

# VISION

focus

## Quantum imaging hub opens on the University of Glasgow campus

*Business-focused QuantIC hub funded by UK government for next five years*

### plus...

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- poLight lens makes debut in 'touch & refocus' smart phone
- How vision systems are seeing our cities
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- Lens-free microscope images cardiac cell contractions
- Corning acquires assets of imaging specialist NovaSol

*...and latest product launches*



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# Vision 2014

## 3D innovations draw record crowds

**After two-year break, expo sees rise in number of exhibitors and visitors, Scotland's Odos Imaging 'best in show', 3D technologies reviewed.**

**Considering the "double record" at last year's Vision 2014 - numbers of exhibitors and visitors were both up on 2012- Thomas Walter, Manager of Industrial Solutions Department at Messe Stuttgart commented, "Our expectations were far exceeded." The 26th edition of Vision produced not only a record number of exhibitors (432) with a high number of foreign exhibitors (54% / 2012: 37, up 49%) but also a record number of visitors. Over 8,700 trade visitors attended, equivalent to a growth of around 25% over 2012. "There was also a rise in international visitor interest," Walter added.**

The latest show success was attributed to its new two-year frequency. Olaf Munkelt, Chairman of the VDMA Machine Vision Group in Frankfurt and MD of MVtec Software, added, "We are pleased with the number and quality of trade visitors. We have received positive feedback from all branches of the industry. The longer break between shows enabled exhibitors to develop better presentations of their innovations. Exhibitors in 2014 came from 31 nations – all types of company were represented, ranging from start-ups to major players. And for the first time, there was a new focus on industrial PCs and embedded PC systems, which are suited for complex, demanding machine vision applications."

### Vision Award 2014

Scotland-based Odos Imaging, which develops innovative 3D vision systems for the MV market, was awarded the prestigious Vision Award 2014, at the Stuttgart expo. The company's flagship product is the real.iZ VS-1000 megapixel 3D vision system (pictured, right).

Chris Yates, CEO Odos Imaging, said, "We are absolutely delighted and honoured, to receive the Vision Award 2014, particularly since so many outstanding products and companies were nominated. We believe our 3D vision systems represent a new

direction for the machine vision industry, seeking to provide high-resolution 3D imaging with the same ease of use as conventional industrial cameras."

Founded in 2010 as a spin out from the Siemens Technology Accelerator and based in Edinburgh, Odos Imaging offers both complete systems and component technologies for use in logistics, industrial automation, agriculture and traffic systems.

### Vision 2014: launch highlights

Vision Focus presents a selection of some of the key product and technology launches in Stuttgart. Organiser Messe Stuttgart said that in 2014, 3D vision systems were leading



Odos Imaging's Real.iZ-1K-VS 3D vision system.

the MV market place, exemplified by technologies such as panoramic imagers, CMOS cameras, 5D Time-of-Flight cameras and fast data interfaces. The innovations were mainly characterized by 3D machine vision solutions. There were also interesting developments with CMOS image sensors and cameras, the increasingly simple integration of systems using USB 3 Vision or CoaXPress interfaces.

### High-speed camera

Mikrotron has released a new high-resolution, high-speed camera for applications ranging from inspections in the manufacture of flat screens and printed circuit boards to particle-based flow measurement and 3D measurements or surface inspection.



Mikrotron.

The EoSens 25CXP is a compact, digital 25 megapixel (80 fps) CMOS camera. Christian Pilzer, president, said, "With a high-performance CoaXPress real time data interface and excellent performance features, it satisfies the high requirements of the high-end area."

### USB3 camera for life sciences, automation

Baumer presented its VisiLine camera series, which has been extended with the USB 3 vision interface. Camera models with Sony VGA and 1.2 megapixel CCD sensors, frame rates of up to 42 images/s are available. A fast VGA CMOS sensor achieves a higher frame rate of 373 images/s.

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## Vision 2014 3D innovations draw record crowds

### 3D scanning with 'structured light'

David Vision Systems presented its SLS-2 scanner. It works with structured light, which allows precise 3D scanning within seconds. The scanner's modular structure enables flexible adaptation to the object size – from a coin to a couch in scale. The 3D model can also present color and texture on its screen.



*David Vision Systems.*

### 3D inspection of precision hole boring

The BoreInspection system, developed by the French manufacturer Mesure-Systems-3D, measures 3D bore holes, internal threads, band measurements, internal fine grooves, counterbores and even cylindrical objects. Complex parts with grooves, edges or beads can also be examined with the contactless 3D inspection system in the production line, assessing up to 50 characteristics.



*Smartek Vision.*

### Enhanced traffic surveillance

The Giganetix Plus from Smartek Vision showed Sony's IMX174-CMOS image sensor, which it says achieves "unprecedented values in terms of sensitivity, dynamics and noise, and provides flawless images of moving objects", states Dr. Ronald Müller, Head of Product Marketing at distributor Framos.

### 360° sensor inspection

The automotive industry uses adhesive connections for the fully automated insertion of glass panes. The 360° inspection system from Isra Vision allows curved glue beads to be inspected with high precision. The integrator developed its Seamstar3D sensor head for this purpose. According to the manufacturer, the intelligent design makes it the world's first sensor with a 360° view.

### SWIR camera for photovoltaics

Allied Vision Technologies presented its Goldeye infrared camera series. This development in the shortwave infrared camera marketplace features an InGaAs sensor, it is sensitive to infrared radiation between 900 and 1,700nm. It is thus suitable for demanding machine vision applications outside the visible spectrum.



*Allied Vision Technologies - Goldeye.*

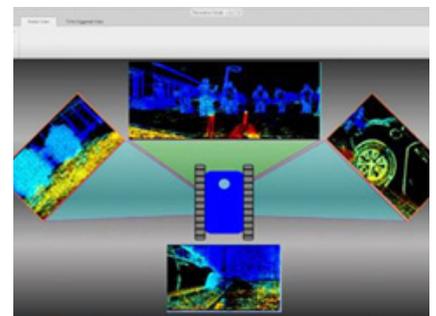
### Surface inspection of strip products

Stemmer Imaging demonstrated the application of diverse machine vision technologies to surface inspection of strip products. Two line cameras from Teledyne Dalsa and JAI, a Contact Image Sensor (CIS) from Mitsubishi Electric, as well as a triangulation camera from Automation Technology,

are elements of the demonstration system. All sensors work autonomously and detect different features of an aluminum plate, which moves on a linear bench.

### Mobile robots with 3D panoramic view

The Austrian Institute of Technology demonstrated its dynamic vision sensor, designed to improve the capabilities of mobile robots, for example in situation recognition, navigation or exploration applications. In combination with a rotating camera, the sensor is the centerpiece of a high dynamic range panoramic stereo camera, which enables the collection of 360° stereo panorama images in real time.



*Austrian Institute of Technology (AIT).*

### 5D Time-of-Flight camera

Bluetechnix's next generation of sensor systems, suited to robot and automation applications or for counting people. The Argos3D-P320 is a depth sensor based on the time-of-flight principle. It is equipped with a smart depth sensor IC and a high-resolution 2D-CMOS sensor. The IC supplies depth information and grey values simultaneously for each individual pixel, while the integrated 2D-CMOS image sensor captures scenes with a resolution of up to 1080p. With active infrared light the sensor is able to supply 3D and 2D information.

<http://optics.org/news/5/11/22>

#### About the Author

Matthew Peach is a contributing editor to optics.org.

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# Quantum imaging center opens in Glasgow

**Business-focused QuantIC hub funded by UK government for next five years.**

**This year saw the opening of the QuantIC “quantum imaging” hub on the University of Glasgow campus, in Scotland. In attendance were partnership academics from at least six UK universities, alongside industrialists and many leading figures from the photonics community.**

The hub brings together scientists from the universities of Glasgow, Bristol, Edinburgh, Heriot-Watt, Oxford and Strathclyde with experts from a range of industrial partners to commercialize new types of camera and imaging systems.

QuantIC is one of the four quantum development hubs, first announced in November 2014, which are sharing £270m in funding from the UK government over the next five years. It will be funded by a £27m award from the Engineering and Physical Sciences Research Council.



*QuantIC's PI: Prof. Miles Padgett.*

More than 30 industry partners are expected to support QuantIC to develop imaging systems to bring new benefits to the UK economy. At the launch ceremony, around 100 attendees from academic, industry and funding councils gathered to

learn more about QuantIC's potential and hear from speakers from organisations including the Scottish Funding Council.

QuantIC's principal investigator Professor Miles Padgett told optics.org, “We already have more than 30 companies signed up to work with the hub including Astra Zeneca, BAE Systems, e2v, Horiba Jobin Yvon, M Squared Lasers, Renishaw and Toshiba.

“The academic and industrial partners will be working together to pioneer a family of multidimensional cameras operating across a range of wavelengths, timescales and length-scales.

“Other R&D-focused groups involved with the QuantIC include our neighbor the Fraunhofer Centre for Applied Photonics and the UK government's Defence Science & Technology Laboratory.”

## Broad scope

Quantum photonics-related innovations that are already on the table for development include:

- Single-photon visible and infrared cameras of “unprecedented sensitivity”.
- Compressed sensing and sub shot-noise imaging, subjecting the object to minimal illumination.
- Extreme timing-resolution single-photon cameras - giving 3D ranging or time-gated imaging immune to the effects of aberrations, or where line of sight is blocked.
- Single-pixel cameras, creating an alternative to expensive or unobtainable focal-plane detector arrays.
- Exploitation of quantum time/number correlations, enhancing signal-to-noise in imaging and spectroscopy.



*Prototype of QuantIC's single-pixel sensor system.*

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## Quantum imaging center opens in Glasgow

- Quantum entangled sources enabling visible images to be acquired using only infrared illumination, or infrared spectral signatures manifest in visible light.

The launch saw a range of technology demonstrators already developed by members of the QuantIC partnership, including a camera which uses a cheap single-pixel sensor to create video images beyond the visible spectrum. This camera can be tuned to make it sensitive to infrared or ultraviolet light, making it capable of visualizing gas leaks, seeing clearly through smoke, or looking under skin for tumors.

The project, developed at the University of Glasgow in close collaboration with nearby M Squared Lasers, has the potential to create affordable handheld video cameras capable of seeing areas of the spectrum - only previously visible with larger and more expensive devices.

Also on display was a new camera, developed by researchers at Heriot-Watt University, which uses highly advanced photon-timing techniques to see through layers of organic tissue, and a detector designed to image minute changes in gravity fields.

Padgett added, "It's our emphasis on industrial engagement that marks us out as different. The hub's opportunities panel, which determines which projects will proceed, is mainly industry people and the only academics are director Steve Beaumont and myself. I'm hoping that this will mean a much clearer path between discovery science at universities and the pre-commercial development of new prototypes that partner companies can present at trade shows and conferences."

### Medium-term objectives

Presentations at the launch detailed two-year and five-year R&D objectives for QuantIC. By mid-2017, the center is expected to develop a range of

## Technical deliverables year 2



### COMPONENTS

- Si SPAD array with microlenses, >50% fill factor
- Ge-on-Si low noise SPAD
- Plasmonic Filters for structural colour
- High Fresnel number superconducting infrared single-photon detector
- 64x64 high-speed LED source
- High-speed pattern sequence projector

### DATA ANALYSIS

- Image reconstruction from photon sparse data
- 3D surface reconstruction from photon sparse data

### SYSTEMS

- 3-axis gravitational field imager
- On-chip silicon interferometer
- Infrared single-pixel camera
- Polarisation-sensitive, single-pixel camera
- Time-gated sub-nanosecond SPAD camera
- Silicon nitride sensing platform at wavelength >1300nm
- Correlated-photon, covert ranger
- Sub shot-noise camera/spectrometer
- Desktop squeezed light imager

QuantIC's year two objectives.

## Technical deliverables year 5



### COMPONENTS

- Infrared Ge-on-Si single-photon detector array
- Metamaterial-based hyperspectral Si-SPAD array
- 100k pixel time-resolved Si-SPAD array
- Superconducting nanowire detector 1D and 2D Infrared single-photon arrays
- Programmable 128x128 light source for ultra-high speed ghost-imaging

### DATA ANALYSIS

- Cryogen-free platform for low-noise detectors
- GPU implementation of image denoising/inversion algorithms

### SYSTEMS

- 6-axis gravitational imager
- Quantum enhanced optical readout of MEM sensor
- Trans-wavelength imaging microscope
- Hyperspectral computational ghost imaging camera
- Aberration resistant prompt light imager
- Non line-of-sight single-photon imaging camera
- Si platform quantum sensing at wavelength ~1500nm
- Loss resistant interferometry for phase microscope

QuantIC's year five objectives.

components, data analysis and systems including a silicon SPAD array with microlenses with a >50% fill factor, a capability for image reconstruction from photon-sparse data and a 3-axis gravitational imager.

And by 2020, QuantIC and its partners should have delivered an germanium-on-silicon single infrared photon detector array, a cryogenic-free platform for low-noise detectors and a 6-axis gravitational imager.

Of the near future and beyond the planned funding period, Padgett commented, "All of the hubs will be reviewed at two years to consider successes such as quick wins,

and whether there is industrial or commercial endorsement of the developments.

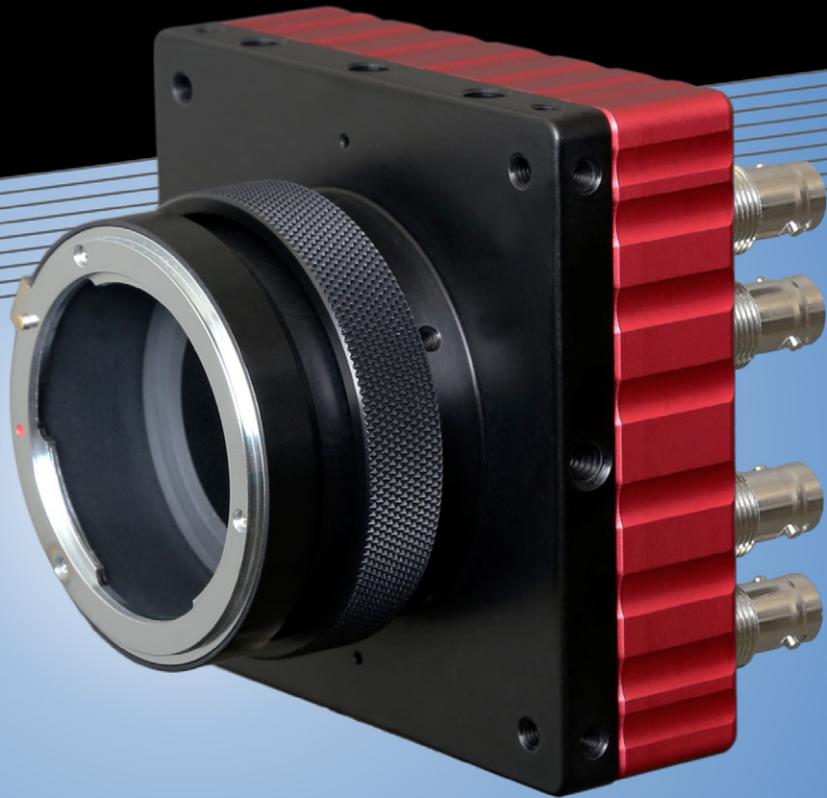
"From a government point of view, they have said that if we make a good job of it then after five years it won't necessarily be the end of the story for us. Hub 2.0, Catapult or some other sort of innovation center are all possibilities," he added, optimistically.

<http://optics.org/news/6/2/36>

### About the Author

Matthew Peach is a contributing editor to optics.org.

# Fast Frame Rate 12 Megapixels



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# ImmerVision targets smart phones with 'panomorph' lenses

**Optical technology provides full 360-degree views of a mobile handset user's surroundings.**

**The Canadian company ImmerVision, which has been developing panoramic optical imaging technology for 15 years, is targeting new applications in mobile handsets and tablets.**

At the giant Mobile World Congress exhibition Barcelona, Spain, the firm launched its 360-degree "panomorph" front-facing cameras. It reckons they will "radically change" how mobile users capture, experience, and share images of their immediate surroundings.

ImmerVision's chief commercial officer Alessandro Gasparini, who is spearheading the company's attempt to penetrate consumer electronics, says that the technology is similar to virtual reality, adding an extra level of interaction that users can share, or view on another tablet, TV, or head-mounted display device like Oculus Rift.



3.8mm panomorph lens.

"Today's mobile technologies are focused on higher megapixels, thinner handsets, and larger displays," he says. "ImmerVision is changing everything by making it possible for any manufacturer to integrate an ultra-compact 360-degree panomorph lens that lets consumers do things they've never thought possible, like capturing entire panoramic moments of life identical to the original experience - all with a single click."



*Dr. Simon Thibault, MSc, PhD, Principal Optical Designer at ImmerVision speaks at SPIE 2014 about miniature 360° super wide angle (panomorph) lenses on smartphones, tablets and wearable devices. <https://www.youtube.com/watch?v=Sb1L9Y0kYol#t=26>*

## Revolutionary perspective

ImmerVision has been working on the lens technology – said to outperform more conventional fish-eye or catadioptric alternatives – for more than a decade, originally aiming larger versions at security markets for applications like closed-circuit TV imaging. But last July the company said it had developed a 3.8 mm panomorph, small enough to be designed into phones and even wearable devices.

It says that the first mobile handsets featuring that technology will appear this year. The lenses are actually manufactured by the Korean company Kolen, while OmniVision is providing high-sensitivity 5 megapixel sensors for the application. Qualcomm's flagship Snapdragon processors convert the distorted 360-degree

image that is captured into something users can recognize and share.

OmniVision's sales chief Ray Cisneros said in ImmerVision's latest statement: "With the launch of this new camera, ImmerVision demonstrates the high-performance 5 megapixel CameraChip sensor, and the result is a revolutionary new perspective on digital imaging."

And when ImmerVision first announced the new lens last year, Kolen's president Jong Jing Lee said: "ImmerVision technology is the most exciting, innovative optical technology we have seen in recent years. Kolen believes this is a game changer, capable of revolutionizing our communication habits and furthering the communications experience across multiple platforms."

## New video standard

Aside from smart phones, ImmerVision's panomorph cameras have found applications in drones, video surveillance, baby monitoring, and the automotive sector.

Its supporting video standard can now be licensed worldwide in a new version called "ImmerVision Enables 2.0." The update is said to add image stabilization, and allow data to be embedded along with captured content, for example heart rate, altitude, speed, and temperature.

ImmerVision was originally based in France, where it started out back in 2000. It relocated to Montreal in 2003, developing so-called "de-warping" imaging algorithms that deliver the wrap-around 360-degree view.

Its patented concept is called anamorphosis, and effectively stretches the image to optimize its capture on a rectangular sensor. Both central and peripheral elements of the image can be magnified, as required by the specific application.

<http://optics.org/news/6/3/8>

## JAI A/S

### New Go-Series

Small, fast and flexible area scan cameras.

JAI's GO-5000 series are new small and flexible area scan cameras featuring adaptable resolution.

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#### Contact Details

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[www.jai.com](http://www.jai.com)  
[camerasales.emea@jai.com](mailto:camerasales.emea@jai.com)  
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## Point Grey

### New 1.3 MP USB 3.0 Board-Level Camera

The Chameleon3 camera line combines USB 3.0 interface, compact size, flexibility of board-level, and the most popular CCD and CMOS image sensors.

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The first Chameleon3 CM3-U3-13S2 models are based on the Sony ICX445, a 1/3" global shutter CCD sensor capable of 1288 x 964 image resolution at 30 FPS.

View now: [www.ptgrey.com/chameleon3](http://www.ptgrey.com/chameleon3)



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## BitFlow

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[www.bitflow.com](http://www.bitflow.com)  
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## IO Industries, Inc.

### NEW Flare 12M180

The new Flare 12M180 from IO Industries Inc. is a high-resolution 12-megapixel camera designed around the CMOSIS CMV12000 global shutter CMOS sensor.

Three sensor options are available including monochrome, bayer color and NIR-enhanced monochrome.

Using a quad CoaXPress interface, full-resolution imaging over 180fps is possible.

By windowing the sensor, up to 500fps is possible with 4-megapixel resolution.

This fanless, low-power camera is ideal for industrial environments and applications including semiconductor metrology, solder paste inspection and glass surface inspection.



#### Contact Details

IO Industries, Inc.  
12-1510 Woodcock St.  
London, Ontario  
N6H 5S1 CANADA  
[www.ioindustries.com](http://www.ioindustries.com)  
[info2@ioindustries.com](mailto:info2@ioindustries.com)  
Tel: +1 (519)663-9570  
Fax: +1 (519)663-9571

## FISBA OPTIK AG

### Miniaturized cameras for highly integrated inspection processes by FISBA OPTIK

Miniature optical systems are used wherever very little space is available or when every gram carries weight, for example in in-line process visualization in industry. The microsystems combine imaging, beam shaping and metrology down to even the smallest of dimensions.

FISBA develops and manufactures miniature visualization systems that are capable of displaying even the smallest spaces and surfaces with high precision. They enable minimally invasive procedures, monitor chemical processes in lab-on-a-chip applications, measure complex cavities or register the labeling on electronic components. Thanks to their light weight, they can even serve as a mobile "eye" on the moving arm of a pick-and-place robot in narrow manufacturing lines.



#### Contact Details

FISBA OPTIK AG  
Rorschacherstrasse 268  
CH-9016 St.Gallen  
Switzerland  
[www.fisba.ch](http://www.fisba.ch)  
[info@fisba.ch](mailto:info@fisba.ch)  
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## Navitar

### MagniStar Bi-telecentric Lenses by Navitar

Navitar's line of MagniStar high resolution bi-telecentric lenses are ideal for imaging and measurement applications requiring extreme precision and parts inspection where greater depth of field is necessary.

Lenses offer excellent MTF performance, no parallax error, and less than 0.1% image distortion.

Magnifications from 0.05X to 2X available.



#### Contact Details

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200 Commerce Drive  
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Tel: +1 585 359 4000

# poLight lens makes debut in 'touch & refocus' smart phone

**"True-focus" optical functionality enhances hazardous area smartphone; on show at Mobile World Congress 2015.**

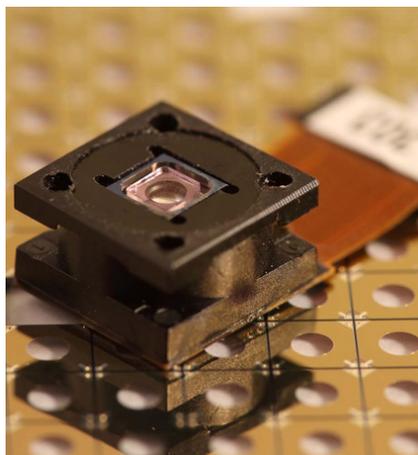
**poLight, Horten, Norway, a leader in high-speed, ultra-low power autofocus actuated lenses, has partnered with video product developer Bartec Pixavi to integrate its TLens-based "Touch & Refocus" technology into mobile phones.**

The Touch & Refocus approach is based on poLight's so-called "true focus" imaging, which can generate full resolution pictures focused at selectable distances and/or depths of field. The driving software works using focus bracketing.

This capability, which poLight claims is brand new, takes advantage of its TLens's ultra-fast 1ms autofocus response time to enable burst image capture at different focus distances. The field of view remains unchanged during the AF sequence hence significantly reducing image processing complexity, CPU cycles and power consumption.

"Smartphone users will therefore be able to edit their pictures and create sharp images of the subject with a natural bokeh (blurred background, which suits certain creative situations)," said Christian Dupont, Chief Marketing Officer at poLight. "They will also be

able to change the depth of focus all the way through to achieving high quality all-in-focus images."



*polight's TLens brings a "true-focus" function to smartphone cameras.*



Christian Rokseth, CEO at Bartec Pixavi, added, "Our customers often work in hazardous and difficult to access environments, so thanks to poLight's TLens functionality, they will be able to take blind shots and still obtain a perfectly sharp picture using this touch & refocus capability. On top of this, poLight's TLens 1ms focus response time will enable our camera to perform Instant focus, as well as all-in-focus video and images."

poLight added that its TLens offers many performance benefits over today's conventional VCM (Voice Coil Motor) technology widely used in

current mobile devices. It achieves a 10 to 15 times faster performance in terms of focus response time and 30 times lower than typical systems in terms of power consumption, the developer added.

poLight is a fabless optical MEMS company and has recently raised \$19m (€17m) to accelerate the commercialization of its TLens which will be produced in the ST MEMS wafer factory in Italy from the second half of 2015.

## About Bartec Pixavi

Bartec Pixavi is based in Stavanger, Norway and develops Ex- and ATEX-certified communication products, mobile devices, and wireless infrastructure for use in hazardous areas. It is part of the Bartec Group, a leading player in explosion protection, based in Bad Mergentheim, Germany.

<http://optics.org/news/6/3/5>

## About the Author

Matthew Peach is a contributing editor to optics.org.

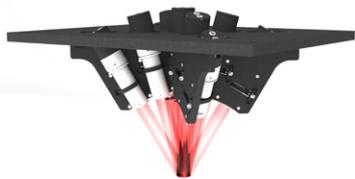


## Meridian™ Production Camera Testing

Optikos announces the next generation of camera testing.

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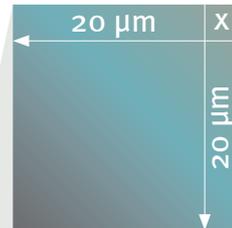
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# Optical clearing meets challenges of live applications

Adjusting the refractive index of biological tissues can enhance a range of imaging techniques.

**Biophotonics imaging techniques are yielding ever clearer views of structures and processes within tissues and cells, but the inherent scattering behavior of those tissues is a constant inconvenience.**

As well as limiting the depth of penetration for both near-IR and visible light into a biological sample, scatter has a deleterious effect on the contrast and resolution ultimately achievable. Eliminating it, or reducing it as much as possible, is a very desirable goal.

One answer is optical clearing (OC). Natural tissues consist of a complex structure of different substances, but in general terms take the form of items having a higher refractive index - cell compartments, collagen and others - surrounded by media of lower RI, such as cytoplasm.

OC aims to replace the surrounding extracellular material with a substance of higher RI, removing this inhomogeneity and reducing the overall scatter of light by the whole sample. In the most eye-catching implementations, it can make areas of organic material translucent. But the infusion of a suitable material is a complex operation.

"Tissue optical clearing involves a number of biophysical processes occurring upon interaction of tissues with the so-called optical clearing agent or OCA," commented Kirill Larin of the University of Houston.

"A number of studies have shown that this could be a much more complicated process than it appears. Important parameters such as the molecular structure of the OCAs, structural modifications of collagen fibers or tissue dehydration can affect the clearing. And it seems that different mechanisms can dominate for optical clearing applied to soft

tissues compared to hard tissues such as tendons and cranial bones."

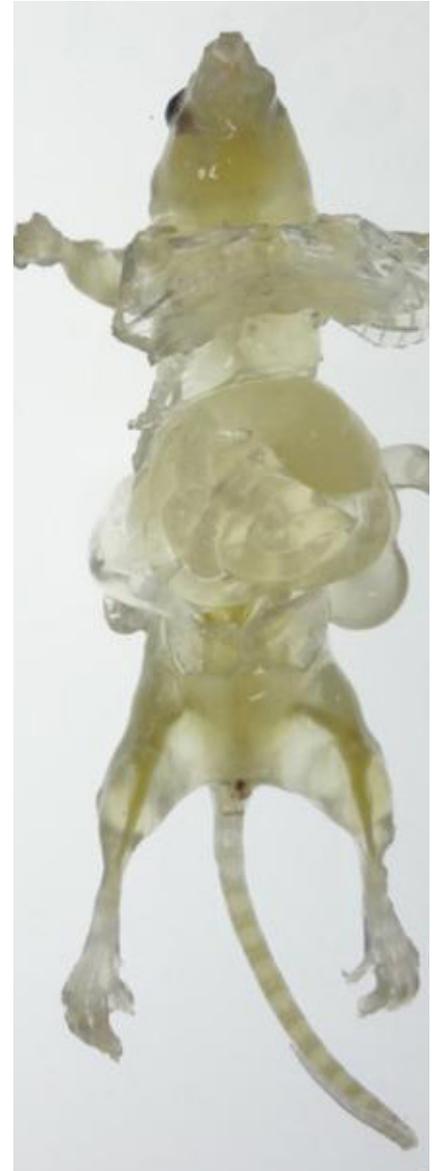
The field of optical clearing is currently a dynamic one, with research into new OCAs and diffusion techniques being carried out, along with the development of ways to enhance the efficacy of existing methods. But as Larin and Valery Tuchin of Saratov State University commented, the constraints and implications for the procedure vary for different scenarios; in particular on whether OC is applied to in vivo or ex vivo samples.

For in vivo use, the challenge is to achieve the best clearing result without inducing significant toxicity or structural defects, while a successful ex vivo application must preserve the structure of fluorescent markers or other species of interest that are present. It should preferably also reduce the time taken for clearing, which can run into weeks or even months.

"Currently, only sugar-based inert agents such as glucose, glycerol, and their derivatives and cocktails, can be considered for live applications," noted Larin. "For ex vivo uses, harsher chemicals can be used - and achieve, of course, a better effect."

## Live kinetics

Despite the obstacles, several groups have demonstrated notable results for both in vivo and ex vivo OC. These have included a method to make in vivo rat dorsal skin transparent through the topical application of a mixture of PEG400 and thiazone for a period of minutes, allowing an OCT



Credit: RIKEN, Japan.

*Techniques to make whole organisms optically clear and then image them at high resolution are becoming more effective all the time, as RIKEN's transparent mouse demonstrates.*

image of the dermal blood flow to be made through the skin.

The thin tissues typically examined by OCT should demonstrate rapid impregnation rates after a topical application of a clearing agent, so these two techniques may prove to be complementary and offer ways to enhance the imaging depth achievable by OCT alone.

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## Optical clearing meets challenges of live applications

Another landmark has been the clearing of an entire mouse body - ex vivo naturally - by a group at RIKEN, Japan, which found that the OCA already used to make mouse brains transparent for imaging could also clear the light-blocking heme chromophore from general blood vessels, given sufficient time.

Some enhancements to the OCA infusion process itself also show promise, including the application of mechanical compression to the tissues, which was employed in the imaging of the rat dorsal skin. This pressure can help to breach the outermost layer of the epidermis, or affect the inherent scattering behavior of the tissue on its own. A combined technique of immersion

and mechanical optical clearing could show promise in a number of scenarios.

"OCA impregnation into tissues is more effective in vivo than in vitro, owing to the higher diffusivity of an agent at physiological temperature, and by the involvement of blood and lymph micro-vessels in the process of agent distribution," commented Larin. "The in vivo kinetics of optical clearing are very sensitive to tissue structure, which might make it an effective marker for the signs of certain conditions such as cancer or diabetes in the tissues."

### Breaking the barriers

A wide variety of tissue spectroscopy and microscopy methods stand to benefit from advances in OC, by virtue of its adjustment to one of the common barriers faced by most of them. "Raman, confocal, fluorescence, laser scanning, near-field, and multiphoton methods could all be enhanced, along with second-harmonic generation techniques in

which scattering is a serious limitation," Larin said.

The performance of photoacoustic microscopy may also be improved; researchers have found that certain OCAs improved the amplitude of the photoacoustic signal detected within ex vivo rat skin from shallow blood vessels, and under certain conditions from deep-seated vessels too.

"Recent achievements in optical clearing have proven that it can break the barriers of optical microscopy," concluded Larin. "Researchers are coming to realize the potential benefits of the clearing techniques, and this field has experienced a boom in development over the last few years."

<http://optics.org/news/6/1/24>

#### About the Author

Tim Hayes is a contributor to optics.org

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# How vision systems are seeing our cities

Some unique ways vision systems are being used in modern cities.

## A Clearer view on city smog

The Robotics Institute of Carnegie Mellon University has developed four high resolution cameras to be used in the Breathe Project, a real-time interactive platform enabling users to see air pollution activity across the city of Pittsburgh.

“service, not just a technology”, according to lead researcher Paul Dille.

Whilst a number of cities employ similar systems to track air quality, none have yet done so quite like the Breathe Project; with a visible effort to create an interactive interface, and to facilitate the use of data on the cities air quality by the residents who live there.



View of Pittsburgh's "North Shore" via the Breathe Cam. Try it here: <http://breatheproject.org/>

The Breathe Cam uses panoramic images alongside data from six other sensors deployed throughout the city to provide a panorama, complete with data showing fine particles, humidity, temperature, wind direction and levels of sulphur dioxide gas.

Presenting a detailed image of pollution throughout the city, the Breathe Project also includes archive footage from the past year to allow users to investigate periods of high and low pollution in localised areas, and to discover what the causes might be. Users can zoom in on their neighbourhood and specific objects, whilst the Change Detection tool brings up the relevant data for that area.

The technology behind the Breathe Cam, developed by the CREATE Lab at CMU, takes pictures 24/7 of a 200 square kilometre area of Pittsburgh and uses software to create the panorama. It can produce a high-resolution image within 5-10 minutes with cameras that are five times the power of 4K televisions. The project has defined itself because of this processing speed as a

## Drive-by Thermography

Normally thought of as an occupation of Google, the latest drive-by data collection is being carried out by heat seeking cameras looking for energy wastage from buildings across the United States.



Capturing energy loss from buildings with the drive-by thermal imaging rig.

The Startup ESSESS, a spinout of MIT (Massachusetts Institute of Technology), are taking thermo images of schools, government buildings and residential homes using IR and NIR cameras mounted on cars. Paired with a lidar system using 3D images to detect the facades of buildings amidst the physical environment, each

system is adept to finding those buildings wasting energy and at a capacity of gathering several terabytes of data per session.

With onboard GPS, the images are processed and matched to produce an accurate map of heat loss across whole towns and districts.

ESSESS now manages a fleet of repurposed vehicles, working with utilities companies, oil refineries and the US department of Defence to combat energy waste.

## Algorithm allows for automatic tracking of pedestrians

Researchers at the University of Washington have developed a system that can track individuals across multiple moving and still cameras.



Automatic tracking of pedestrians is now possible across a network of cameras.

The process of Visual Simultaneous Localization and Mapping (V-SLAM) is achieved by each camera in the network first identifying the nuances between their frames. This algorithm trains the cameras to track individuals based on clothing colour, texture and body movements, regardless of the variations in light, angle or distance and without the need for facial recognition.

Professor of electrical engineering at UW, Dr. Jenq-Neng Hwang said, "Our idea is to enable the dynamic visualization of the realistic situation of humans walking on the road and sidewalks." The implications of this technology on surveillance and security in the modern city are discernible. So far the UW team have installed the cameras on cars, robots and drones, but the possibilities seem vast, especially as the only prerequisite for its operation is wireless and cloud connectivity.

### About the Author

Henry Tipping is a contributor to optics.org

# FLIR finds momentum in security and consumer markets

With restructuring over, the company saw organic revenue growth for the first time since 2010.

**Increased revenues across many of its markets boosted quarterly and full-year results for FLIR, making for what CEO Andy Teich described as a significant year for the company in the thermal imaging industry.**

Fourth quarter 2014 revenue was \$434.4 million, a rise of 9 percent over the same quarter of 2013, with net income for the equivalent periods increasing from \$28.7 million to \$72.8 million.

Full-year figures indicated a two percent rise in revenue to \$1.53 billion, while net income for 2014 increased by 13 percent to \$200.3 million.

"For the year we returned to positive organic revenue growth for the first time since 2010, while increasing our earnings per share by 14 percent over 2013," Teich told analysts. "We were very successful in realigning our operations to better serve our existing and future customers, while also reducing our operating costs."

The largest increase in quarterly revenue came in the company's security products segment, which rose by 35 percent to \$56.4 million, as part of a 27 percent increase for the full year. "We look forward to introducing some very innovative new products during 2015 that will create further momentum for the security segment," commented Teich, who expects it to remain the fastest growing part of the company's portfolio.

Currency exchange factors played a part in the overall picture, in particular impacting FLIR's maritime segment where more than 60 percent of sales were in currencies other than US dollars. The strength of the currency contributed to a fall of six percent in revenue year-on-year from that particular sector, the only one to decline.

Although not mentioned by name, FLIR's legal victory over Raytheon in a long-running dispute about trade secrets contributed to a rise in



The next-generation FLIR ONE unit should increase compatibility across iOS and Android devices.

corporate administrative expenses of 29 percent; CFO Tony Trunzo commented that concluded litigation matters should now have no further material impact.

Alongside the earnings announcement, the company approved a new share repurchase program aiming to acquire up to 15 million shares over the next two years, representing approximately eleven percent of FLIR outstanding common stock.

## FLIR ONE: the next generation

FLIR ONE, which brings thermal imaging capability to individual consumers via an attachment to mobile phones, continues to be a focus of the company's attention, with the latest iteration of the device bringing a new smaller form-factor and attaching to a phone as a dongle rather than a full-size case.

The company is keeping its options open for future designs, but a dongle version should bring improved compatibility with both iOS and

Android phones, boosting market penetration of the platform beyond its current level. Shipments will begin during the first half of 2015.

"The reality here is that FLIR ONE was launched to drive awareness in the market and find new applications,"

Teich said. "It's performed very well in that regard. The revenue expectations for the second generation FLIR ONE product are meaningfully higher than we had with the first generation."

FLIR's other significant 2014 introduction, the Lepton low-cost thermal imaging core, will see further utilization across most of the company's market segments according to the CEO, who predicted a relative increase in launches around the core in 2015 compared to the previous year.

Business acquisitions are now also on the company's agenda. "We have finished the strategic portfolio review and identified the areas that we feel offer the strongest growth for the business," Teich said. "M&A will become an important part of our strategy to augment those growth areas in the next year or two."

- The markets liked what they heard, with FLIR shares rising by 4% immediately after the results announcement and continuing upwards.

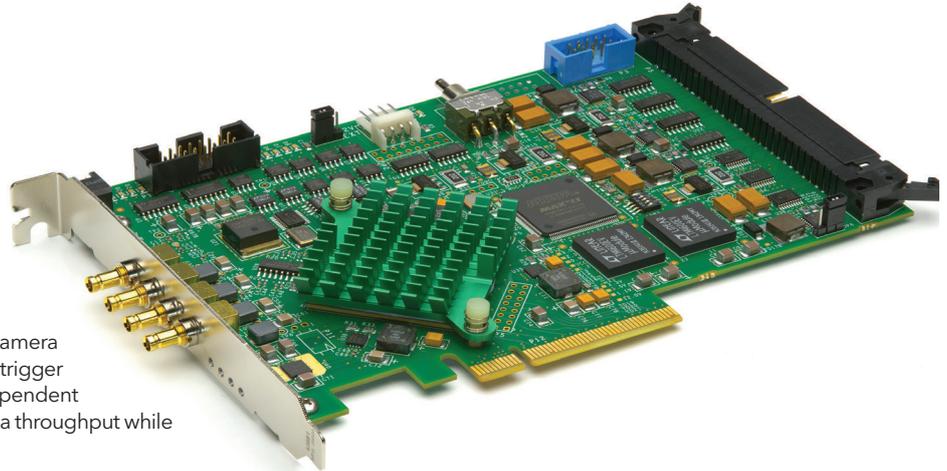
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# Lens-free microscope images cardiac cell contractions

Phase-contrast imaging looks useful for screening new drugs for their cardiac effects.

**A research team at IMEC in Belgium has developed a lens-free microscope that shows cardiac cells starting to contract and “beat” spontaneously.**

Veerle Reumers, a biomedical engineer at the research hub in Leuven, is working with optics specialists to come up with a completely new type of assay. It could have a dramatic impact on drug development, where cardiotoxicity – side-effects causing arrhythmias and even sudden death – is the main reason why new products are withdrawn from trials.

Reumers and her colleagues have taken specific types of cells, known as cardiomyocytes, from young rats. In tandem with pacemaker cells, these begin to contract spontaneously, generating a heartbeat when grouped together.

That cell contraction and conduction velocity – the speed of the electrical signal associated with the contraction – can now be watched directly on a microscope slide, across a field of view nearly 20 times larger than is possible with a conventional microscope but with comparable image quality.

“With a normal microscope we can see cells beating, but with this new system we can see speed and conductivity,” Reumers said. Those factors are critical for screening drugs that may cause arrhythmias.

The extra-large field of view with the lens-free approach also means that samples can be evaluated much faster,

with a single “shot”, and without the need for manual adjustment of focus.

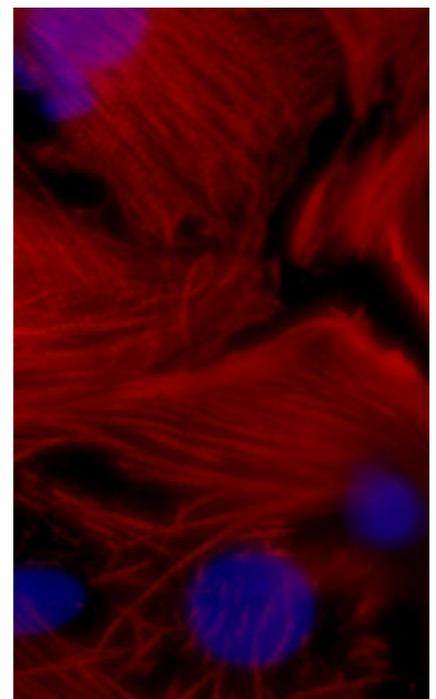
## Phase contrast image

The prototype lens-free kit is based around a coherent source – in the case of IMEC’s Photonics West exhibition demonstration, a diode laser – and software reconstruction of the light diffracted from the sample in the form of a hologram. That means a phase-contrast image can be collected at the sensor, showing effects that are otherwise impossible to see.

In work presented at the BiOS conference running in parallel with Photonics West 2015, the IMEC team showed how the lens-free microscope could image the effect of the drug verapamil. It is used to treat high blood pressure and angina, and works by blocking the uptake of calcium ions by muscles in the heart and in arteries.

After incubating the cardiac cells with increasing concentrations of the drug, the microscope images clearly showed a decrease in the frequency and strength of contractions, with no contractions at all at the highest verapamil concentrations.

As a result, the technique promises to complement the accepted assay method of electrophysiology, which measures cell contraction but has a



Credit: Scripps Research Institute

*Cardiomyocyte cells, imaged more conventionally by a team from the Scripps Research Institute. The IMEC team’s approach offers a simple and highly scalable way to show the effect of developmental drugs on heart muscle contraction.*

number of shortcomings. “We need a way to predict how drugs affect the contraction of cells,” Reumer said.

The IMEC team is currently looking for partners interested in developing the approach, which looks ideal for scaling up to high throughputs, for more widespread use.

<http://optics.org/news/6/2/17>

# Corning acquires assets of imaging specialist NovaSol

Acquisition follows glass and diversified optics giant's purchase of Samsung's fiber optics business.

**Corning have announced that it has acquired the assets of NovaSol, Honolulu, Hawaii, a developer of advanced hyperspectral imaging systems. The terms of the agreement were not disclosed.**

This new deal by the New York State-based manufacturer of materials including optical fiber and display glass, follows the acquisition in December of the fiber optics business belonging to Korean electronics giant Samsung.

Founded in 1998, NovaSol specializes in the research and development of next-generation active and passive optical systems, including electro-optical systems and optical communication systems. Corning said the acquisition will be integrated into its Advanced Optics business unit within the Specialty Materials division.

Curt Weinstein, VP and general manager, Corning Advanced Optics, commented, "We are excited about the opportunity to expand our portfolio of hyperspectral imaging solutions. NovaSol has a proven history of providing best-in-class performance in innovative imaging solutions. We



*NovaSol developed a compact version of its successful Dual Mode Optical Interrogator for free space optical communications.*

look forward to having NovaSol's talented team working with us to address current and emerging market opportunities."

Corning hopes that NovaSol's technology portfolio – see below – combined with its experience in developing optical imaging systems, will deliver high-performance, low-



*Expansive: Corning's headquarters in New York State.*

cost imaging solutions. Additionally, the companies' combined expertise should enable Corning to more efficiently address the needs of emerging industrial markets for advanced spectral imaging solutions.

Dr. Rick Holasek, NovaSol's president and CEO, said, "Corning's extensive production capabilities in optical systems and components and the company's commitment to research and development are synergistic with NovaSol's core competencies in imaging systems and optical communications."

## About NovaSol

Previously an employee-owned company, NovaSol provides technical solutions to complex military, industrial, medical, and environmental problems, notably for defense and government agency sectors. It is headquartered in Honolulu, Hawaii, with a mainland USA operation in San Diego, California.

Its focus is on the research, development, and productization of next-generation active and passive optical systems across the entire spectrum from the ultraviolet to the infrared with panchromatic to ultra-

spectral resolution. NovaSol applies its core technical competencies in sensors, optics and stabilization miniaturization technologies, performance modeling and simulation, software, spectral and spatial algorithms, data analysis.

## Airborne Hyperspectral Remote Sensing

One of NovaSol's areas of expertise is airborne hyperspectral remote sensing, which the company says

has "come of age" for small manned and unmanned aircraft. Its website states, "Miniaturization of imaging and processing modules enables use of low-cost aircraft – manned and unmanned. Computing power and powerful software/algorithms enable real-time/near real-time processing of hyperspectral collections, and price points enable broader applications across many civil and commercial markets."

NovaSol provides turnkey imaging and navigation solutions to government and industry, specializing in the development and production of visible/Near-InfraRed (visNIR) and Short Wave Infra-Red (SWIR) hyperspectral imaging (HSI) systems. Applications for these systems range from surveillance, tracking, mineral and other natural resource exploration, agriculture, homeland defense, and environmental monitoring to search and rescue, military reconnaissance, and urban planning.

<http://optics.org/news/6/1/36>

### About the Author

Matthew Peach is a contributing editor to optics.org.

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