connecticut-headquartered firm.

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NIR sensor targets AR/VR eye-tracking, facial ID security

OmniVision's new camera module, with wafer-level optics and low power consumption, is suited to headsets.

OmniVision Technologies, Santa Clara, California, a developer of digital imaging solutions, has launched its OVM7251 CameraCubeChip module – a near infrared sensor designed for the AR/VR eye-tracking, and facial recognition security markets.

Built on the company's 3 micron OmniPixel 3-GS global shutter architecture, the OVM7251 offers designers "a small form factor, low power consumption and cost effective 640x480 VGA resolution camera module," states the new camera's specification.

The module is available in two versions: an 850nm model for AR/VR eye tracking, and a 940nm model for machine vision and 3D sensing in mobile facial authentication.

Aaron Chiang, marketing director at OmniVision, commented, "Until

now, most camera modules for these applications have been built with rolling shutters, which have latency issues. Meanwhile, global shutter modules have



AR headset-friendly: the OVM7251 offers small form factor, low power requirement and 640x480 VGA camera.

previously been too large and expensive. The new OVM7251 overcomes these challenges by providing a cost effective

VGA module with global shutter performance in a wafer-level, reflowable form factor."

The new module's sleep current consumption is 5mA, and during active mode, its global shutter enables rapid image capture. This combination can result in extended battery life for a broad range of applications, such as head-mounted displays for AR/VR, facial authentication in smart phones, and machine vision for factory automation, barcode readers and robot vacuum cleaners, says the company.

Smart view

Additionally, by using the OVM7251 for eye tracking in AR/VR headsets, designers could further reduce power consumption by programming the system to only process the display areas where users are currently looking, instead of the entire image.

The new modules are also said to reduce design time by integrating the image sensors, processor and lenses in a miniature wafer-level, reflowable chip-scale package. The OVM7251 module is available now for sampling and volume production, along with an evaluation kit. It will be demonstrated at OmniVision's private suite at the Computex expo, in Taipei, Taiwan, between May 28-30.

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<http://optics.org/news/10/5/46>*

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Stemmer expands with acquisition of Infaimon



Image: Infaimon.

Stemmer has increased its European footprint.

successful integration of Elvitec continued to have a positive effect. Swedish and Dutch subsidiaries in particular made "significant revenue contributions". With growth of 6.0%, figures outperformed the strong third quarter in the previous year.

At €3.08 million, adjusted operating earnings were up on the previous year's figure of €2.91 million in the third quarter of the 2018/2019 financial year. The adjusted figure takes into account ancillary costs related to acquisitions and the costs of the change of segment, which amount to a total of EUR 0.42 million in the reporting period.

As of 31 March 2019, total assets in the Stemmer Imaging Group, of €83.66 million were down on total assets as of 30 June 2018 (€85.07 m). Non-current assets increased to €13.50 million as of 31 March 2019 (30 June 2018: €9.05 million). As well as the acquisition of Elvitec, this rise is due to measuring shares in Perception Park using the at-equity method.

The company's current assets decreased to €70.16 million. Stemmer commented, "The decline is attributable primarily to the sale of securities at the beginning of January 2019, which caused cash and cash equivalents at the Group to rise to €42.14 million as of 31 March 2019.

Full year, 2019

For the whole year, the 2018/2019 financial year was in line with the forecast communicated in the 2018/2019 half-year report. The Executive Board does not anticipate any significant changes in the economic environment or the industry environment.

Due to the "robust development of incoming orders", the successful integration of subsidiary Elvitec and the continued success of the expansion strategy, Stemmer's Management Board expects a revenue volume in the range of €108 million to €111 million and adjusted EBITDA of €10.0 million to €11.0 million.

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<http://optics.org/news/10/5/38>

Machine vision firm pays "tens of millions of euros" for Spanish firm; and now represented in all European markets.

Stemmer Imaging has agreed to acquire Spanish firm Infaimon, a developer of software and hardware for machine vision and robotics. Under the agreement, Stemmer will pay a sum "in the low tens of millions of euros" for the acquisition of all shares in the group.

Stemmer expects the deal to result in an additional revenue contribution of around €18 million and an EBITDA contribution of around €3 million in the 2019/2020 financial year. Subject to approval by the antitrust authorities, consolidation is planned starting from 1 July 2019.

Headquartered in Barcelona, Spain, with subsidiaries in Portugal, Mexico and Brazil, Infaimon develops machine vision and image recognition processes and their application in subsystems. In particular, the company has many years of experience in bin-picking applications.

These subsystems play a key role in Industry 4.0 and smart factories and are used in the automation of production and logistics processes, among other areas. For example, industrial robots are used in this sense to pick up a preprocessed blank from a production line and place it at the next point for further processing.

"With the acquisition of Infaimon, we are now represented in almost all major European markets. We will immediately broaden our sales network, expand our product and service range with innovative technologies, and gain a high-margin company. The Infaimon locations in Brazil and Mexico will give us opportunities to advance into other regions such as the USA in the future," said Arne Dehn, Stemmer's CEO of Stemmer.

Salvador Giro, CEO of Infaimon, added, "We are delighted that we are now part of a larger and even more international group. This will enable us to leverage the great potential for bin picking applications in the European market in a timely and efficient manner."



Stemmer has just listed on Germany's Prime Standard stock exchange.

Stemmer lists on Germany's Prime Standard

On May 10, 2019, Stemmer Imaging announced that it had successfully started to trade on the Prime Standard of Frankfurt stock exchange. The company's statement said, "By switching segments, Stemmer now complies with the most exacting transparency requirements for listed companies in Germany, and is opening itself up to a broader investor base. The Management Board believes that it can gain additional investors in Germany and abroad."

Lars Böhrnsen, CFO, commented, "We aim to provide even greater transparency and align ourselves even more closely with international investors. Against the backdrop of our long-term growth, we will further step up our dialogue with all capital market participants."

Latest trading figures

Stemmer Imaging Group's revenue in the first nine months of the 2018/2019 financial year was €79.43 million, up 6.6% year on the previous year's equivalent figure of €74.49 million.

The company commented that the

North American MV market grows by 10% in 2018

AIA survey reveals record sales of \$2.87 billion, last year, following six straight years of growth.

North American sales of machine vision components and systems that provide vision intelligence to robots and other machines reached \$2.874 billion in 2018, an increase of 9.2 percent over 2017 and a new record for the market.

According to statistics from the AIA, the industry trade group and part of the Association for Advancing Automation (A3), application-specific machine vision (ASMV) systems led the growth with \$1.998 billion in sales in 2018, an increase of 7.8 percent over 2017, followed by smart cameras with \$466 million, an increase of 14.2 percent.

'New records'

Machine vision component markets also set new records in 2018 with \$401 million in total sales representing 11.7 percent growth. This increase was driven primarily by component camera sales, which increased 16.2 percent to \$219 million, followed by software (8.9 percent to \$21 million), optics (8.8 percent to \$44 million), lighting (7.9 percent to \$77 million) and imaging boards (1.5 percent to \$40 million).

"Vision technologies are becoming smarter and smaller to solve the increasingly complex challenges associated with emerging automation applications such as AI-driven bin picking, autonomous vehicles, and advanced inspection technologies," said Alex Shikany, vice president of AIA and business intelligence at A3.

"Vision components in everything from cameras to lighting to software must work together seamlessly to provide the visual intelligence that robots and other smart machines require to do their jobs. We're excited to see what new innovations are



Image: Photoneo

Growth sector: Photoneo's new PhoXi 3D camera was a winner at last November's VISION Show in Stuttgart, Germany.

created in the months and years ahead to make this data collection even simpler and more intuitive."

According to AIA's latest survey of industry experts, 80 percent of respondents believe that sales of machine vision components will remain flat or decrease in the next six months. Similarly, 62 percent believe machine vision systems markets will plateau or decrease in the next two quarters.

According to Shikany, this predicted stagnation might come from a "slight

softening of the manufacturing sector seen in the last quarter of 2018, which showed the PMI dipping to the low 50s and the semiconductor market decreasing." The results are also a reflection of experts' belief that this market is due for a normalization of growth, having posted six straight years of expansion.

MV at Automate 2019

Focusing on the theme of Win the Future, Automate 2019 (April 8–11 in Chicago, IL, U.S.) will explore how automation such as machine vision "can secure a company's

success in a technologically fast-paced world that is rapidly shifting the dynamic of today's manufacturing."

More than 500 vendors, integrators, and other automation companies are expected to demonstrate their solutions on the show floor, with many also sharing expertise in the conference sessions. The Automate show is free to attend.

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<http://optics.org/news/10/4/6>

Cognex forecasts sales dip amid consumer electronics slowdown

Machine vision specialist reports strong growth in logistics applications, offset by weaker demand elsewhere.

Cognex, the Natick, Massachusetts, company specializing in machine vision equipment, is expecting full-year sales in 2019 to decline on last year's result, largely because of a slowdown in demand from the consumer electronics sector.

Despite reporting record sales of \$173.5 million for the opening quarter of the year, CEO Robert Willett told investors to expect a slight decline this year, amid a wider slowdown across key manufacturing sectors.

Company founder and chairman Bob Shillman said: "Slower business conditions have dampened our expectations for growth in the near term. Nevertheless, our products are a key element of factory automation and logistics, which we believe are both growth markets, and we remain optimistic about Cognex's future over the long term."

Willett added: "Our history shows that growth for Cognex is not linear; we've had ups and downs in the past driven by various external factors. This current slowdown will be temporary and does not change our positive view of the long-term potential for Cognex."

Markets responded to that outlook by sending the company's stock down around 15 per cent on the Nasdaq



Earlier this year, Cognex expanded its 3D vision capability with the release of three new products. Using techniques including bursts of blue light, alongside high-speed laser scanning and telecentric optics, such technologies are expected to find use in factory inspection and other industrial environments.

exchange in early trading April 30, the day after the Cognex executive team released the latest figures.

Deferred investments

During an investor conference call to discuss the latest results, the CEO further explained: "Lower spending by customers in China and in the automotive sector in the Americas offset most of the strong growth that we achieved in logistics.

"In consumer electronics, we now expect customers to defer investments in automation and machine vision, particularly in smartphone manufacturing."

That is expected to reduce sales into

consumer electronics application by as much as one-third this year, continuing a decline that began in 2018.

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Cognex forecasts sales dip amid consumer electronics slowdown

“While there’s inherent volatility in consumer electronics as we witnessed over the past three years, we remain confident that we are not losing share in this market, and that Cognex machine vision is a key element of manufacturers’ long-term plans,” reassured Willett.

As a result of that decline, the automotive sector is expected to represent the company’s largest single application area this year. But automotive is another sector that is in retreat currently, with Willett adding:

“After three years of strong growth, revenue from automotive is relatively flat due to lower sales in China and the Americas. Manufacturers are scaling back and delaying large automation projects in response to changes in consumer purchases, declining unit sales and evolving product roadmaps.”

On the plus side, trends towards electric vehicles and greater use of electronics

within vehicles should all benefit Cognex in the long run.

3D vision opportunity in logistics

In the buoyant logistics sector, Willett reported increased uptake of Cognex barcode readers among household names in e-commerce that are increasingly automating their warehouse and distribution center operations.

While barcode readers are the mainstay products within logistics right now, Willett does see plenty of potential in the sector for much more advanced technology – including 3D machine vision.

“We’re seeing it expand into vision more for various tasks like inspecting packages, looking for damaged packages, or looking at numbers or letters on packages and symbols such as hazard symbols,” said the CEO.

Concluding the investor call, founder and chairman Shillman commented that it was “obvious” that things were slowing down in the world of manufacturing.

“The sale of new phones doesn’t seem to be growing, and the sale of cars seems to be slowing, maybe millennials or whatever,” he said.

But despite that, Shillman added, Cognex is still generating a very healthy profit and plenty of cash. Net income according to standard accounting procedures in the latest quarter came in at \$33.1 million – down from \$37.2 million a year ago but still representing a healthy chunk of sales.

On its balance sheet, Cognex now lists some \$864 million in cash and equivalents, up very strongly in the latest quarter, giving Willett and Shillman plenty of scope to consider further expansion through mergers and acquisitions.

The company has also decided to pay shareholders another quarterly dividend of \$0.05 per share.

- Following the financial update, Cognex’ stock price slipped back more than 15 per cent as investors reacted negatively to the 2019 outlook.

At around \$45 on the Nasdaq exchange, the stock is now trading around 25% down on its all-time high, reached in 2017.

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Cognex’ stock price dropped in value by around 15% in early trading April 30, the day after it reported solid Q1 2019 results but an outlook impacted by slowdowns in the key areas of automotive and consumer electronics manufacturing.

Facial recognition spots happy pigs

Project from Scotland's Rural College and UWE could alert farmers to animal health problems.

Assessing the emotional well-being of animals is challenging, although it can represent a valuable insight into their state of mind for farmers and vets alike.

The health of pigs is currently monitored to an extent using RFID tags, but pigs happen to be one farm animal known to be highly expressive and communicate with each other using different facial expressions.

'moods' of animals under our care."

The workflow developed by the project involves SRUC capturing 3D and 2D facial images of its breeding sow population under various situations that are likely



Credit: SRUC/UWE.

Facial recognition in pigs and other animals could be valuable to farmers and vets alike.

The ability of humans to read porcine faces has been limited, but a collaboration between Scotland's Rural College (SRUC) and machine vision experts at UWE in Bristol has now developed a possible route to monitoring and understanding these facial expressions more fully, using machine learning and facial recognition technology.

"By focusing on the pig's face, we hope to deliver a truly animal-centric welfare assessment technique, where the animal can 'tell' us how it feels about its own individual experiences and environment," said Emma Baxter of SRUC. "This allows insight into both short-term emotional reactions and long-term individual

to result in different emotional states, such as the discomfort of lameness and its subsequent treatment. Detection of a pain-free and positive mood is more tricky, but the team believes that this too reveals itself in facial recognition scans.

Images are processed at UWE's Centre for Machine Vision, part of the Bristol Robotics Laboratory, where machine learning techniques automatically identify different emotions conveyed by particular facial expressions. After validating these techniques, the team plan to develop the technology for on-farm use with commercial partners, where individual sows in large herds will be monitored continuously.

Animal welfare

The current project builds on previous work at the two institutions on the use of convolutional neural networks (CNN) as a non-invasive biometric technique to analyze pig facial expressions, and potentially those of other animals too.

In trials on an initial sample of 10 animals, SRUC developed a CNN able to analyze standard webcam images and discriminate between individual pigs by comparing the snout and the wrinkled region above it; the top of the head where markings are most prevalent; and the eye regions. According to a 2018 project paper, its CNN achieved an accuracy of 96.7 percent on 1553 images of ten pigs, said to outperform at least one of the standard face recognition techniques frequently used in human face recognition.

The other strand of research is to use the facial expression as a potential indication of emotion and intention, an area of behavioral study where concrete data has been harder to come by. Last year the project published results of a study into pigs' facial expression prior to the occurrence of aggression, during aggression, and during retreat from being attacked, and related facial metrics such as ear angle, contraction of the snout and openness of the eyes to the different behaviours. It concluded that facial expressions could indeed be a signal of intent as well as emotional state.

Having proven the principle, the project intends to investigate the impact of different camera viewpoints, and on the effects of more changeable aspects of the pig's appearance, such as age and cleanliness.

"Machine vision offers the potential to realize a low-cost, non-intrusive and practical means to biometrically identify individual animals on the farm," commented Melvyn Smith of UWE. "Our next step will be, for the first time, to explore the potential for using machine vision to automatically recognize facial expressions that are linked with core emotion states, such as happiness or distress, in the identified pigs."

Author:

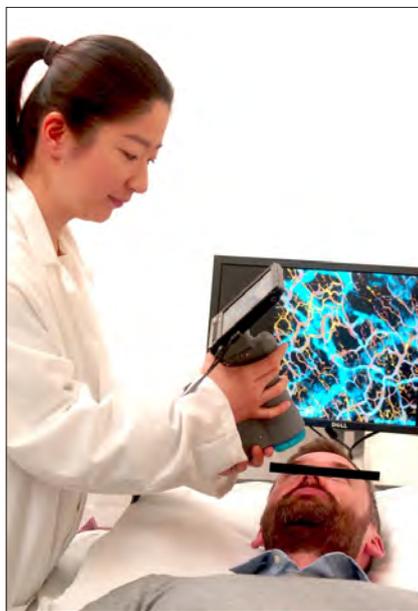
Tim Hayes, Contributing Editor, optics.org
<http://optics.org/news/10/3/33>

Miniature hand-held OCT probe offers effective pediatric imaging

University of Washington project improves scanning efficiency and ease of use.

The impact of OCT in ophthalmic imaging has been substantial, but use of the technique has been most straightforward in the examination of adult patients. Detecting eye disease in children and infants, where exact positioning of the instrument is needed and some form of hand-held OCT is effectively essential, has been more challenging.

The difficulties involved in using clinical OCT systems on young patients, along with the relatively low scan rates available in



Credit: University of Washington.

The miniaturized OCT probe has been tested on adults and premature infants.

existing hand-held alternatives, has certainly hindered the detection and diagnosis of infant eye diseases such as retinopathy of prematurity (ROP), according to Ruikang Wang at the University of Washington.

A project in Wang's Biophotonics and Imaging Laboratory has now demonstrated a new design of miniature hand-held OCT probe, capable of high-speed OCT and OCT

angiography (OCTA) of young children and infants in a clinical setting. The work was published in *Biomedical Optics Express*.

"General improvements to the speed and sensitivity of OCT will always benefit pediatric imaging, because the improvement of those characteristics can mitigate motion artifacts in angiography imaging, delivering higher quality of OCTA images," Wang commented to *Optics.org*.

"On the other hand, the overall challenges of pediatric imaging can only be fully overcome by using a unique design of imaging probe. This particular application requires an easily accessible and conveniently operable probe, since the time window allowed for imaging is very short and easily interrupted by the movements of the patients."

The team tackled the problem by developing a portable OCT system based around a 200 kHz swept-source laser from Axsun Technologies. Particular features redesigned to support infant imaging included a direct-view iris camera incorporated into the hand-held probe; an on-probe display for the operator when performing imaging; and on-probe controls allowing the operator to operate the motorized optomechanical components.

The probe was designed to feature a scanning angle of ± 36 degrees on the pupil, covering the full perifoveal region of the eye, and to allow 3D OCT and OCTA scan times of 0.8 and 3.2 seconds respectively.

More comfortable and more efficient

"Our core considerations in making the hand-held probe, and in designing the whole OCT system, were to improve the

efficiency of data collection and user friendliness," said Wang.

"There have been many attempts in the past to improve the experience of the OCT operator, but our direct-view iris camera is a useful assistance for rapid alignment. Mounting a screen on the probe means that the operator does not need to look away from the patient, while the swept source engine at 200 kHz enables high-speed, wide-field angiography imaging while extending the field-of-view, a particular challenge in a hand-held probe."

In tests on adult volunteers and premature infants, the probe proved capable of providing capillary-level resolution en face OCTA images. Operators reported that the prototype hand-held OCT probe was significantly more comfortable and efficient, thanks to the introduction of the iris viewer and the visual feedback available from the on-probe display when positioning the probe.

The project's next steps will focus on two main topics. One will be more improvements to the field-of-view on the infant retina, since the peripheral retina is important for screening the characteristics of ROP. Another task is to further improve the imaging speed and the capacity for real-time en face viewing of the infant's fundus, reducing the burden on the operator further and enhancing data collection efficiency.

"We recognize that our OCTA imaging quality on infants' retina is still not as good as traditional, bench-top OCT systems, in terms of image resolution and amount of motion-artifacts," commented Wang.

"However, imaging infants and premature babies using traditional ophthalmic OCT systems is simply not feasible, and other existing hand-held OCT probes have shown very limited field-of-view capabilities for angiographic imaging, if any. We have now demonstrated a newly developed probe designed for this purpose, and successfully tested its feasibility for providing retinal structural images and angiograms in both adults and premature infants."

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SRI will design a low-light-level CMOS image sensor for digital night vision camera prototypes to support the US Army's IVAS (Integrated Visual Augmentation System) program. Microsoft, FLIR, and SiOnyx are among the other partners involved in the development effort.

SRI International joins US Army night vision development program

California laboratory joins Microsoft and SiOnyx as partners on 'IVAS' effort to improve soldiers' situational awareness.

SRI International, the non-profit technology development laboratory in Menlo Park, California, has signed a deal to deliver new digital night vision camera prototypes to the US Army.

The agreement relates to the Integrated Visual Augmentation System (IVAS) program, which is intended to improve soldiers' situational awareness and mobility, and already involves the likes of Microsoft, FLIR Systems, and SiOnyx.

Awarded on behalf of the Night Vision and Electronic Sensor Directorate (NVESD), the deal will see SRI design a low-light-level CMOS image sensor and integrate the device into a custom camera module optimized for low size, weight and power (SWAP).

'Fourth-gen' imagers

Colin Earle, associate director for imaging systems at SRI, said in a lab release that the program represented a "tremendous

opportunity" to demonstrate the new imaging technology.

"SRI has been steadily advancing the low-light-level performance of night vision (NV) CMOS image sensors, and we are pleased that the IVAS program will incorporate our fourth generation NV-CMOS imagers," he added.

Earlier this year the Massachusetts company SiOnyx signed a \$20 million agreement under IVAS, to develop technology capable of low-light identification and thermal recognition of people at stand-off distances of 150 m and 300 m respectively.

That came a couple of months after Microsoft controversially agreed to provide

the US Army with an updated version of its HoloLens augmented reality headset under the same program.

Some Microsoft employees have protested against that deal, but CNBC reported earlier this month that a test version of HoloLens featuring thermal imaging capability was now being trialled.

According to that CNBC report, the headset uses a thermal sensor provided by FLIR Systems and as many as a dozen sensor contracts have been awarded under IVAS. It also states that the US Army expects to begin fielding the technology to thousands of soldiers in 2022 or 2023.

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*Mike Hatcher, Contributing Editor, optics.org
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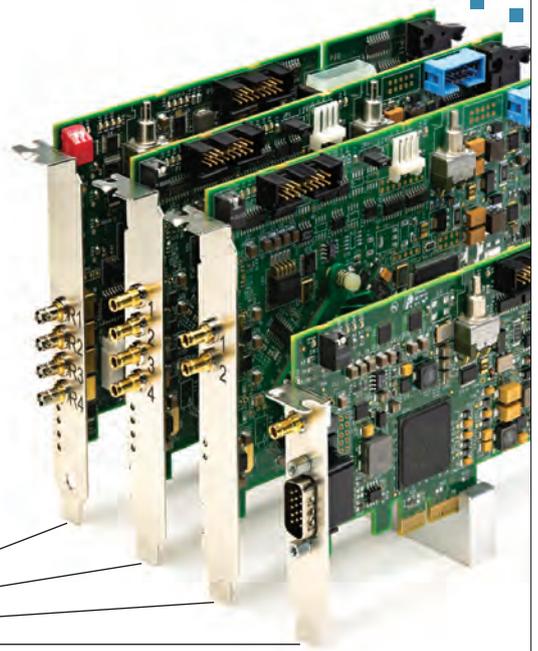
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Orbiting telescope spies first Earth-sized exoplanet

NASA's 'TESS' probe locates hot new world orbiting a star 53 light years away.



Image: NASA

Launched a year ago, TESS is part-way through a survey of the cosmos designed to locate Earth-like exoplanets orbiting relatively nearby stars that can then be further probed for signs of life.

NASA's Transiting Exoplanet Survey Satellite (TESS), launched almost exactly a year ago, has for the first time spotted an Earth-sized world orbiting a distant star.

At approximately nine-tenths the diameter of Earth, exoplanet "HD 21749c" is believed to have a rocky make-up. However, because it is orbiting very close to its host star, with an orbit lasting just eight days, it is thought to experience temperatures as high as 427°C. That puts it outside the so-called "Goldilocks zone" required to harbor liquid water and therefore life.

Around 53 light years away in the constellation Reticulum, the newly discovered exoplanet is the tenth that TESS has identified so far, and the second to be found orbiting the same star.

Multi-camera suite

TESS uses a suite of four identical imaging cameras to survey a broad swath of the night sky, searching for regular dips in the brightness of stars that could indicate the presence of orbiting planets.

Designed and built by the Massachusetts Institute of Technology's (MIT) Lincoln Laboratory in Lexington, Massachusetts, and the MIT Kavli Institute, the cameras on board feature 16.8 megapixel CCD sensors. Each of the four cameras features seven lenses to provide a wide (24x24°) field of view, while other features include a red-optical bandpass covering the 600-1000 nm wavelength range.

TESS is scheduled to survey 26 sectors of the sky over two years of operations, equivalent to around 85 per cent of

the entire sky in all. So far it has been concentrating on the southern sky, and is set to switch its attention to the northern sky shortly.

Once it has completed its sweep of the northern sky, around 5000 transit-like signals ought to have been captured for follow-up with direct imaging. Out of those, approximately 50 transiting exoplanets of a similar size to Earth are expected to be identified for future investigation.

Using the more advanced imaging and spectroscopic equipment offered by probes like the James Webb Space Telescope (JWST) and instrumentation in large terrestrial observatories currently under construction, astronomers and astrophysicists will be able to search for signs of life, for example oxygen gas and water vapor in exoplanet atmospheres.

Measuring exoplanet mass

Publishing results of this first Earth-sized discovery in *Astrophysical Journal Letters*, lead author Diana Dragomir from the MIT Kavli Institute and colleagues also reported their observation of a Neptune-like exoplanet in the same star system that has an orbit lasting 36 days.

Dragomir told MIT News that the result represented a milestone for TESS, and set the path for finding smaller planets around even smaller stars that might prove more habitable.

Just as in our own Solar System, smaller planets are generally thought to exist in "families", suggesting that more rocky worlds could be orbiting the same star.

While this represents TESS' first identification of an Earth-sized exoplanet, NASA's Kepler Space Telescope has previously discovered scores of similar worlds. However, many of Kepler's discoveries are relatively distant and would be impossible to interrogate further using current instrumentation.

In contrast, TESS is looking for planets orbiting much closer and brighter stars, meaning that scientists should be able to measure Earth-like exoplanet masses for the first time.

Author:

Mike Hatcher, Contributing Editor, *optics.org*
<http://optics.org/news/10/4/25>

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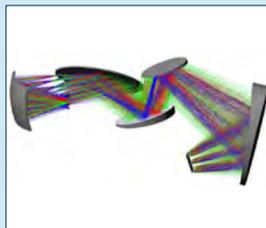
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Improved mid-infrared imaging spots signature of cancers

ICFO and DTU project upconverts mid-IR to near-IR for faster computer-assisted biopsy screening.

Hyperspectral imaging in the mid-IR wavelength region is of interest in many sectors, thanks to the number of chemical species with a spectroscopic response in that range. But efficiently detecting that response has proven to be challenging.

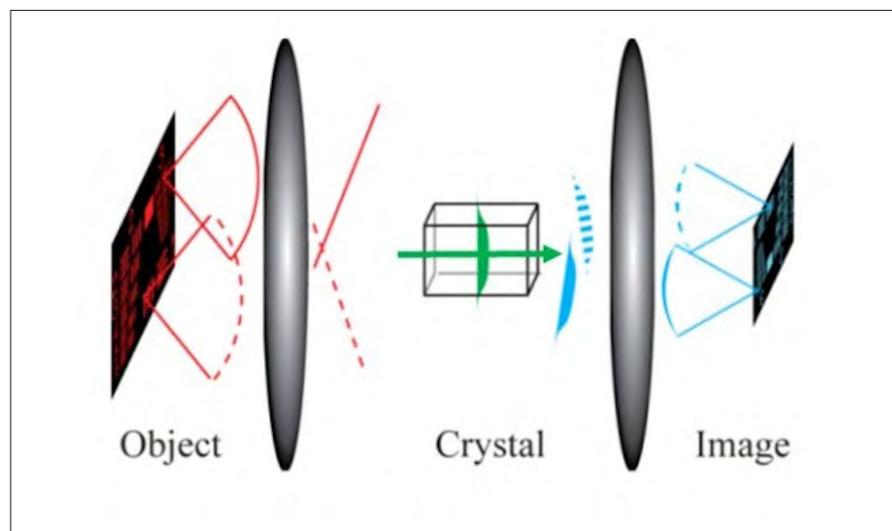
A common approach has been to apply Fourier transform IR (FTIR) imaging, which in turn requires the detectors to be cooled cryogenically to achieve the levels of performance needed, adding to the operation's cost and complexity. Modern laser sources and novel detectors can improve things, but such platforms still rely on direct detection of the mid-IR signal.

A project at DTU Fotonik in Denmark and

"To overcome this barrier, we used an approach that translates information from the mid-infrared region, where the chemical signatures are most distinct, to the near-infrared, where today's camera technology is most mature and sensitive."

The team's system uses a mid-IR illumination source developed at ICFO delivering 20-picosecond pulses; and a lithium niobate crystal as the non-linear medium for the upconversion process, transferring mid-IR imaging signals to the near-IR range. A standard CCD camera handles image acquisition.

The nature of the non-linear medium usually puts a limit on the field of view (FoV)



Frequency conversion shifts the mid-IR image into the near-IR range while preserving the spatial information.

ICFO in Spain has now developed a possible solution, in which the mid-IR spectral information is shifted into the near-IR while preserving all the spatial information. The work was published in *Optica*.

"Although mid-infrared spectroscopy is recognized as a powerful tool for chemical analysis, its applicability has been hampered by a lack of affordable light sources and sensitive detectors," said Peter Tidemand-Lichtenberg of DTU Fotonik.

achievable in upconversion operations, but the project team tackled this by using a galvoscaner to rotate the crystal, an approach known to allow concentric rings in the object plane to effectively be upconverted separately.

Even small rotations can have a significant impact on the field of view, and the project improved things further by adjusting the crystal rotation time to match the camera integration time, removing the need for post-

processing of the images. In practice the team found that the FoV was increased by a factor of five compared to a static design, corresponding to an increase in the number of spatially resolvable elements by a factor of 25.

"This approach is generic in nature and constitutes a major simplification in realizing video-frame-rate mid-IR monochromatic imaging," commented the project in its published paper.

Computer-assisted biopsies

One area where improved mid-IR hyperspectral imaging could be most valuable is histopathology, where absorbance by chemical bonds within tissues can provide molecular-specific contrast from unstained tissues. The new system may offer a route to simplifying current biopsy workflows and encouraging objective, rather than subjective, decision making from the spectral data, potentially allowing automated platforms to be used.

To test the system, a pilot study conducted alongside the UK's University of Exeter and Gloucestershire Hospitals NHS Foundation Trust applied the technique to esophageal tissues, evaluating cancerous and healthy samples through a computer-assisted biopsy classification.

It found that morphology and spectral classification using the system matched well with the standard stained histopathology images, and that images from only 62 wavelengths could provide enough spectral data to enable preliminary, unsupervised clustering of tissue types with a performance similar to FTIR imaging. In its paper the team suggests that the number of images needed for computer-assisted classification of biopsies may be as low as 10 to 20.

"Our upconversion imaging approach is generic and constitutes a major simplification in realizing video-frame-rate, mid-infrared monochromatic imaging," said Tidemand-Lichtenberg. "The spectral information provided by this technique could be combined with machine learning to enable faster, and possibly more objective, medical diagnostics based on chemical signatures without the need for staining."

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<http://optics.org/news/10/5/41>

Credit: Peter Tidemand-Lichtenberg, DTU Fotonik

Hyperspectral imaging and metasurfaces combined for novel biosensing platform

EPFL project could assist in personalized medicine and at-home disease detection.

The concept of at-home medicine relies on effective ways to identify diseases without needing the initial services of the healthcare industry, and in turn requires the development of new platforms to image and analyze biological species.

A project at the Swiss research institute EPFL in Lausanne has now developed an optical sensor that could be an important step along this road, allowing the straightforward identification of undesirable biomarkers in blood or saliva. The work was published in *Nature Photonics*.

The device, designed at EPFL's BioNanoPhotonic Systems Laboratory (BIOS), involves the use of an optical chip coated in a metamaterial, a class of optically active material in which carefully designed surface nanostructures influence and control the behavior of light falling on the chip.

This optical component, combined with a standard CMOS camera and subsequent image analysis, is able to count biomolecules one by one in a sample and determine their location, according to the project team.

EPFL employed a specific type of metamaterial termed an all-dielectric asymmetric metasurface, in which the symmetry of the arrays of nano-scale units is deliberately broken. These surfaces are known to be capable of exhibiting high-quality optical resonances, arising from the behavior of the quantum states present in the material.

In this case, the nanostructures are able to squeeze certain frequencies of light into extremely small volumes, creating ultra-sensitive optical hotspots. When light shines on the metasurface and hits a biomarker molecule at one of these

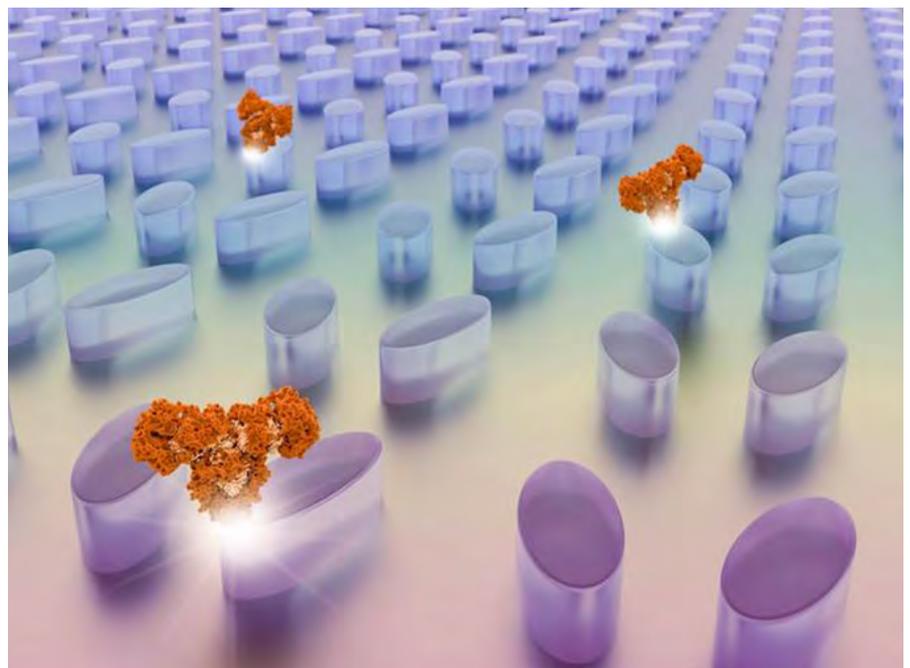
hotspots, the molecule can be detected immediately, thanks to the change in wavelength it brings about.

Personalized medicine

A second key aspect is the platform's use of hyperspectral illumination, to maximize

the unprecedented level of less than three molecules per square micron."

The EPFL platform proved capable of retrieving spectral data from a single image without the use of spectrometers, potentially a significant step towards eventual portable diagnostic applications. It also extended the known capabilities of dielectric metasurfaces as tools to analyse two-dimensional layers of biological entities at atomic-layer thicknesses, according to the team.



Credit: EPFL

A novel biosensor platform makes use of a dielectric metasurface.

the sensing efficiency and sensitivity of the device. CMOS images recorded at different wavelengths and passed through image analysis algorithms allowed the project to precisely count and analyze specific molecules in a sample.

"We combine dielectric metasurfaces and hyperspectral imaging to develop an ultra-sensitive label-free analytical platform for biosensing," commented the project team in its published paper. "Our technique can acquire spatially resolved spectra from millions of image pixels and use smart data processing tools to extract high-throughput digital sensing information at

A modified version of the same platform in which the metasurfaces are designed to resonate at different wavelengths in different areas is also being investigated—a potentially simpler technique, but less precise in locating the molecules.

"Optical sensors could play a major role in addressing future challenges, particularly in personalized medicine," commented Hatice Altug, head of the EPFL BIOS lab.

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<http://optics.org/news/10/4/8>*

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