

# Electro Optics

- + Has China already won the AR/VR race?
- + UK research funding shake-up
- + Why fragile lab kit won't cut it for scaling quantum photonics

# Breaking America

Optoman's Huyen Vu on why the Lithuanian IBS firm is taking on the US (and the mistake European rivals keep making)



**BiOS catch-up: Meng Wang, Igor Meglinski and Junjie Yao**

+ Show reports: TOP 2026 reviewed and looking ahead to Optatec

+ Shortlist announced on Page 8

**PHOTONICS FRONTIERS AWARD 2026**

Plus join us for the announcement of the winner at Optatec on May 6



# The *State of* Photonics 2026

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**Electro  
Optics**

The **PHOTONICS**  
**100**

Insights from the  
Photonics100 on future  
**challenges, opportunities  
and technologies**

# COMING SOON

# 06/2026





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# AI, quantum computing and the fight for UK photonics funding

With the backdrop of serious global AI and quantum sector ambition, and a formal recommendation by the Council for Science and Technology to take coordinated national action on photonics technologies, UK research funding has announced significant restructuring, but it's making the scientific community anxious

The UK's photonics sector is a success story by almost any measure. Generating £18.5bn in turnover in 2024, representing growth of around 20% over two years and contributing approximately £8.6bn to the UK economy, the figures are impressive. Optical technologies have quietly become one of the country's most strategically significant industrial assets.

In fact, the Council for Science and Technology (CST) estimates that, by 2035, more than 60% of the UK economy will need to depend directly on photonics to remain competitive. It's a projection that lent considerable urgency to a formal letter the advisory body recently delivered to the Prime Minister.

Drawing on the UK's long heritage in optical science, dating back to James Clerk Maxwell's 1865 theory of electromagnetism, the letter sets out three central recommendations to the UK government. They are:

- **Develop a national photonics roadmap**
- **Use public procurement to support domestic capability**
- **Expand international partnerships and exports**

Behind each recommendation lies the same concern: without coordinated national action, the UK risks losing momentum in a field where, according to the CST, it currently has a genuine comparative advantage.

"Photonics is a platform technology (that's) core to modern communication networks, smart display screens, biomedical imaging and precision cameras, and underpins 13% of global innovation output," wrote the CST in the letter.

"To capitalise on the investment the UK has already made in photonics and build technological leadership, government will need to act now, or risk losing momentum to international competitors within the next three-to-five years."

## A national photonics roadmap

The first recommendation set out by the CST, to develop a national photonics roadmap, isn't just suggested as a part of regular strategic planning, it's an attempt to coordinate government departments, funding agencies and academic institutions with industry. Public funding for photonics-related technologies is currently spread across multiple initiatives such as the National Quantum Technologies Programme and the UK Semiconductor Centre. While relevant and independently worthy, writes the CST, these programmes lack alignment; whereas a unified national roadmap would help coordinate funding priorities and align investment with long-term infrastructure development.

Beth Betts, Head of Marketing at Microelectronics UK, said: "The renewed focus on photonics within UK industrial and research policy is a strong signal for the sector. A national photonics roadmap would provide much-needed long-term direction across research, manufacturing and commercialisation – essential for an industry that underpins technologies from advanced communications and sensing to emerging quantum systems.

"For the wider microelectronics ecosystem, clearer funding structures and sustained investment should help strengthen supply chains and encourage deeper collaboration between academia, start-ups and established manufacturers. Through our work convening industry leaders, engineers and researchers across semiconductors, photonics and embedded systems, we are seeing growing momentum around photonics as a foundational technology for next-generation electronics and advanced manufacturing in the UK."

Also addressed by the CST is the geography of the sector. Photonics clusters in the UK extend well beyond the so-called 'Golden Triangle' of London, Oxford and Cambridge, with significant capabilities at universities in Southampton, Aston,



UK Prime Minister Sir Keir Starmer is pictured delivering a speech at London Tech Week

Sheffield, Strathclyde, Glasgow, Heriot-Watt and Queen's University Belfast. These institutions are key to supporting breakthrough research in optical fibres, lasers, quantum photonics and optoelectronic devices, and have developed their own local start-up and SME ecosystems. Therefore, the CST argues a national roadmap could help activate and utilise these clusters more effectively.

Callum Littlejohns, Deputy Director at Cornerstone, the open-source silicon photonics foundry based at the University of Southampton, agrees: "The UK's Council for Science and Technology's call for a national roadmap comes at a vital moment. The UK already possesses strong capabilities in silicon photonics and AI-driven optical computing, but maintaining that momentum demands alignment across research, procurement and skills. A dedicated roadmap linking photonics with the government's broader quantum and semiconductor investments would offer the clarity needed to speed up commercialisation, bolster onshore supply chains, and ensure the UK remains competitive with international peers in AI and computing technologies."

Another point broached by the CST is the widening skills gap, identified as a potential constraint to growth. Time-bound commitments from the Global Talent Taskforce, UKRI and Skills England to attract and retain specialists are clearly being called for. Specific suggested commitments include simplifying visa processes, developing re-skilling programmes and representation in national-level skill strategies.

Dr Andy Sellars, Cornerstone's Director of Strategy, cautions that skills attraction is only part of the equation: "It's encouraging to see the Government take steps to mitigate the UK tech talent

shortage and ensure that we're still attracting the brightest minds to study here. However, we also need to look at talent retention, workforce development and how the UK bridges the gap between academia and industry. We can't extract the maximum value from these talented researchers unless we can provide them with the support they need to turn their ideas into viable UK-founded businesses to drive economic growth.

"This is something we see acutely in silicon photonics, where the pipeline of academics and research is strong, leading to a healthy start-up community. However, the scale-up challenge requires access to seasoned industry experience and facilities, with strong competition from overseas. We need a more coordinated approach for how we support talent and industry overall, which brings together academic researchers, scale-up partners and government support to generate economic growth. Otherwise, companies and investors will push funds and talent toward countries with clearer strategic visions."

#### Procurement and sovereignty

The second of the CST's recommendations suggests the Government can support economic growth by fuelling the demand for photonics technologies, arguing that public procurement can be used as a tool to create stable, long-term demand for photonics, beginning with defence and national security applications such as directed energy and quantum navigation. A five-year procurement would help "de-risk private investment, support resilience of our industrial base and build sovereign capability in critical defence technologies," writes the CST, which proposes an early adoption pilot scheme for optical computing in the public sector, >

- > accelerating technological maturity and establishing reference customers for early-stage industries to attract.

The absence of a National Photonic Integrated Circuit Foundry is identified as an example of a specific infrastructure gap, resulting in a lack of prototyping and low-volume production capabilities. Although the UK does have identified strengths in chip prototyping at Southampton and Sheffield, a dependence on overseas semiconductor factories is a limiting factor and addressing it would mean these research capabilities could be better translated into industrial production.

### International exports and partnerships

CST's third and final recommendation addresses the UK's international positioning. With more than half of the UK's photonics companies exporting 75%-plus of their output, the sector already attracts substantial foreign direct investment. On the recommendation of the CST, however, these foundational figures could be better built upon with a UK Photonics Export Support Programme delivered by the Department for Business and Trade and the Office for Investment.

Deeper ties with technology-partnering nations such as Taiwan, Japan, Singapore and South Korea are called for to improve R&D, standards development, talent exchange and supply chain resilience. In Europe, especially, there are unexplored opportunities, writes the CST, with deeper engagement with European hubs.

"UK photonics is already a success story," concludes the CST in the letter, "by developing a national roadmap to improve coordination, investing in UK security and developing trusted partnerships, we can capitalise on our comparative advantage."

If implemented, the CST estimates it could help expand the sector to £50bn by 2035, and create up to 150,000 additional jobs.

### A quantum example

The letter has been written at a crucial point of the UK's developing science policy, shortly after the Government announced a £2bn package for quantum research, with UKRI committing to support the development and installation of large-scale quantum computers in the UK, and the news that the National Quantum Computing Centre and the Quantum Software Lab at the University of Edinburgh will receive £20m to test, benchmark and validate cutting-edge quantum computing systems with "the confidence to innovate at pace".

Meanwhile, a further £13.8m is being injected into the National Quantum Technology Hubs, which have developed applied research programmes with more than 120 industry partners across quantum comms, computing, imaging, sensing and timing. With an additional £12m directed to a dedicated commercialisation skills centre, the UKRI has described it as the first country to "commit to roll-out quantum computing at this scale", which could lead to £200bn being added to the economy by 2045.

"Quantum technology holds transformative potential across everything from healthcare and renewable energy to national security and defence," said UKRI Senior Responsible Owner for Quantum, Professor Charlotte Deane. "(The) announcement signals a shift in pace towards turning research into commercial deployment that delivers meaningful benefits. It reflects years of sustained government and UKRI investment in the UK's quantum research base and the nurturing of exceptional talent, skills and partnerships that have made this moment possible."

Richard Murray, who is the co-founder and CEO of ORCA Computing, said: "It's fantastic to see such positive commitment to quantum, which shows a real understanding of how the UK's leading position in deep tech can translate to prosperity."

"Key to the quantum announcement was the inclusion of a sizeable sustained procurement programme, which acts over-and-above where grant funding can take you in order to catalyse late-stage commercial and product development. The quantum programme has shown what the UK can do if it leads from the

# "The Government needs to act now, or risk losing momentum to international competitors"

front with a coordinated programme, and I hope that this can be copied across different areas of deep tech.

"I therefore welcome the commitment to a future photonics roadmap that has a similar potential to deliver UK competitiveness," he said.

### Restructuring of UK research funding

Driven by photonic integrated circuit (PIC) development for data centre interconnects, optical AI accelerators, lidar systems and quantum photonic processors, the CST predicts the optical computing market will grow from £710m-plus in 2024 to almost £13bn by 2035. But not all research is created equal...

Counter to the above stated figures and investment, the Science and Technologies Facilities Council (STFC), part of the UKRI, has announced a warning to the particle physics, astronomy and nuclear physics (PPAN) communities that its budget could be slashed by 30% after steep inflation and rising operational costs.

In what the STFC called a reprioritised funding model, investments are to be assigned across three distinct areas, including curiosity-driven, investigator-led research; support for innovation and more targeted support for identified government and societal priorities.

"To support a comprehensive appraisal of (the funding) options," writes the STFC, "we will ask individual projects to identify how their project would respond to cash reductions of 20%, 40% and 60%, and identify the specific funding loss percentage at which the project ultimately becomes non-viable." Information, it says, will then be used to make redistribution decisions.

After a resulting backlash from the research and innovation community, UKRI CEO Sir Ian Chapman acknowledged the anxiety felt about the changes, apologising for the uncertainty this has caused and committing to wider consultation before final decisions are made.

"Uncertainty about funding is an unhelpful overlay when already faced with great challenges," he wrote, recognising researchers "need great resilience to persevere in the face of adversity".

He pointed, however, to the protection of applicant-led, curiosity-driven research, with UKRI's responsive-mode grant budget growing from £737m in the current financial year to £866m by 2029/2030. "Curiosity-driven research is protected," he said, "both in scale and in scope."

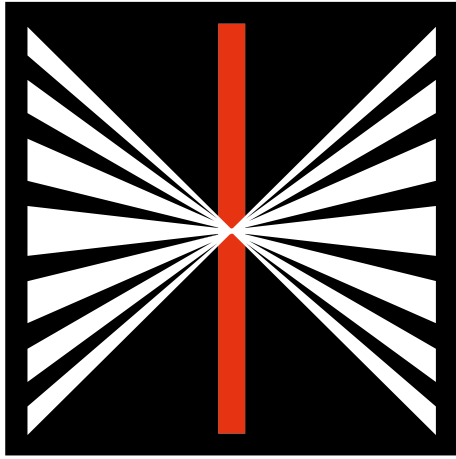
For the researchers themselves, the emerging picture certainly remains one of anxious uncertainty. But is there a glinting diamond of opportunity to be found among the dirt?

The CST's recommendations align with the Government's commitments, pointing towards coordinated, strategically-oriented investment in optical technologies as a foundation for future economic competitiveness on the global stage.

But far from simplifying the system, the simultaneous reduction, restructuring and reprioritisation of research funding may instead introduce an additional layer of complexity. **EO**



Report:  
**James Wormald**



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# Photonics Frontiers Award shortlist is announced

With just weeks to go until Optatec 2026 in Frankfurt, Germany, the finalists for the Photonics Frontiers Award have been announced. You can read details of the shortlisted finalists below at [www.electrooptics.com/frontiers](http://www.electrooptics.com/frontiers).



## Biophotonics & medical applications

- » Improving breast cancer diagnostics with multimodal photonics – Politecnico di Milano
- » Plug-and-play adaptive optics module for routine microscopy workflows – Phaseform
- » Polarimetric imaging for tissue characterisation during brain tumour surgery – Ecole polytechnique, CNRS

## Defence / Aerospace / Space

- » Wavefront-shaping display to replace multi-monitor arrays – Brellyon
- » Quantum dot InAs modulators to replace optical interconnects in space – Xtreme Photonics Group

## Industrial imaging

- » Bringing nanometre surface metrology to the shopfloor – Wyse Light

## Industrial laser systems

- » Using machine learning and a photonic 3D fingerprint to guarantee weld quality – Audi
- » Making inkless laser colour marking on metal commercially viable with closed-loop AI – Oraclase
- » Stabilising laser energy delivery with passive radial polarisation – Technology Innovation Institute (TII)

## Optical communications & data transfer

- » An integrated DWDM laser source for AI data centre optical interconnects – Scintil Photonics
- » Overcoming AI's 'laser bottleneck' with Very Large Scale Photonics – Lightmatter

## Quantum tech & optical computing

- » 'World first' industry-ready photonic

co-processor – Q.ANT

- » Turning VCSELs' 'nuisance noise' into truly random quantum encryption – Quside

## Sensing & measurement applications

- » Boosting infrared avalanche photodiode sensitivity with antimony – Phlux Technology
- » Bringing velocity sensing to industrial robotics with chip-scale FMCW lidar – Voyant Photonics
- » Closing the gap between lens design and reality with active MTF alignment – IB/E Optics

## The award ceremony

The winner will be revealed at a special ceremony on Wednesday, 6 May, at 3:30pm in the Exhibitor Forum at Optatec 2026, Booth 625.

## Nvidia invests \$4bn into Coherent and Lumentum for AI data centres

Nvidia has announced \$2bn investments into Coherent and Lumentum, alongside strategic partnerships, to secure the advanced optical components it needs to scale next-generation AI data centres.

The two agreements each include multi-year, multi-billion-dollar purchase commitments alongside future capacity access rights covering advanced laser components and optical networking products. Both investments are intended to support research and development, as well as the expansion of US-based manufacturing facilities; with Lumentum also announcing plans for a new fabrication facility.

As AI workloads grow and the compute clusters underpinning them expand into what Nvidia describes as 'AI factories', the copper interconnects traditionally used within data centres cannot provide the bandwidth density, reach or energy efficiency required.

"Computing has fundamentally changed," said Jensen Huang, Founder and CEO of Nvidia. "In the age of AI, software runs on intelligence with tokens generated in real time by AI factories for every interaction and every context. Nvidia is pioneering next-generation silicon photonics to enable AI infrastructure at unprecedented scale, speed and energy efficiency. AI has reinvented computing and is driving the largest computing infrastructure build-out in history."

Both partnerships focus on the convergence of two interrelated technology areas: optical interconnects and advanced package integration. Co-packaged optics is widely seen as a likely successor to pluggable optical transceivers, reducing signal loss and power consumption by shortening the distance between the electrical and optical domains.

Professor Graham Reed, Director of the Cornerstone silicon photonics innovation centre led by the University of Southampton, said the combined \$4bn commitment was a turning point: "This is the clearest signal yet that silicon photonics (SiPh) is entering the



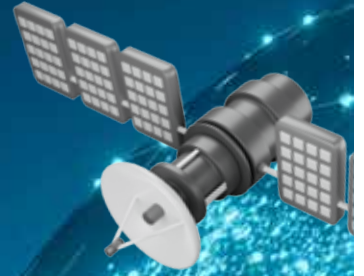
Nvidia's two partnering HQ sites, Voyager (pictured) and Endeavor, sit side-by-side in Santa Clara, California

mainstream. While SiPh is already serving as the backbone of data-centre communications, this move marks its transition into becoming the foundational technology for enabling low-energy AI. As reducing AI power consumption becomes a government and business imperative, we are likely to see more businesses follow its lead and invest in SiPh to reduce data centre and energy consumption yet further."

Reed also pointed to implications that sit beyond the immediate commercial context: "(The) move is undoubtedly positive for the industry overall, but it must also serve as a reminder for companies, industries and governments that are not yet prioritising silicon photonics as a strategic technology for the future."

"This currently includes the UK, which had the first SiPh company in the world and has a leading academic research base, but is at risk of losing out without urgent action. As Nvidia's investment underscores, now is the time to be investing in SiPh, and by investing in scale-up infrastructure, the UK will be able to ensure our SiPh industry can compete on a global scale."

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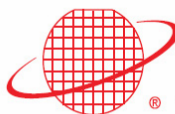
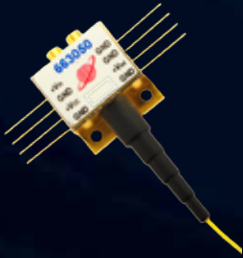


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# TOP 2026: photonics takes centre stage in the age of AI

Industry leaders, researchers and academics converged at TOP 2026 at London's Kia Oval to debate the photonics boom, fuelled by rising AI infrastructure demands and advances in photonic integration, satellite networks, free-space optical wireless and quantum communications

**N**ow in its fifth year, the TOP Conference 2026, held 29 to 30 January at the Kia Oval, London, brought together leading voices from industry, academia and research to explore the fast-evolving landscape of photonics, optical networking, quantum communications and data centre technologies.

The event featured keynote addresses, technical sessions, a poster exhibition and a trade exhibition showcasing photonic products and solutions. Speakers represented organisations including Nvidia, Lumentum, Microsoft, Huawei, ESA and CSA Catapult, alongside academics from the Universities of UCL, Oxford, Cambridge, Heriot-Watt, Ghent and Glasgow, plus the National Institute of Information and Communications Technology (NICT), Japan.

"The UK punches above its weight in telecoms, optics and photonics," said Conference Chair Wlodek Forysiak, Professor of Data Centre Networks at the University of Bristol and a member of the

TOP Technical Programme Committee. "The UK Government recognises this and recently reaffirmed a portfolio of critical future technologies, four-out-of-five of which are relatable to the topics of this conference."

### Setting the scene: the keynotes

Two keynote addresses framed the intellectual boundaries of the event. Ashkan Seyedi of Nvidia opened with 'Networking in the Age of AI', making the case that as AI systems scale to trillions of parameters and exascale compute clusters, optical interconnects, co-packaged optics and energy-efficient link technologies in particular, are fundamental to the performance and sustainability of tomorrow's AI factories. He highlighted how advanced photonic approaches are reshaping not only bandwidth and latency, but the environmental footprint of AI infrastructure.

Elham Kashefi of the National Quantum Computing Centre (NQCC), University of Edinburgh and CNRS, brought a quantum

perspective, presenting on 'The Networked Quantum Data Machine'.

Drawing on recent breakthroughs, Kashefi described how measurement-based quantum computing (MBQC) provides the foundational architecture for scaling secure distributed quantum services, and how adaptive state injection grants linear photonic circuits the non-linear expressive power needed for quantum machine learning to achieve a proven polynomial advantage over classical models.

### Panel discussions: photonics, AI and the investment boom

One of the conference's most animated sessions was the first panel discussion, 'Photonics for AI: Opportunity, Investment and Innovation', which assembled Photonics100 honouree Matt Sysak, CTO of Lumentum; Dr Xianxin Guo of Oxford University and Lumai; George Zervas of UCL and Oriole Networks; and Dave Grimm, partner at venture capital firm Albion.



Delegates from across industry, academia and research gathered to hear from more than 20 speakers spanning data centres, photonic components, free-space optics and quantum communications

Moderated by James Regan of Oriole Networks, the discussion tackled the questions swirling around a sector experiencing unprecedented investment and equally unprecedented pressure.

“Photonics for AI is a massive topic,” opened Regan, alongside nods of agreement from the four panellists.

“Optics is fundamental (to AI),” agreed Sysak, and Zervas stated that industry “innovation is happening at an incredible pace”. But innovation brings excitement, excitement causes investment and with investment hype comes natural concern.

The first question put to the panel was simple: “Is this a bubble?” Have we learned lessons from the telecom bubble of the early 2000s, or is history repeating itself?

“Maybe (it’s a bubble),” admitted Grimm, “but will the infrastructure still be needed? Yes. The build-out is real.” So, bubble or not, the opportunity is there. The consensus followed, that while valuations are being over-hyped in places, the underlying product – AI infrastructure – will be used by virtually everyone, making it categorically different from the telecom bubble.

The core technical challenge facing AI, said Guo, is energy efficiency: “Everyone using AI systems is being limited by power, (and) there’s a limit to what can be done with electronics,” therefore, the door is open for the photonics solution to “do what it can to solve the energy problem,” said Regan.

Rather than its ability to solve a problem, however, it was suggested that photonics would either stand or fall based on its ability to find real-world use cases.

Asked what the killer use case would actually be, Sysak said it’s there already. “AI (itself) is the killer use case,” he said, pointing to how ever-present the technology has already become in such a short time.

Grimm, however, was more cautious, pointing out that “for every \$1 ChatGPT earns from its customers, it spends \$3-to-\$4 serving them” – a sobering reminder of the real-world economic gap yet to be bridged.

On the subject of reliability versus performance, Sysak gave a realistic tone, stating “reliability is critical, but the world is driven by performance. I can find a way to work around reliability problems, but I need performance. Performance is king right now.” And despite overly-healthy market appetites causing stresses in the supply chain, the effect they have on innovation are worth it.

“In the past, timelines were in years, now it’s one year or less,” said Zervas, on the speed of the innovation cycle.

### Technical streams: highlights of presentations from the floor

#### Data centres

Data centres are among the most photonics-intensive environments on the planet, relying on optical interconnects, integrated photonic circuits and advanced switching architectures to move vast volumes of

TOP Conference



The conference featured contributions from organisations including Nvidia, Lumentum, Huawei Technologies, the European Space Agency and Nokia Bell Labs, alongside prominent international universities

data at speed and with energy efficiency increasingly at the fore. Three presentations addressed this space, looking at 3D-printed photonic structures for improved chip-to-fibre coupling, optical-domain signal processing and reconfigurable optical circuit switching for AI clusters.

Professor Dan Marom of the Hebrew University of Jerusalem demonstrated cascaded photonic lanterns for VCSEL multiplexing via direct laser writing, achieving an impressive 4.4dB total link loss and a 2dB chip-to-fibre improvement, “which is a record” Marom told the audience.

Sarah Masaad of imec and Ghent University presented “trainable and versatile” photonic reservoir computing as a low-power alternative to DSP, processing signals directly in the optical domain across multiple wavelengths simultaneously.

And Dr Ana Gonzalez of iPrionics examined silicon photonics-based optical circuit switching, enabling dynamic, fault-tolerant AI network topologies “by adapting to real-time workloads”.

#### Photonic components

If the data centre stream addressed how photonic technologies are deployed at system level, the photonic components stream dug into the building blocks themselves, the modulators, amplifiers, switches, waveguides and integrated platforms that determine what optical systems can actually achieve.

Across a total of seven presentations on both days, speakers addressed the urgent demand for greater power efficiency, the materials race to succeed silicon photonics at higher speeds and the simulation and fabrication tools shaping the next generation of photonic devices.

Sysak set the tone with a frank survey

of power-efficient optical technologies for data centres, covering high-speed indium phosphide (InP) modulation, optical switching and high-power laser technology.

“We talk a lot about the virtuous cycle for AI scaling,” he said, before noting the uncomfortable reality that it means going to ever greater lengths to generate enough power for AI data centres.

When asked about which technology the future would be built on, he was direct: “Silicon photonics will still be around for 450G, but InP or thin-film lithium niobate (TFLN) is where the future is, and the difference between the two is not performance, it’s size.”

Meanwhile, Photonics100 honouree Professor Liam Barry of Dublin City University addressed the same power challenge from a different angle, demonstrating terabit-per-second data centre links using mode-locked lasers (MLLs) and semiconductor optical amplifiers (SOAs), which, he said, can achieve energy efficiency below 300 femtojoules per bit. “SOAs have great potential to enable high-capacity and energy-efficient links,” he concluded.

Giuseppe Talli of Huawei Technologies then extended the conversation to passive optical networks (PONs), arguing they must evolve toward 200Gb/s and become AI-embedded for dynamic resource provisioning. “Coherent will expand PON beyond typical residential cases,” he predicted. Closing out the first day, Charlie Johnson of COMSOL woke up a flagging crowd by demonstrating how multiphysics simulation supports photonic crystal device development across the full workflow, from bandgap engineering to performance optimisation for waveguides, filtering and demultiplexing.

A second day of photonic components



The first panel brought together (l-r): academics-turned-entrepreneurs Dr Xianxin Guo and George Zervas, VC investor Dave Grimm of Albion and Lumentum CTO Matt Sysak to debate whether the photonics boom is a bubble – and what will come next

talks began with Professor Mike Wale of UCL surveying the emerging materials, including III-V quantum dots, TFLN, ferroelectrics and graphene, that are converging with silicon photonics to deliver capability across data centres, lidar and quantum systems. “The demands of these systems are continuing to escalate,” he said.

Dr Ning Zhang of CSA Catapult then outlined a roadmap for advancing PIC-based all-optical switching “from prototypes to rack-level deployment,” projecting microsecond-class reconfiguration and meaningful reductions in energy per bit versus MEMS approaches, and Dr Thalia Dominguez Bucio of the Optoelectronics Research Centre closed out the session by making a case for silicon nitride photonics, stating “its wide transparency range, low propagation losses and compatibility with established CMOS fabrication” enable integrated circuits to perform “beyond the constraints of traditional silicon-on-insulator technologies”.

**Free-space optics**

Free-space optical wireless technologies are moving rapidly from research curiosity to practical infrastructure, and four presentations across the two conference days reflected that maturity, spanning AI-enhanced optical wireless communications, programmable surfaces for 6G, satellite optical networking and indoor positioning. Together, they painted a picture of a field where light is no longer confined to fibre, but is increasingly being put to work across the atmosphere and in orbit.

Paul Anthony Haigh of Queen Mary University of London kicked off the first Free Space Optics session by exploring where AI and machine-learning fit into the optical

wireless communications (OWC) landscape, examining how adaptive beamforming, spatial diversity, interference mitigation and channel modelling can be enhanced through intelligent algorithms.

Haigh argued that “the integration of AI/ML into OWC systems offers exciting new possibilities for optimising performance”, and called for greater interdisciplinary collaboration to harness that potential.

Following Haigh, Dr Hanaa Abumarshoud of the University of Glasgow presented her work on reconfigurable intelligent surfaces (RIS) for 6G, showing how programmable optical surfaces can turn the wireless propagation medium from an impediment into “an additional degree of freedom”.

According to Abumarshoud, the VCSEL-based light-emitting RIS architecture supports mmWave communications through light-based localisation and sensing with millimetre-level accuracy, delivering improvements in spectral efficiency and physical-layer security.

Closing out the first day, Kasia Balakier of the European Space Agency rewarded attendees for choosing her talk by detailing ESA’s vision for global satellite optical networks. Balakier introduced the agency’s HydRON programme which, she said, envisions a future where terrestrial high-capacity networks seamlessly extend into space, creating ‘Internet beyond the cloud(s)’. Meanwhile, the agency’s Scylight programme aims to weave together optical non-terrestrial and terrestrial fibre networks into a single interoperable system spanning orbital, atmospheric and subsea layers.

Finally, Iman Tavakkolnia of the University of Cambridge and the LiFi Research and Development Centre addressed a gap that

affects almost everyone. “Most people spend around 90% of their time indoors,” he said, “yet current location-based services are optimised for outdoor use.”

Tavakkolnia described how optical wireless positioning (OWP) could offer centimetre-level indoor accuracy through AI-based approaches. And “when integrated with radio systems,” he said, the technology “ensures continuous navigation from indoor to out”.

**Quantum communications**

On the subject of quantum photonics for communications applications, Robert Starkwood, Head of Performance at KETS Quantum Security, presented his talk, ‘Chip-Based Quantum Key Distribution (QKD) for Large-Scale Deployment’, setting out how it will transform digital security by establishing intrinsically quantum-safe networks.

Addressing the key barriers to adoption, which he identified as their cost, bulk and complexity, Starkwood introduced KETS’s photonic-integrated-circuit-based QKD systems, which are manufactured in commercial photonic foundries using silicon-on-insulator transmitter chips and optically self-contained quantum random number generators. According to Starkwood, the company’s most recent breakthrough, receiver chips co-integrated with single-photon avalanche detectors, solves “the last remaining hurdle to the miniaturisation and large-scale deployment of discrete-variable quantum key distribution systems”.

**Poster highlights**

The poster exhibition drew contributions from both industry and academia, offering a window into the practical and experimental work advancing photonics beyond the

conference podium. From automated PIC packaging and ultra-low-loss quantum interconnects to AI-driven network design and optical neural network activations, the posters demonstrated the breadth of innovation being pursued across the sector.

**Top three industry posters**

Ruky Toje, AI Product Manager at Proteus AI, addressed the human side of photonic network transformation to examine the “skills gap in network automation roles, the lack of AI-readiness within traditional engineering teams and the product-development bottlenecks that delay deployment”. Her poster offered practical strategies for building future-proof workforce pipelines and integrating AI tools without disrupting critical infrastructure.

Josue Parra Cetina of ficonTEC presented work on the automated packaging of microlens arrays with integrated turning mirrors for PIC connectivity, a critical enabler for co-packaged optics. Combining passive and active alignment techniques, the poster described how ficonTEC’s assembly systems achieve the micron-level precision required for high-throughput manufacturing, with the demonstrated assembly supporting “direct applications in connector pluggability” and out-of-plane optical coupling to a PIC on a glass interposer.

Presenting a new class of ultra-low-loss fibre connectors that achieve coupling losses “well below 0.1dB,” Diamond SA’s poster revealed a novel connector architecture and manufacturer approach which, it said, enables both systematic loss reduction and exceptional mechanical stability, directly addressing the stringent performance requirements of quantum photonic systems in computing, cryptography and precision sensing.

**Top three academic posters**

Wanqi Yang of the University of Southampton’s Optoelectronics Research Centre demonstrated reconfigurable optical transfer functions via four-wave mixing in cascaded highly nonlinear fibres, approximating ReLU, Softplus and Sigmoid-like activation functions for optical neural networks.

Deployed as lookup-table activations in a MNIST classifier, Yang’s poster said the system achieved more than 97% test accuracy, suggesting “Kerr nonlinearity could offer a promising route to ultrafast, low-latency activation operations for photonic AI accelerators”.

A number of researchers from Aston University’s Institute of Photonic Technologies meanwhile proposed a scalable photonic platform based on Kerr microring resonator frequency combs for optical

reservoir computing, enabling “GHz-speed, low-power processing,” said the poster, validated across time-series forecasting and benchmark classification tasks. According to the team, the platform also shows promise for telecom signal equalisation, positioning it as a candidate architecture for integrated photonic AI accelerators in next-generation data centre systems.

A generative AI model that “captures structural and spectral properties while enforcing biconnectivity and sparsity” was presented by Akanksha Ahuja of the University of Cambridge. Trained on more than 100,000 physical network topologies, the model Ahuja has named ‘Topology Architect’ is capable of generating 100-node optical network designs in sub-second time and, according to the researcher, produces embeddings with an order-of-magnitude greater topological diversity than conventional approaches to address a longstanding computational bottleneck in large-scale optical network optimisation.

The wealth of information and innovation presented across two days at the Kia Oval was a convincing testament to the health and ambition of the UK’s photonics community. And with the event already having confirmed a move to a larger Earl’s Court venue for 2027, the conversation is expected to get larger, longer and louder. **EO**

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# European AR/VR firms need a wake-up call

Following his recent trip to the CIOE show in Shenzhen, Photonics100 alumnus **Dr Faisal Kamran** says it is no longer a question of whether China will become a major player in AR/VR and automotive HUD markets – it's whether Western firms can remain relevant at all...

Is China overcoming technical hurdles faster than the West? The short answer is 'yes', through aggressive vertical integration and a willingness to iterate on hardware at software speeds. The distinction is not that China picks better technologies. It runs all bets in parallel – geometric waveguides, diffractive waveguides, MicroLEDs, LCoS (liquid crystal on silicon), DLP – and commercialises whichever path delivers a shippable product first. This approach means China is mastering multiple available paths while aggressively scaling the ones that enable lightweight consumer forms now.

## The more critical question is 'how are they doing this?'

While Western firms often wait for a technology to be perfect before scaling, Chinese players are industrialising 'good enough' solutions while simultaneously funding the 'holy grail'. Three specific areas that illustrate this stood out at CIOE:

## AR optics

It is a misconception that China is only focused on one type of optic. I saw a robust ecosystem for geometric waveguides (Raypai and Shoujing, for example) delivering high image quality. However, the clear strategic bet for the mass consumer future is on diffractive waveguides paired with microLEDs.

Why? Because Chinese OEMs are prioritising form factor (thinness/weight) above all else to crack the 'everyday wear' market. They aren't waiting for the perfect optic; they are optimising what fits in a 50g frame today.

## MicroLEDs

The 'red light' efficiency problem has been a global bottleneck. At CIOE, I saw firms such as Raysolve and Hongshi demonstrating monolithic full-colour microLED chips that solve this on the wafer level, bypassing the bulky prism-combiners the rest of the

industry still relies on. They are moving from lab concept to pilot line at a pace that I haven't seen elsewhere.

## Automotive HUDs

Chinese EVs are leaping past the 'postage stamp' head-up displays (HUDs) common in European cars. Players such as Huawei and XPeng are already deploying 'panoramic' HUDs that turn the entire windshield into an AR canvas. These are powered by locally produced, high-brightness LCoS (liquid crystal on silicon) and DLP (digital light processing) engines, driven by software-defined optics that lock graphics to the road. The iteration cycle is annual – closer to smartphones than automotive.

Whether walking through CIOE or Shenzhen itself, there are clear signs that China is developing the scale to dominate, by building a self-reinforcing supply chain that is increasingly immune to external shocks.

The most telling signal at CIOE was Lingxi



Dr Faisal Kamran outside the CIOE exhibition in Shenzhen, China

AR launching a mass-production waveguide for \$50. This shatters the BOM (bill of materials) cost barrier. When optics become commodities, Western firms competing on price will be wiped out. And the effects of this cost collapse are already visible on the streets of Shenzhen.

#### The 'Huaqiangbei effect'

Walking around Shenzhen's electronics markets, such as the famous Huaqiangbei, I was shocked by what I saw: a massive variety of AR/smart glasses from competing manufacturers are available right now at varying price points. They aren't just building one 'Pro' device – they are filling every market tier, from cheap notification glasses to high-end AI assistants.

China is building the 'Android of AR hardware' – a diverse, commoditised ecosystem. By the time Western ecosystems fully mature, Chinese consumers will already be accustomed to wearing smart glasses, and their supply chain will have optimised the costs down to smartphone levels.

The 'iPhone moment' for AR glasses will likely happen in China first, and within 20-30 months. With access to \$50 waveguides and cheap microLED engines, domestic brands can flood the market with consumer-grade smart glasses in the \$200-\$300 range, establishing the dominant OS and app ecosystems before Western hardware is even affordable.

## “European firms should double down on being the ‘arms dealers’ of the industry – making the tools and materials China’s volume factories rely on”

#### So, what should European firms do?

Europe cannot win a volume war against this machine. The strategy must be one of 'precision and partnerships'.

Europe still leads in complex, high-precision manufacturing equipment (NIL tooling, metrology) and advanced materials (high-index glass). European firms should double down on being the 'arms dealers' of the industry – making the tools and materials that China's volume factories rely on. Companies such as SCHOTT, whose specialty glass substrates are already embedded in Chinese waveguide production lines, show this model works. They do not compete on volume; they supply the inputs that volume depends on. It should also pivot

to 'specialised' quality. China is winning on consumer volume (diffractive waveguides). Europe should dominate the high-performance niches (geometric reflective) required for enterprise, medical and defence, where image quality and privacy (zero light leakage) matter more than price.

Thirdly, European companies should move 'up the stack'. They need to stop selling components and start selling modules. If you just sell a lens, you will eventually be replaced by a lower-cost domestic/international supplier. If you sell a calibrated optical engine that solves a system-level problem (such as motion sickness in VR), you remain indispensable.

#### A final observation

Walking the floor at CIOE, the energy is undeniable. It reminds me of Silicon Valley in the early 2000s – a relentless drive to build, ship and iterate. I knew the word scale, but understood and saw it in China.

It's a wake-up call: the centre of gravity for optical manufacturing has already shifted. The question now is whether the centre of innovation will follow. **EO**

**Dr Faisal Kamran, a Photonics100 alumnus, is the Principal Technology Analyst and CE & Sustainable Business Strategist at Sony Technology Partnerships Europe.**

**For more on China, see page 36**



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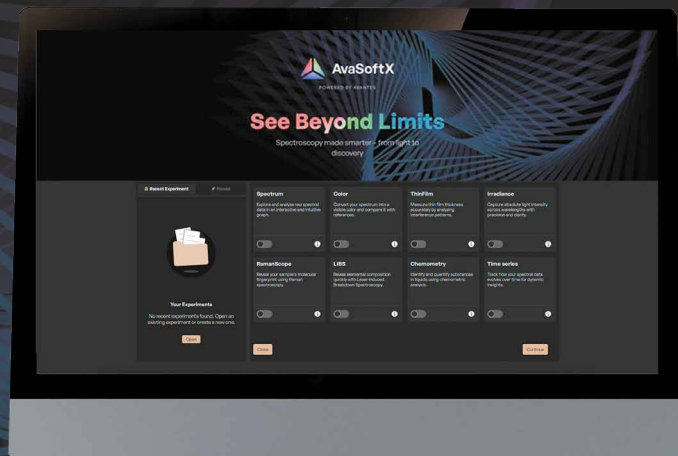
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# Optatec 2026 Preview: partnering with the Photonics Frontiers Award



With Optatec less than a month away, Project Manager **Fabian Kruger** (right) tells us why the annual event was keen to partner with the Photonics Frontiers Award 2026 and why this year's event is likely to see a big focus on the miniaturisation of photonic components

## **Electro Optics: What are the key themes and technological focus areas that will define Optatec 2026?**

**Fabian Kruger:** Optatec, the trade fair for optical technologies, components and systems, will be held in Frankfurt am Main, Germany, from May 5-to-7 this year, focusing on the technical use of light. It will showcase the latest developments in the fields of optical components, optomechanics, optoelectronics, fibre optics, optical waveguides, laser components, digital microscopy, as well as processing machines and manufacturing systems for the production of optics. This highly specialised platform for optics and photonics is recognised as a leading trade fair with a high degree of internationality and showcases optical technologies, components and systems at the highest level.

## **EO: What new exhibitor segments or innovations can visitors expect to see that were not present in previous years?**

**FK:** One important trend is the miniaturisation of photonic components in order to achieve more compact and efficient devices – for example, in medical technology and security technology. New materials and modern manufacturing processes are making this possible. Growing quality requirements and increasing automation are also shaping the agenda and generating new segments. Other trends and drivers of photonics development include autonomous systems and assistance systems in various areas.

## **EO: What factors make Frankfurt an ideal location for a trade show centred on optical technologies?**

**FK:** As a central transport hub with Germany's largest commercial airport and direct motorway connections, the traditional exhibition location of Frankfurt offers optimal accessibility for international trade visitors and exhibitors from all over the world. The Rhein-Main region, with Frankfurt at its centre, is a strong location for business, industry and research, offering easy access to users and potential customers of photonics.

The region has strong links to the optical industry – at Frankfurt University of Applied Sciences and other nearby universities, optics and photonics are well-established fields of research with their own specialised laboratories.

## **EO: Are you seeing any challenges with the escalating cost of travel and global geopolitical matters? Are they affecting attendance figures?**

**FK:** Well, it remains to be seen whether and how the current difficult geopolitical situation will affect general travel activity between now and the show in May. We have no influence over this. However, it can be assumed that, precisely because of the current challenges, those involved in the industry will plan their trade fair participation carefully and prepare in such a way that their actual presence on site is not impaired. After all, the aim is to meet the target group, deepen contacts and implement business projects.

## **EO: Is there particular value for engineers, developers and decision-makers prioritising attending Optatec, particularly in a year without Laser World of Photonics?**

**FK:** Yes, visiting Optatec definitely offers special added value. One reason for this is that photonics and optics technologies are developing rapidly, for example in the areas of manufacturing technology, the integration of artificial intelligence and data communication. Optical technologies are among the most important industries of the 21st century. Many innovations would not be possible without photonics. Photonics plays a central role in digitalisation because it enables the transmission and processing of data using light.

In this respect, Optatec deals with extremely important key technologies and is relevant for the digital infrastructure in many different areas that are constantly expanding and changing. On the other hand, the added value of participating in Optatec for exhibitors and visitors is a given because the Frankfurt trade fair location offers ideal conditions for travel and accommodation.

## **EO: Can you share any special forums, workshops, or live demonstrations that you are particularly excited about?**

**FK:** Yes, we are looking forward to a special supporting programme, including the 'Photonics Talks' – they specifically combine optical technologies with engineering, natural sciences and industry. During the panel discussion, which

the trade fair organiser is preparing in collaboration with optics.org as part of a strategic partnership, experts will spend two days discussing the development of optical manufacturing, the state of global markets, and technological and manufacturing challenges.

Industry leaders will engage in direct exchange to provide insights into new manufacturing processes, market trends, and strategic innovations for the future generation of technology.

Another highlight we are very much looking forward to is the presentation of the Photonics Frontiers Award, which perfectly complements the high-calibre and exciting supporting programme at Optatec 2026.

**EO: How do you envision the role of Optatec evolving over the next few years as optical technologies become increasingly essential?**

**FK:** As mentioned earlier, Optatec deals with key technologies and future topics. Optical technologies are developing rapidly and are becoming increasingly important in all industries and areas of life. That is why Optatec will be able to expand its importance as an internationally recognised and valued platform for knowledge transfer and business. This

is because suppliers and users come together in person in an ideal environment and can exchange ideas.

Optatec will continue to fulfil this important role in the future.

**EO: This year, you are partnering with Electro Optics on the Photonics Frontiers Award 2026. What made the partnership so appealing?**

**FK:** We are delighted that, following its successful launch in 2025, the Photonics Frontiers Award 2026 will now be presented at Optatec. We find it very interesting and worthy of support that you are using this prize to honour application-oriented projects that solve real-world problems thanks to photonics technology. The award draws attention to the power of photonics and its ability to solve urgent problems.

We find this very appealing and are eagerly awaiting the award ceremony!

**The Photonics Frontiers Award 2026 winner will be announced at the show on May 6.**



For details of the show, please visit [www.optatec-messe.de/en/](http://www.optatec-messe.de/en/)

# PHOTONICS FRONTIERS AWARD 2026

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View the shortlist on Page 8

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# BiOS plenary speakers highlight the latest biophotonics advances

Three plenary speakers from BiOS 2026 tell **James Wormald** about their biophotonics research projects, what else excited them at the event, whether cross-sector collaboration really works and what's the big deal with AI in biomedical research.

**A**s the largest annual gathering of biomedical photonics professionals, the Biomedical Optics Symposium (BiOS) at Photonics West draws researchers, clinicians and industry players to San Francisco each January to hear, see and discuss the latest advances across light-based imaging, therapeutics and diagnostics.

After the 2026 instalment, *Electro Optics'* James Wormald caught up with three researchers whose presentations spanned structured light, vibrational chemical imaging and photoacoustic sensing. The trio comprised Igor Meglinski, P100 honouree and Professor of Quantum Biophotonics and Biomedical Engineering at Aston University; Meng Wang, Senior Group Leader at HHMI Janelia Research Campus; and Junjie Yao, Jeffrey N. Vinik Associate Professor of Biomedical Engineering at Duke University.

## Sensing through scattering tissue with twisted light

Igor Meglinski's presentation focused on how structured photonics using orbital-angular-momentum (OAM) light enables robust biochemical sensing through strongly scattering tissue.

"The key result is that twisted light preserves a topologically protected phase memory, allowing weak chiroptical signals to be converted into a measurable azimuthal phase rotation that survives multiple scattering," said Meglinski.

"This makes it possible to detect molecular chirality and refractive-index changes ( $\sim 10^{-6}$  sensitivity) even when conventional polarisation and intensity signals are destroyed.

"Demonstrated with glucose as a model system, the approach enables non-invasive, enantiomer-specific sensing through tissue, opening a new class of topology-based photonic diagnostics beyond the ballistic-photon regime."

## The research pathway

"Compared with five-to-10 years ago, the application of photonics in biomedical diagnostics, especially techniques that exploit structured light and multiple-scattering resilience, has moved from early conceptual proofs to accelerating experimental validation and real-world relevance.

"A decade ago, most optical diagnostics were limited by the reliance on ballistic or quasi-ballistic photons, meaning that imaging and sensing were effective only in thin tissues or required invasive access. Research focused on incremental improvements in OCT, diffuse optical imaging and polarisation contrast, with little robust capability to extract weak chiral or molecular signals deep in tissue.

"Over the past five years, however, there's been a noticeable shift: the field is increasingly embracing novel light degrees of freedom (such as orbital angular momentum, spatio-temporal structuring and speckle correlations), topological photonics and computational imaging strategies that exploit, rather than avoid, scattering. These developments are still emerging, but multiple groups are now reporting quantitative biochemical sensitivity in highly turbid media, which would have been difficult to achieve 10 years ago," he added.

"The field is significantly more mature now, with stronger theoretical foundations and experimental demonstrations, yet it remains early in terms of clinical translation compared with established optical modalities. The trend over the next few years is toward increased sensitivity, deeper tissue interrogation and integration with AI/ML for inverse problem solving, which were far less accessible a decade back.

## Applications

"This work will impact applications where biochemical or structural information must be recovered through highly scattering tissue, beyond

**“Our understanding of in vivo metabolism remains very limited, even today”**

**Junjie Yao**



**Meng Wang, Senior Group Leader at HHMI Janelia Research Campus**

the reach of conventional optics. The most immediate beneficiaries are non-invasive diagnostics, such as glucose monitoring, chiral biomarker detection and early-stage disease sensing, where subtle refractive-index or molecular changes precede visible pathology.

“More broadly, it affects biophotonics and pathology, enabling label-free tissue assessment that is less dependent on staining and subjective interpretation, as well as pharmaceutical and chemical analysis, where enantiomer-specific sensing is critical. Clinicians, diagnostic technology developers and patients benefit through earlier, more reliable detection, while industry gains a new class of topology-based photonic sensors capable of operating in realistic, turbid biological environments rather than idealised laboratory conditions.

#### Real-world impact

“We’re actively working on (translating the research into real-world impact) through the EIC Pathfinder OPTIPATH project, which is specifically focused on moving these concepts beyond proof-of-principle toward clinically relevant systems. OPTIPATH is addressing the hard parts of real-world impact: simplifying the optical architecture, integrating structured light with compact hardware, developing robust computational reconstruction and validating performance in realistic biological settings.”

While challenges remain – particularly tissue heterogeneity, motion and regulatory validation – the fact that this work is now embedded in a dedicated translational programme reflects that the field has moved from exploratory physics into early-stage clinical technology development, where impact is difficult but clearly within reach.

#### Mapping organelle metabolism in living organisms

Meng Wang’s presentation focused on the use of vibrational microscopy in chemical imaging, highlighting how the technology is advancing our understanding of organism health and longevity. “Specifically,” said Wang, “I introduced the Boxcar-enhanced Fluorescence-detected mid-Infrared photothermal Microscope (BoxFILM), developed by Professor Ji-Xin Cheng’s group at Boston University in collaboration with our team at HHMI Janelia Research Campus, and discussed its application in profiling the metabolic composition of lysosomes in live cells and organisms.

“I demonstrated how BoxFILM has enabled us to uncover previously unknown metabolic heterogeneity of lysosomes within the same cell and to identify early-onset metabolic dysfunction of lysosomes during ageing, highlighting its potential to map the metabolic landscape in vivo with high spatial resolution and rich chemical information.

#### The research pathway

“Metabolism research has traditionally relied on biochemical approaches that analyse extracts obtained by breaking down cells and organisms. While these disruptive methods are essential for identifying metabolic products and enzymes within metabolic pathways, they fundamentally eliminate spatial information. As a result, our understanding of in vivo metabolism remains very limited, even today.

“Over the past two decades, the use of imaging mass spectrometry to profile a series of metabolites has advanced in situ metabolic imaging. The development of metabolite biosensors has also provided

a means to image one metabolite at a time at high resolution in live cells. Moreover, innovations in vibrational microscopy have further propelled metabolic imaging across various chemical groups at high resolution and speed in vivo.

#### Applications

“We expect BoxFILM to have a significant impact on both biological and biomedical research. Its application will help uncover the previously unknown spatial organisation of metabolism across scales – from diverse organelles such as lysosomes, mitochondria and lipid droplets, to distinct cell types and different organs – within their physiologically relevant contexts.

“This will enable us to understand how this organisation unfolds during development and changes with ageing, providing new insights into these fundamental questions. Meanwhile, BoxFILM will facilitate the discovery of in vivo metabolic alternations associated with pathological conditions, particularly metabolic disorders, offering new biomarkers for disease diagnosis and potential targets for therapeutic development.

#### Real-world impact

“Using my own research as an example: over the past few decades, vibrational microscopy has enabled us to perform high-throughput genetic and chemical screens, leading to the discovery of new genes and chemicals that modulate lipid metabolism. Its application has also helped us understand microbe-host interactions from a metabolic perspective and reveal metabolic dynamics in vivo.

“However, to disseminate these technologies to a broader community and unlock their full potential in various applications, building, operating and maintaining the microscope remain challenging tasks. Community efforts, such as consortium initiatives, will make microscopy systems more accessible to a wider range of users, and instrumental commercialisation will help lower the barriers to adopting this technology in standard biomedical research labs.”



2024 Photonics100 honouree Igor Meglinski (right), pictured with Europa Science CEO Warren Clark, gave a presentation on 'Optical angular momentum as a tool for next-generation tissue diagnostics' at BiOS earlier this year

> **Photoacoustic imaging at clinically relevant depths**

Junjie Yao spoke about advances in functional and molecular photoacoustic imaging, describing “a hybrid modality that converts light absorption into ultrasound signals, allowing us to see optical contrast at depths far beyond conventional microscopy”.

“Photonics is being used not just to form images, but to interrogate physiological and molecular states in intact tissues,” said Yao.

“The core challenge in deep-tissue imaging is extracting weak molecular signals from a highly scattering, absorbing biological background. By combining engineered light delivery, sensitive acoustic detection and computational reconstruction, we are overcoming long-standing trade-offs between depth, resolution and specificity.

“The solutions emerging from this approach include imaging neuroinflammation, tumour microenvironments, vascular dysfunction and even the early molecular hallmarks of neurodegeneration. Rather than incremental improvements in resolution, the focus is on enabling entirely new biological questions to be asked in living systems, particularly those involving function and molecular state at clinically relevant depths.

**The research pathway**

“Five-to-10 years ago, much of deep optical imaging research was still proof-of-concept; impressive technically, but limited in biological deployment. Today, the field has matured significantly and several enabling technologies have converged such as high-repetition-rate laser sources, improved acoustic detectors, better light modelling in scattering tissue and increasingly powerful computational reconstruction methods. At the same time, biology has become more quantitative, demanding real-time functional and molecular readouts rather than static structural images.

“We are also seeing stronger translational momentum. A decade ago, photoacoustic imaging was largely academic. Today, commercial systems exist, wearable platforms are being developed and regulatory conversations are underway. The emphasis has shifted from ‘can we detect this?’ to ‘how reliably can we deploy it in real biological and clinical settings?’ In short, the field has moved from technical

“These ideas are being demonstrated in tissue-like media, suggesting realistic pathways toward quantum-enhanced biomedical sensing and diagnostics”

**Igor Meglinski**

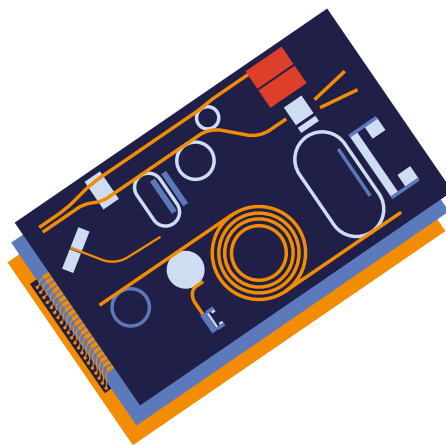
novelty toward platform technology, and that transition is critical for sustained impact.

**Applications**

“Applications span neuroscience, oncology, vascular medicine and maternal-fetal health. In neuroscience, deep functional imaging allows us to monitor haemodynamics and inflammation without invasive procedures. In oncology, molecular contrast can reveal tumour metabolism and immune responses. In obstetrics, non-invasive monitoring of placental perfusion may enable earlier detection of complications.



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Junjie Yao's talk at BIOS 2026 was titled: 'From light to sound: Imaging, treating and building tissues at depth'

**“Emphasis has shifted from ‘can we detect this?’ to ‘how reliably can we deploy it in a real setting?’”**

**Junjie Yao**

clear clinical advantage. A technology such as photoacoustic imaging must not only work; it must solve a problem better than existing methods. That said, the trajectory is promising...

“We are already seeing commercial photoacoustic systems in vascular imaging, oncology and dermatology, and ongoing work in wearable and portable platforms suggests broader clinical deployment within the coming decade,” he said. “The remaining barrier is less about physics, and more about interdisciplinary execution, industrial engagement and hospital adaption.”

#### Other exciting developments in biophotonics

Asked to look beyond their own research programmes, each of the three researchers pointed to a different development. Meglinski introduced growing evidence that the topological properties of light and quantum polarimetric observables are being preserved even in complex scattering environments.

“Traditionally, quantum and polarisation-based measurements were assumed to be too fragile for realistic biological media, but recent work has shown that certain phase- and symmetry-protected observables survive where intensity and polarisation do not,” said Meglinski. “In quantum polarimetry, this means accessing subtle depolarisation, birefringence and symmetry-breaking effects with sensitivities beyond classical limits, while topology provides a form of built-in robustness against disorder.

“What is particularly exciting is that this is no longer just abstract quantum optics: these ideas are now being demonstrated in tissue-like media, suggesting realistic pathways toward quantum-enhanced biomedical sensing and diagnostics that operate outside the ballistic regime. The convergence of topological photonics, quantum measurement and biophotonics feels like a genuine shift compared with even five years ago, opening possibilities that were previously considered impractical for medical applications.”

Meng Wang, meanwhile, pointed to the Cell Observatory initiative led by Eric Betzig, which focuses on imaging dynamic biological processes across spatial scales in living organisms. “Adaptive optics-integrated lattice light-sheet microscopy (AO-LLSM) compensates for sample-induced aberrations and restores diffraction-limited resolution within deep tissues, enabling the tracking of subcellular dynamics across large fields of view,” said Wang.

“This approach allows multicolour imaging of several thousand cells in live, whole organisms at  $\sim 240 \times 240 \times 300\text{nm}$  resolution. Meanwhile, the future integration of transformer-based networks is expected to support segmentation, classification, quantification and interpretation of these high-content datasets. Together, these advances create exciting new opportunities to study cellular dynamics in their native contexts and link them to organismal physiology, which will drive new hypothesis generation and exploration.”

An alternative area of research that excited Junjie Yao, is the recent progress that's been made in stimulated Raman scattering (SRS) imaging, particularly work that has been led by Lingyan Shi at the University of California San Diego. “Her group has been pushing SRS

> “The beneficiaries are both researchers and patients. For researchers, the ability to observe dynamic molecular and functional processes in vivo accelerates discovery and reduces reliance on destructive end-point assays. For clinicians, the promise lies in earlier detection, longitudinal monitoring and personalised treatment assessment. Beyond hospitals, wearable photoacoustic-ultrasound platforms could extend monitoring into outpatient or even home settings. And that's where the long-term impact lies, turning photonic technologies into accessible diagnostic tools rather than confined laboratory instruments.”

#### Real-world impact

“The science is advanced and the engineering is robust. The challenge now is integration, validation and scale. Moving from laboratory demonstrations to real-world impact requires solving several non-trivial problems: system robustness, cost reduction, regulatory approval, workflow compatibility and user training. Biological variability also complicates the translation, human tissues are far more heterogeneous than controlled laboratory models. Another challenge is demonstrating

beyond label-free chemical imaging toward quantitative metabolic and functional readouts in living systems,” said Yao. “What is especially compelling is the ability to image metabolic flux and biochemical composition without exogenous labels, achieving subcellular resolution while preserving tissue context. That capability is transformative for studying ageing, neurodegeneration and metabolic disorders.

“From a broader perspective, SRS complements deep-tissue modalities such as photoacoustics. SRS excels at high-resolution chemical specificity, while photoacoustic imaging extends molecular contrast to greater depths.

“Together, these technologies represent a multi-scale, multi-contrast future for biophotonics, where we no longer choose between chemical precision and penetration depth, but integrate both. The convergence of vibrational imaging, molecular engineering and computational reconstruction is redefining how we interrogate living biology.”

#### **Cross-sector (and cross-industry) collaboration: what makes it work?**

In Igor Meglinski’s opinion, cross-sector collaboration can be enormously beneficial. “Academic research is where new physical principles emerge, but industry is essential for turning those principles into robust, scalable and usable technologies,” said the academic from Aston University. “When the two work together, it forces clarity: the physics has to be not only elegant, but also reliable, manufacturable and relevant to real constraints.

“Cross-industry interaction is just as powerful. Medical applications drive sensitivity, safety and validation; consumer technologies push miniaturisation, cost reduction and usability; automotive and industrial sectors contribute expertise in robustness, real-time sensing and systems engineering.

“When these perspectives meet, biophotonics moves faster, from lab demonstrations to deployable systems, and often in unexpected directions. It’s in these collaborations that biophotonics performs at its best, because light-based technologies are inherently transferable once the core physics is understood.

“Collaborations, both successful and challenging ones, have shaped how I approach biophotonics. A good example of success is our work with OPTIPATH, where academic groups, clinicians and technology developers work together from the outset. That alignment has helped translate quite abstract concepts, such as structured light and phase-based diagnostics, into system-level designs that are clinically meaningful. I would say that clear roles, shared milestones and early clinical input have been key.

“On the other hand, I’ve also seen collaborations struggle when expectations weren’t aligned, typically when industrial partners wanted rapid, near-market solutions while the underlying physics was still exploratory, or when academic novelty was prioritised without a clear route to integration. Those experiences reinforced that cross-sector collaboration works best when there is mutual respect for different timescales and incentives, and when translation is treated as a co-development process rather than a handover.”

Agreeing that collaborations are vital to maximise the impact of biophotonics, Meng Wang said that, by uniting expertise from across academia, industry and application-specific domains, technology innovation and dissemination can be accelerated, and new biological questions and solutions can be unearthed that would not be found with isolated silos. “Industrial partners often have the engineering resources and commercialisation expertise needed to transition advanced biophotonic technologies from specialised research labs into robust, accessible tools for broader use,” said Wang. “Meanwhile, cross-disciplinary investigations bring together physicists, engineers, biologists and clinicians to tackle complex biological and medical problems from multiple perspectives.

“This synergy fosters the development of new imaging modalities, analytical methods, mechanistic insights, diagnostic approaches and therapeutic interventions.”

Using BoxFILM, developed in collaboration with photonics expert Ji-Xin Cheng, as an example, Wang said a discussion surrounding the technical challenges of biological research “highlighted the



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“Twisted light preserves a topologically protected phase memory”

Igor Meglinski

Biophotonics was put under the microscope at Photonics West in January, at the BiOS conference and exhibition

> importance of profiling the metabolic states of organelles in live cells and organisms, and our respective efforts to use stimulated Raman scattering microscopy, which showed promise but lacked sufficient chemical sensitivity, were shared. The conversation sparked the idea to use mid-infrared photothermal microscopy.

“Throughout the development process, our complementary expertise enabled us to identify thermosensitive and photostable fluorescent dyes for organelle labelling, implement an optical boxcar configuration to mitigate photobleaching and interference from water absorption and integrate AI to enhance signal detection. The collaboration also rapidly advanced the biological and biomedical application of BoxFILM for understanding cellular ageing and lysosomal storage diseases.”

According to Junjie Yao, biophotonics thrives at the interface. “Academic labs excel at innovation and fundamental exploration, while industry brings engineering discipline, manufacturability and scalability,” said Yao. “When aligned properly, this combination accelerates translation dramatically.

“Cross-industry collaboration, for example, between medical imaging, semiconductor manufacturing and even automotive sensing, also introduces mature technologies into biomedical contexts. Many advances in lasers, detectors and signal processing originate outside medicine. I would say that the key is shared objectives and realistic timelines. When both sides understand each other’s constraints – regulatory, financial and scientific – collaborations can transform promising prototypes into deployable systems.

“One example that has been particularly meaningful is our collaboration with Eli Lilly and Company, which is focused on metabolic imaging of biological tissues. In academia, we often tend to develop imaging technologies with broad biological flexibility. In contrast, industry requires highly specific, decision-enabling tools, systems that can reliably answer whether a therapeutic candidate is altering metabolism in vivo, and do so reproducibly across cohorts. Working with Lilly forced us to refine our platforms toward robustness, quantification and biological validation rather than purely technical

performance metrics. “The collaboration was successful because expectations were aligned early,” he said. “We defined measurable endpoints, established realistic timelines and maintained continuous dialogue between the engineers, biologists and translational scientists. That structure ensured that technical innovation directly addressed pharmaceutical needs.

“The most important lesson is that cross-sector collaboration works best when technology development is driven by clearly articulated biological or clinical questions. When that alignment exists, the impact can be accelerated dramatically.”

#### Effectiveness of AI in biological research

Igor Meglinski said: “AI is already having a real and measurable impact on biophotonics, but it’s also an area where hype can easily outpace substance. Where AI genuinely adds value is in tackling inverse and high-dimensional problems that are intrinsic to biophotonics, phase retrieval, speckle interpretation, image reconstruction in scattering media and multimodal data fusion.

“In these areas, machine-learning is not replacing physics; it’s augmenting physically grounded models and making previously intractable problems solvable in realistic timeframes.

“The hype appears when AI is treated as a black box that can bypass optical limitations or compensate for poorly designed experiments. Without strong physical constraints, large datasets and careful validation, AI risks producing results that look impressive but lack robustness or interpretability, especially problematic in medical settings. The most impactful work today combines first-principles photonics with AI as a constrained inference tool, not as a substitute for understanding. Used this way, AI is becoming a powerful enabler rather than a buzzword, and its influence on biophotonics is likely to be long-lasting rather than transient.”

Meng Wang said: “AI has provided a major boost to biophotonics research from several perspectives. BoxFILM demonstrated, for example, that the application of AI-based denoising algorithms can

significantly improve signal-to-noise ratio, enabling faster scanning across broad spectral ranges and/or large fields of view while maintaining image quality. In other contexts, AI helps overcome practical resolution limits imposed by diffraction and noise by inferring high-resolution features from low-resolution measurements through computational super-resolution approaches.

“AI also enhances adaptive optics performance in deep scattering tissues by rapidly estimating and correcting sample-induced aberrations. Furthermore, AI accelerates multi-modality investigations by deconvolving high-dimensional imaging datasets and integrating imaging data with other modalities (such as sequencing and mass-spectrometry).”

Junjie Yao revealed: “AI is already reshaping biophotonics, particularly in reconstruction, denoising, spectral unmixing and inverse modelling. In deep-tissue imaging, where signals are weak and scattering is complex, AI can extract information that traditional analytic methods miss. However, hype emerges when AI is treated as a substitute for physics. Robust systems require physics-informed models combined with data-driven refinement. Blind application of neural networks risks artefacts and reduced interpretability.”

#### Alternative innovations in biomedical engineering

Away from AI, powerful physics-driven photonic solutions are also raising the efficiency of biomedical research by extracting far more information from simple, minimally invasive samples, says Igor Meglinski. He added: “A strong example is the use of advanced polarimetric and Mueller-matrix imaging, combined with digital holography to analyse complex biological media such as dried blood films. By reconstructing 3D maps of optical anisotropy, including linear and circular birefringence and dichroism, these methods reveal subtle molecular and structural changes linked to disease, well before conventional biochemical markers become evident.

“Crucially, this approach is label-free, reagent-free and rapid, enabling high diagnostic accuracy from a single drop of blood while avoiding invasive biopsies.

“Such innovations are important because they reduce cost, improve reproducibility, accelerate screening and make sophisticated diagnostics scalable, bridging the gap between advanced photonics research and routine clinical and laboratory practice.”

According to Meng Wang, there are many innovative solutions aimed at improving the efficiency of biological research. But she is particularly interested in the development of fluorescent lifetime-optimised biosensors due to their relevance to in vivo metabolism.

“While vibrational microscopy is powerful for probing metabolic functional groups,” said Wang, “it lacks the ability to track individual endogenous metabolites with high specificity.

“Genetically encoded fluorescent biosensors help address this gap; however, their analysis needs to expand beyond intensity measurements to enable quantitative and simultaneous monitoring of diverse metabolites.

“Advances in fluorescence lifetime imaging, together with lifetime-optimised sensors, offer exciting solutions through lifetime-based multiplexing and quantification. I am very much looking forward to its future development and potential integration with chemical imaging approaches to provide complementary and multidimensional insights into in vivo metabolic regulation.”

Meanwhile, for Junjie Yao, there are two major innovations that stand out. “First, multi-scale imaging systems that bridge microscopic and macroscopic regimes within a single platform reduce experimental fragmentation and allow seamless transition from cellular to whole-organ analysis,” said Yao.

“Second, the integration of functional imaging with molecular and omics data combines spatial omics with deep-tissue photonic imaging, providing both structural and molecular context and accelerating hypothesis testing and reducing redundant experimentation.

“Efficiency in biomedical research increasingly depends on convergence: photonics, computation, molecular biology and engineering working together. The more integrated the workflow, the faster discovery translates into measurable biological insight.” **EO**

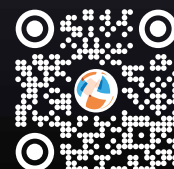
# ISOLATION OF CRITICAL WAVELENGTHS

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# ‘Time zones alone were a killer of good customer service’



**Huyen Vu** (right), newly appointed CEO of Optoman Inc (US), tells **Fin O’Reilly** why the time was right for the Lithuanian IBS specialist to build its North American operations and the ‘blind spot’ European photonics firms need to avoid in the US

Lithuanian IBS specialist Optoman opened a new office in Folsom, California, in January of this year, and appointed Huyen Vu as CEO and President of Optoman Inc (US operations). With more than 20 years of experience working for photonics companies including Laser Components, Laser Vision, Wavelight and Laser2000, in both the US and Germany, he tells us why time zones and tariffs were not the only drivers for the move and offers a peek at what’s on the horizon for the company’s US operations.

**Electro Optics: You’ve spent more than two decades leading sales and operations for major photonics companies in Europe and the US. What led you to becoming CEO of Optoman Inc (US operations) at this time?**

**Huyen Vu:** The timing felt exactly right – both professionally and personally.

After more than two decades in photonics, I’ve experienced growth phases, downturns, successful expansions and painful lessons. I’ve seen firsthand how differently the two markets think, move and make decisions. I’ve seen both sides of the Atlantic – the cultures and the markets. That transatlantic perspective is incredibly valuable when you are trying to connect European engineering depth with American speed, pragmatism and market expectations.

There’s also a personal element. My kids are grown up now and starting to have their own lives. It’s the perfect time to use all the experience I’ve gained, combined with the personal freedom I now have, to start and commit to something new.

What attracted me to Optoman was its clarity of focus. Since 2017, the company has built a reputation around world-class ion beam sputtering (IBS) coatings, particularly for high-power laser applications – validated by winning the HiLASE LiDT competition in 2025 and the Innovation Award. Instead

of trying to be everything to everyone, Optoman has doubled down on this core technology and built deep expertise around it. That kind of discipline and focus is rare.

I saw a real opportunity to build the US operations for this upcoming European company the right way – not just as a remote sales office, but as a true American outfit with local presence, faster support and, eventually, local production.

I’d say the ultimate goal is to translate Optoman’s European technical excellence into tangible value for US customers, without diluting the standards that built its reputation in the first place.

**EO: One of the stated goals of your recently opened office in California is “faster support”. How will having a localised presence change the design and prototyping cycle for your American partners, compared with working solely with the Lithuania headquarters?**

**HV:** Time zones alone were a killer of good customer service. When a customer in California has a question at 2pm, that’s midnight in Lithuania. By the time they get an answer, they’ve already moved on. That delay slows conversations and, in competitive markets, speed matters. We’re eliminating that friction completely.

But it goes deeper than just response time. Having salespeople on the ground means we can get directly involved when problems arise. We can understand better and faster what’s really needed, without the miscommunication and delays that come from trying to sort everything out over email across time zones.

The design and prototyping cycle fundamentally changes when you have someone local who can have face-to-face conversations, understand the application context, and then work directly with our Lithuania engineering team to develop the optimal solution. It’s not just about faster

email responses – it’s about proximity, about being there in person when it matters.

And here’s something people don’t always think about: customs and import logistics are a massive pain point. By consolidating shipments from Lithuania to our Folsom (California) facility weekly, then distributing domestically, we’re making that problem disappear for the customer. They get a simple, domestic purchasing experience with a true local supplier.

**EO: To what extent have shifting US trade policies and tariffs influenced your operational strategy, and how are you positioning Optoman to navigate the ‘Buy American’ requirements in federal contracts?**

**HV:** Tariffs didn’t create this move, but they definitely accelerated it.

The Buy American requirements in defence and aerospace are complex, and they’re not going away. Our approach is pragmatic: we’re establishing Optoman Inc as a US entity, not just a subsidiary or mailbox. We have US employees, US operations, US banking, US infrastructure. That changes the conversation entirely.

We’re realistic – full manufacturing in the US doesn’t happen overnight. But we’re building the foundation. Our fulfilment model through Folsom gives us domestic presence. As volume grows, we have a clear path to establish coating capabilities here. The strategy is to build Tier 1 strategic accounts – high-growth OEM customers who see us as a true partner, not just a vendor – and let that volume justify the capital investment into US production.

The other piece people miss is that ‘Buy American’ isn’t just about where it’s made – it’s about reliability, support and partnership. A local team that understands your application, responds in your time zone, and can be on-site when needed? That’s strategic value.

**“US production would create parallel capabilities, not replace Lithuania. Lithuania would remain the R&D hub, the centre of innovation”**

**EO: What’s the roadmap for Optoman in establishing physical IBS coating capabilities within the US, and how would US-based production specifically alter your current supply chains?**

**HV:** The roadmap is deliberate and absolutely customer-driven. We’re not going to build a facility for headlines. We’re going to build it when the business fundamentally demands it, and we’re going to do it properly.

I’d say Phase One is what we’re in now: establishing the commercial presence, building the customer relationships, and validating the demand. We’re focused on strategic accounts – customers with high growth potential who can scale with us. We might even put our production site close to them – location will be strategic, not arbitrary.

Phases Two and Three, which we anticipate in the 12-to-24-month timeframe, is selectively stocking high-volume items in Folsom and establishing actual coating capabilities. By mid-2026, we expect to select a location for production and start the process – building lease, financing, determining how many IBS chambers we need and what specifications. Then we order the equipment. From order to operational chambers, you’re looking at approximately 12 months. And then there’s the whole process of hiring talent for this operation, which is absolutely critical.

As for supply chains, US production would create parallel capabilities, not replace Lithuania. Lithuania would remain the R&D hub, the centre of innovation, the place where we’re pushing the boundaries on high-power IBS coatings, and – at the same time – make large-scale production of accessible premium optics. The US facility would be optimised for serving the specific needs of the North American market – particularly defence and aerospace customers who need or prefer US-manufactured components.

**EO: As you grow into a multinational entity with the new US branch, how do you plan to maintain the specialised, custom-order ‘boutique’ feel that Optoman was built on?**

**HV:** We don’t see specialisation and ambition as opposites – we see them as reinforcing each other. Our goal isn’t to stay small. The goal is to scale in a smart way.

First, let me be clear about our lane: IBS coating. Everything that can be done with IBS technology is what we do and where we shine. That’s our core. Yes, we’ve added complementary expertise to accompany our core business – for example, polishing capability and optical assemblies – but IBS coating is the foundation.

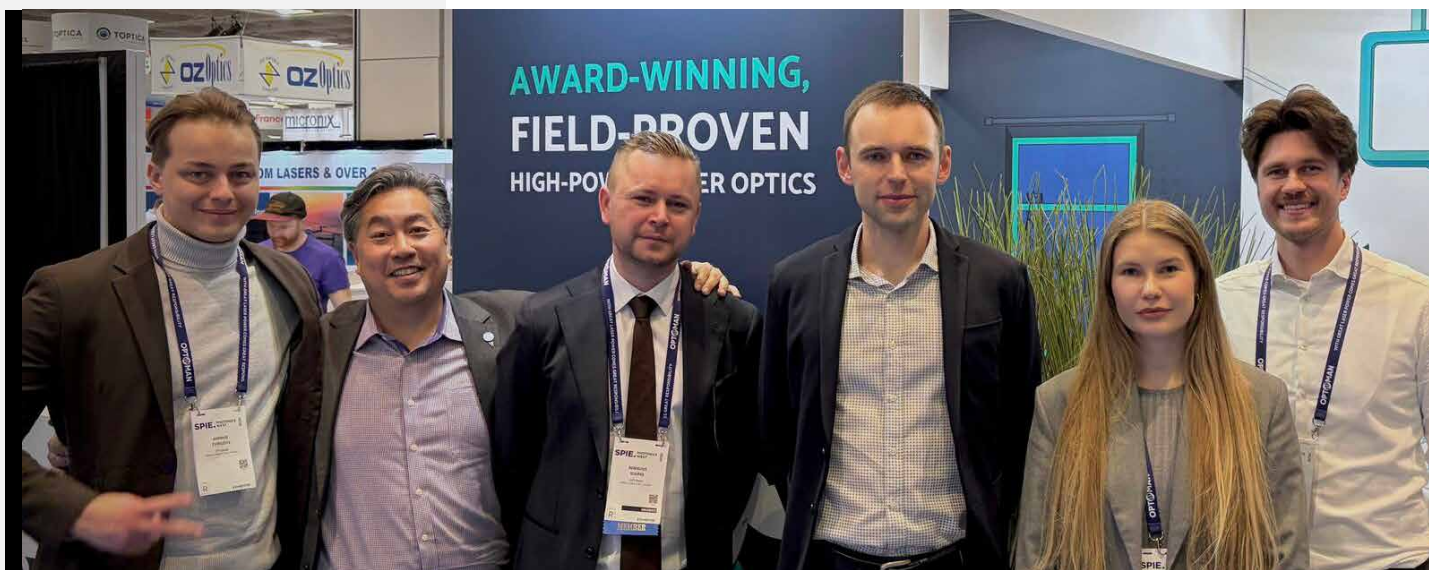
We want to become a global reference for high-power IBS coatings – the company people think of first when performance truly matters. That requires investment, talent and international presence. But it also requires discipline: knowing what you’re great at and doubling down on it.

Our tiered customer structure really supports that ambition. With strategic Tier One accounts, we work deeply and collaboratively, often co-developing solutions. As we scale, we’ll replicate that partnership model, not replace it. Growth should amplify our impact, not standardise it.

And hiring will be critical. We’re not building a volume sales machine. We’re building a technically strong, commercially sharp organisation that can operate globally without losing its engineering DNA. In short: we intend to grow significantly. But we’ll grow as specialists with global reach.

**EO: Drawing on your experience on both sides of the Atlantic, what is the one cultural or regulatory ‘blind spot’ European photonics firms often overlook when attempting to scale in the US market?**

OPTOMAN Inc



Huyen Vu, second from left, with the team at the Optoman booth during this year’s Photonics West event in San Francisco



Huyen Vu at his desk in the Optoman Inc office in Folsom, California. The familiar posters behind him are promoting the company's celebrated Superhero League

**“The US facility would be optimised for serving specific needs of the North American market – particularly defence and aerospace customers who need or prefer US-manufactured components”**

> **HV:** Americans buy relationships before they buy products. European companies – and I saw this constantly in my previous roles – come to the US thinking the technology will speak for itself. They have superior specs, better performance, great pricing and they're confused when they lose deals to inferior competitors. What they miss is that US customers, especially in B2B technical sales, really need to trust that you'll be there when things go wrong.

US customers want to know: can I call you at 3pm Pacific time and get someone who understands my problem? If there's an issue with a coating, can someone be on-site tomorrow? If I'm designing a new laser system and I need to collaborate on the optics, can we iterate quickly, or am I waiting days for email responses across different time zones?

The regulatory piece is real too – compliance requirements, export controls, 'Buy American' provisions – but, honestly, those are solvable with good legal counsel. The cultural gap around customer relationship expectations? That's what kills companies. You can't outsource that. You must have genuine local presence with genuine authority to make decisions.

The other blind spot is marketing. European companies in this space tend to be very engineering-focused, very technical, very “the data speaks for itself”. The US market responds to story, to brand, to personality. Look at what we're doing – we created the Photonics Promoter award, which was extremely well received in the market. We shipped the award to winners all over the world, and they're posting about it on LinkedIn, creating organic buzz.

We've created a custom Optoman-branded, highly technical board game that we're shipping to customers in the near future. We've created the Superhero League, partnering with other photonics companies on campaigns promoting photonics networking in a fun way.

That's how you build mindshare in a crowded market. In the US, brand matters alongside performance.

**EO:** The US market has unique demands in the defence, space and medical sectors. How do you see the technical requirements for these sectors developing in the near future, and which specific application is pushing the limits of your IBS technology the hardest now?

**HV:** Defence is driving the frontier on high-power laser damage thresholds, no question. Directed energy weapons, laser-based defence systems – these aren't science fiction any more, they're active programmes with real budgets. The damage threshold requirements are pushing into regimes that were considered impossible just a decade ago.

That's where Optoman's competition really wins in LiDT testing matter – we're not

just meeting specs, we're setting them.

Space is fascinating because you're optimising for multiple constraints simultaneously – not just optical performance, but radiation hardness, thermal cycling, outgassing, long-term stability in vacuum. And the qualification cycles are brutal – you can't just say “it works”, you have to prove it will work for 10 to 15 years in conditions you can't fully test on the ground. The bar for custom coatings in space applications is extraordinarily high.

Medical is moving toward higher powers and shorter pulses. Femtosecond laser surgery, high-precision ablation for ophthalmology, laser-based cancer treatments – these all need coatings that can handle extreme intensities without degrading. Longevity is key across all these sectors – our recently award-winning non-degrading coating is testament to that.

If I had to pick the single application pushing our IBS technology hardest right now, it's laser fusion research. This is where we're tested the most, but also where we manage to separate ourselves from the competition. The requirements are similar to what I described for industrial applications – you're talking about extreme peak intensities combined with high average powers – but the stakes and precision requirements in fusion research are even more demanding. That's where we prove ourselves.

**EO:** With industry events such as SPIE Photonics Europe and SPIE Defense + Security on the horizon, what can the photonics community expect to see from Optoman Inc by the end of 2026?

**HV:** You'll see us – and you'll feel us. We're exhibiting at SPIE Defense + Security and Optics & Photonics, likely ICALEO, and I'll be presenting at SPIE High-Power Laser Ablation. Our R&D lead, Sabina, will most probably present at Optics & Photonics too.

I want to be clear about our approach – we're not trying to posture as the next billion-dollar empire. We're the new kids on the block building something deliberate. Focused. High-performance. Collaborative. Think less “loud newcomer” and more “serious specialist who delivers”.

Our new US website launches this spring, positioning our high-power IBS capabilities and competition wins.

We're expanding the Superhero League, with a major industry player joining soon – bringing even more energy and personality into this photonics field that can sometimes take itself too seriously.

But beyond events and marketing, here's what I want the community to see by year-end: Optoman as a credible and trusted US partner – technically uncompromising; fast; and easy to work with.

Ask me again in October – I expect that we'll be talking about real projects, not just plans. **EO**

# The benefits of solid-state illumination for FISH

How solid-state light engines optimise FISH workflows for more precise and scalable nucleic acid analysis

**W**hat is FISH? FISH is a technique for the detection of specific nucleic acid sequences (DNA or RNA) in the cells or tissues where they reside based on complementary base-pairing of double-stranded nucleic acids.

## The name of the technique spells out its key utilities:

**F:** Fluorescence microscopy is used to image target nucleic acid sequence locations. Other variants of this technology use chromogenic labelling (CISH).

**IS:** Target nucleic acid sequences are detected in situ – in the spatial context of the cells or tissues where they reside. FISH provides information on the location, as well as the identity and multiplicity, of target nucleic acid sequences.

**H:** The underlying mechanism for recognition of specific nucleic acid sequences is hybridization of single-stranded probe sequences with single-stranded target sequences via complementary base pairing.

## FISH in biomedical research

FISH has enabled scientists and clinicians to map genes, study chromosome organisation, diagnose and evaluate genetic diseases, and characterise chromosomal abnormalities.

One area of interest has been the analysis of telomeric regions at chromosome ends. Telomeres play a pivotal role in preserving genetic information during cell division by protecting chromosome ends from degradation. Telomere abnormalities such as duplications or deletions can easily be identified via screens that utilise FISH, where telomeres are labelled with fluorescent probe sequences (illustration). Given that these irregularities can result in various disorders such as age-related syndromes or cancer, the identification of telomere aberrations can provide new insights into disease mechanisms and potentially guide the development of targeted therapies.

While FISH is a powerful cytogenetic tool used in biomedical research, the visualisation of specific nucleic acid sequences within cells relies heavily on the quality and functionality of the illumination. Through consistent performance in the face of demanding workloads, Lumencor Light Engines enable clinicians, researchers and equipment manufacturers to achieve improved genomic and molecular diagnostics.

## Five Illumination requirements for FISH (and how solid-state Light Engines fulfil them)

### 1. Spectral range to support multiplex detection

The spectral output of Lumencor's SOLA FISH Light Engine allows fluorescent labels with five or more excitation/ emission wavelength ranges to be used to simultaneously detect a corresponding number of different DNA target sequences. Genetic disorders are usually multifactorial making this spectral diversity a ubiquitous requirement. For example, analyte specific reagent kits such as the Vysis MultiVysion PB Multi-color FISH Probe Kit (Abbott Molecular) can be used to simultaneously detect copy numbers of chromosomes 13, 16, 18, 21, and 22 – crucial in detecting chromosomal abnormalities significantly impactful on foetal health and viability. Solid-state illuminators such as the SOLA FISH can facilitate engineering of spectral output to optimally align with the requirements of such cytogenetic testing.

### 2. Linear intensity adjustment

With solid state illuminators such as the SOLA FISH, light output can be electronically attenuated with a linear control response over a 20-fold dynamic range. When illumination intensity needs to be adjusted to accommodate variance among specimens, it can be accomplished via electronic software control in a predictable and reproducible manner without the insertion of additional optics such as neutral density filters. Also, the output spectral distribution doesn't change when electronic attenuation is applied.

### 3. Unit-to-unit consistency

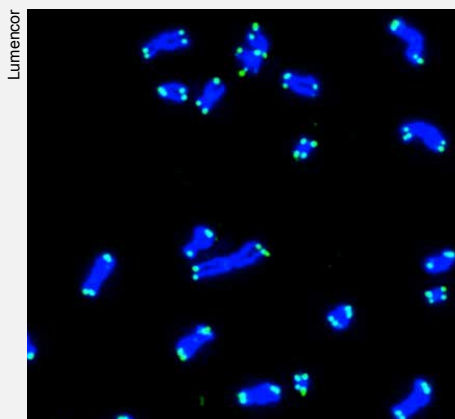
When purchasing a fleet of illuminators for use in multiple cytogenetic testing facilities, consistency in performance and operational characteristics across all illuminators is crucial. Low variance translates into internally consistent data and operational efficiency. Solid-state Light Engines such as the SOLA FISH demonstrably meet these requirements as illustrated by effectively identical unit-to-unit spectral output.

### 4. Long service lifetime and operational reliability

Solid-state illuminators are maintenance-free, and consumable expenses are minimal compared to mercury and metal halide lamps where expenditure on replacement bulbs can run into thousands of dollars per year. The capital cost of a SOLA FISH can be recouped within two-to-three years of its 10-to-15-year service lifetime from savings in consumable expenditures.

### 5. Built-in metrology and automation compatibility

Modern solid-state illuminators such as the SOLA FISH incorporate on-board microprocessors that monitor system performance in addition to controlling operations. Data such as cumulative light output duration, power consumption and internal operating temperature are available for uploading to laboratory information management systems (LIMS) and supporting regulatory compliance validation. In addition, multiple Light Engines can be linked by ethernet connections, permitting operational control from a single central point.



Karyotype from a human cell with 46 chromosomes at metaphase

Overall, Lumencor's SOLA FISH Light Engine combines advanced technology, reliability, and cost-effectiveness, making it the preferred choice for FISH applications in various research and clinical settings. **EO**

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# ‘Lab-scale components are too fragile’

Monarch Quantum CEO **Timothy Day** (right) tells **James Wormald** about the company’s Quantum Light Engine, and why replacing fragile components built for the lab with compact, ruggedised alternatives built to scale is critical to enable real-world quantum systems



**Electro Optics: Tell me about Monarch Quantum, and your work developing integrated photonics for quantum computing. Are laser benches really the single greatest bottleneck to scalability?**

**Timothy Day:** It’s actually more than just the laser. Most quantum systems require lasers combined with many additional components. And, early on, it became clear that the lab-scale components that have served as the backbone of quantum scientific discovery were too fragile, large and bespoke to scale.

If you can’t reproduce the optics reliably outside a lab, you can’t move quantum from a paper or demo into real-world impact. We set out to fix that by miniaturising, ruggedising and industrialising the optics so quantum systems can be deployed at scale.

**EO: Why hasn’t this been attempted before?**

**TD:** Up until this point, the focus has been on proving physics. The ecosystem has spent less time investing in the systems engineering and manufacturing needed to make those proofs useful in the field. We bring together photonics, system engineering and precision manufacturing expertise with a production-first mindset. That system-level approach lets us do what others couldn’t.

**EO: Tell me more about your Quantum Light Engine, then... what does it include and how have you managed to squeeze it all in there?**

**TD:** The Quantum Light Engine is our turnkey optical core: stabilised lasers, amplifiers, modulators, stabilisation loops, fibre/free-space optics and low-noise electronics in a compact, rugged package. We design components together – optics, mechanics and electronics – so nothing is an afterthought. Precision micro-optics, automated alignment and embedded calibration software let us pack lab-grade functionality into a commercial-ready device.

**EO: What made you select hybrid micro-optics packaging over photonic integrated circuits?**

**TD:** Hybrid micro-optics gives immediate, reliable performance for the high-power,

low-noise needs of atom optics and space qualification. PICs are the future and we are actively developing them to operate in all of the shorter wavelengths required by many quantum systems... but, today, hybrid approaches hit the sweet spot for performance, flexibility and readiness. It lets us deliver now, then migrate to PICs where and when they’re ready.

**EO: What engineering techniques do you employ to maintain alignment, especially in non-laboratory environments?**

**TD:** Our engineers leverage their deep experience with aerospace and defence engineering from the past several decades to develop systems that are predictably reliable. Our team consists of opto-mechanical, mechanical, electrical, firmware and software with the unified goal of meeting customer requirements for non-lab environments.

**EO: So, how do robotic assembly and machine learning improve the manufacturing process?**

**TD:** Robotics gives us repeatable, high-precision assembly at scale. Machine vision and automated metrology verify and correct alignment during build. Machine learning speeds calibration, optimises production parameters and detects anomalies before they become failures. Combined, they let us move from bespoke builds to predictable, high-yield production – which is essential for real-world deployment.

**EO: What sacrifices have to be made when scaling from precision manufacturing to a high-volume product?**

**TD:** It’s not a sacrifice, but we need to work closely with partners to deliver new materials and manufacturing processes to meet the demands of quantum, in order to produce small-scale devices in shorter wavelengths.

**EO: What about the size difference? What can the Quantum Light Engine do that optical tables can’t in terms of applications?**

**TD:** The size is an enabling feature that allows for applications such as quantum sensing,

where size and reliability (are key) when deployed in space, and in computing, where the photonics needed to achieve the ideal number of qubits necessitates a smaller scale.

**EO: What about the cost comparison, and how long before this will come into play?**

**TD:** We are confident that with our approach to semi-automated assembly and robust supply-chain development, combined with our roadmap to self-obsolence with integrated photonics components, we will be able to scale in cost as volumes increase.

**EO: Are there any ongoing partnerships or pilot programmes you can share?**

**TD:** There are several key partnerships – it’s a core pillar in our business to collaborate closely with leaders across academia and the commercial sectors. Most importantly, we work very closely with our customers to understand their requirements and the future state of their products and applications. You will have to stay tuned for the press releases.

**EO: By making off-the-shelf systems simpler, how big an effect can this have on the skills gap?**

**TD:** I’d say we have deep experience in transitioning integrated photonics systems products into commercial manufacturing. By implementing disciplines such as design-for-manufacturability, while simultaneously investing in workforce development, qualified production technician labour can be deployed as is typical of other photonics-based products that have transitioned into commercial manufacturing.

**EO: After co-packaged optics and PICs, what’s the next stage of development?**

**TD:** We believe that the market for quantum light engines will continue to expand exponentially as systems become commercially deployed. Our roadmap development of integrated photonics will necessarily involve the integration of photonics and electronics to realise truly photonic integrated circuits. We see that development cycle continuing into the foreseeable future. **EO**

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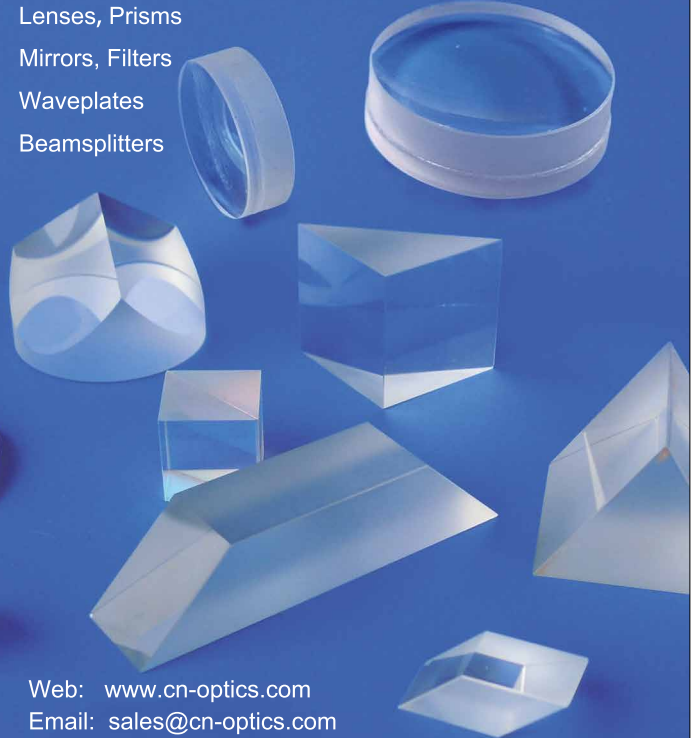
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# How to use OCT, ultrasound and robotics for medical imaging

**Alexandra Eggemann** (right), Project Manager OCT, explains how Thorlabs combined OCT with ultrasound and robotics for a joint trade show demonstration of advanced medical imaging alongside the Institute of Robotics and Mechatronics at the German Aerospace Center



**O**ptical Coherence Tomography (OCT) is a non-invasive and contactless imaging technology which enables the user to see and investigate the inner layers under the surface of different materials given by high-resolution, cross-sectional images. OCT uses infrared light waves – typically 700nm

to 1,600nm – to capture tomographic volumetric data, similar to how ultrasonic (US) imaging uses sound waves.

Samples of interest are biological tissues, particularly in ophthalmology, cardiology and dermatology, but also samples for non-destructive testing such as displays, laser welds or contact lenses.

Swept-source OCT (SS-OCT) and spectral domain OCT (SD-OCT) are two common types; they differ primarily in how they collect and process the light to generate images. SS-OCT uses a tunable laser that rapidly sweeps across a range of wavelengths and a photodiode pair for detection. SD-OCT uses a broadband light source, usually a superluminescent diode, that emits a wide range of wavelengths simultaneously and has a spectrometer to measure the interference pattern across the spectrum.

With the goal to combine three powerful technologies, US + OCT+ robotics, DLR and Thorlabs started in March 2025 to create a demo set-up for the automatica trade show in June 2025.

In previous work, the DLR could already realise an advanced robot interaction control for the MIRO robotic arm in the context of ultrasound scanning in brain surgery. This so-called “mesh-based impedance control”, in combination with US image processing, enables the robot to perform optimised US imaging by ensuring proper acoustic coupling and probe alignment.

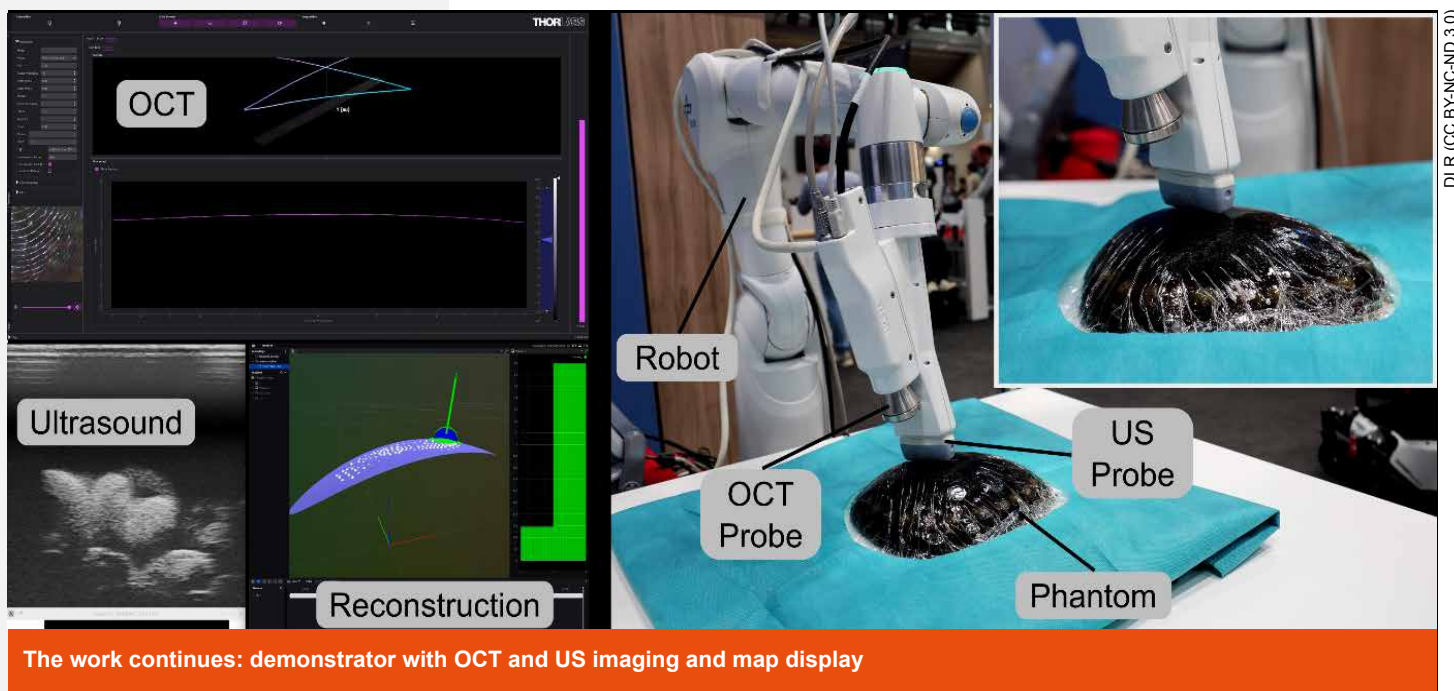
Intraoperative brain tissue imaging for cancer detection is crucial for surgical success. Preoperative imaging helps to identify the location of cancerous tissue in the surrounding healthy brain. During surgery, however, brain shift can cause drastic changes to tissue geometry and location, making it difficult to identify the surgical target.

Using ultrasound for imaging during surgery provides radiation-free image feedback to the surgeon and allows for real-time tissue characterisation.



Preoperative imaging helps identify cancerous tissue, but “brain shift can cause drastic changes to tissue geometry and location,” says Thorlabs’ OCT Project Manager Alexandra Eggemann (right)

Thorlabs



DLR (CC BY-NC-ND 3.0)

The work continues: demonstrator with OCT and US imaging and map display

Ultrasound and OCT can complement each other well in such a task due to their different imaging depths and resolutions. US offers a high imaging depth at low resolution, while OCT offers very high resolutions at low imaging depths.

The new technical demonstrator added OCT to a robot-guided ultrasound set-up. In doing so, DLR and Thorlabs showed how US and OCT can be used to guide robotic imaging and enhance the robot's capabilities in challenging applications.

#### OCT assists in several ways:

- Continuous one-dimensional data acquisition during initialisation to measure the distance between a US probe and tissue and allow for automatic gentle contact establishment.
- Providing continuous information about the tissue surface geometry and location-based depth information through two-dimensional data acquisition.
- With three-dimensional data acquisition a topographic map is generated to adjust the US probe to the sample in closed loop control.
- With its high-speed feedback as a safety feature, a collision with the patient is avoided.
- OCT images offer further insights into the first millimetres of the tissue.

The set-up includes the MIRO collaborative robot, a lightweight robot specifically designed for medical applications within the MIRO Innovation Lab at the DLR; a GE LOGIQ e ultrasound machine and the Thorlabs OCT System TEL411 with a lightweight OCT-Probe special. The phantom is made of ballistic gel and olives to mimic semi-soft tissue and simulate structures similar to those in the human brain.

The OCT will use its 3D-ranging feature

to steer the robot in a closed loop fashion to the sample, fetch the topography to allow the robot to optimise the US probe position and orientation and collect OCT data in parallel for simultaneous US and OCT imaging.

By combining these three technologies, the robot was able to guide the US probe along the previously unknown tissue phantom surface, maintaining proper probe alignment and achieving good US imaging – all while additionally acquiring and visualising OCT data.

A force sensor positioned beneath the brain tissue phantom verified that this technological demonstrator is capable of multimodal tissue scanning while applying minimal pressure to the phantom, which is an important safety feature when imaging soft tissue.

Besides autonomous scanning, the set-up allows the operator to take over control and steer the robot along the phantom in a teleoperated fashion.

Additional features of the demonstrator's software included the construction of a topographic map of the previously unknown phantom surface geometry based on collected OCT and US data, displayed in parallel to the robot's movement.

This set-up demonstrates only one example of how OCT can be used in robot control mechanisms. Beyond its use in surgical robotics, the combination of OCT and robotics may be of interest in many other applications where precise guidance with micrometer accuracy is required.

Work on the current concept is continuing as part of the ongoing co-operation. In addition, we plan to look into further applications to extend the system's capabilities and expand its potential deployment. **EO**

**“Using ultrasound for imaging during surgery provides the surgeon with radiation-free image feedback for real-time tissue characterisation”**

# How photonics and data science can transform disease diagnosis

Researchers from the Leibniz Institute of Photonic Technology and Friedrich Schiller University of Jena reveal how combining photonics and data science enables faster, label-free disease detection

**H**ealthcare systems are facing unprecedented challenges worldwide. On the one hand, chronic, infectious, lifestyle- and age-related diseases keep increasing as a consequence of our growing lifespans and expanding global transport network. While on the other, both the number of clinicians and the financial ability to employ them decreases year-by-year. Technical breakthroughs are now urgently needed to provide a better range of healthcare, while also lowering costs.

As enablers of innovative and transformative tools, photonic technologies demonstrate vast potential in this regard, allowing the biochemical composition and molecular structures of samples to be investigated in a non-destructive, non-invasive and label-free manner, thus providing the opportunity to answer biomedical questions at a molecular level and pave the way for early diagnosis – a critical factor in the treatment of many serious diseases such as cancer.

The introduction of data science allows photonic technologies to have more involvement in biomedical investigations, as photonic signals can be effectively and efficiently translated into meaningful biological knowledge. Photonic data science in biomedical investigations normally follows a simple workflow, where biological samples are imaged in small tile sections then reconstructed into one image with a large field-of-view covering all of the sample area.

The quality of the measured image is enhanced by preprocessing algorithms to reduce artefacts from the measurement, before any modelling methods are applied to extract biological knowledge.

## Image quality assessment

Good-quality images play a critical role in ensuring the validity of any imaging-based investigations. This is particularly important for biomedical applications, in which the samples of different medical statuses

often bear only subtle differences. Existing methods usually work by comparing a measured image with the ground truth. But the full-reference mechanism often limits performance and applicability, showing poor agreement with visual perception. To tackle these limitations, we proposed a multi-marker strategy, which is able to assess image quality from a range of multiple perspectives in a reference-free manner.

A linear discriminant analysis (LDA) is constructed as a classifier, using multiple standard quality markers calculated from semi-synthetic images with known artefacts. In this case, the semi-synthetic images are generated by corrupting high-quality images with varying levels of artefacts.

A set of reference-free metrics are then employed to benchmark the amount of the artefacts contained in an image.

Fourier ring correlation (FRC) is used to estimate the image resolution, of which the degradation was characterised by the sum of the FRC curve. The signal-to-background noise ratio (SNR<sub>σ</sub>) and the contrast to background (SNR<sub>μ</sub>) were adapted from the definition of the signal-to-noise ratio (SNR), where the presence of noise is represented by the sum of the high-frequency components of the image power spectrum and the structural complexity.

The vignetting effect is detected by the energy ratio between the edge pixels and the entire image.

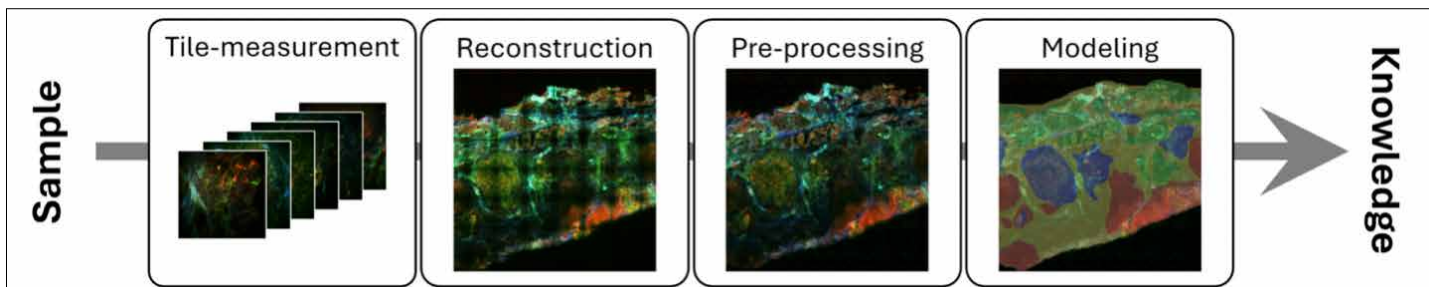
The calculated metrics are then fed into the LDA to classify the type of artefact contained in the corresponding image, with the output decision score indicating the probability of an image belonging to each class. Given images with different artefacts, the resulting decision scores were ranked based on image quality.

Example images of different ranks are rated as good-, medium-, and low-quality, with the ranking scores aligning with visual inspections. The proposed approach is proven to be simple, reliable and

“The introduction of data science allows photonic technologies to have more involvement in biomedical investigations”

Researchers from the Leibniz Institute of Photonic Technology and Friedrich Schiller University of Jena

Alek Sokolov from Pixabay



A view of the normal workflow of photonic data science currently seen in biomedical investigations

interpretable for image quality assessment without reference images.

**Computational staining**

Among all photonic techniques, multimodal non-linear imaging has demonstrated particular potential in biomedical investigations. It combines three non-linear imaging modalities: coherent anti-Stokes Raman scattering (CARS), two-photon excited fluorescence (TPEF) and second-harmonic generation (SHG), which are sensitive to lipids/proteins, auto-fluorophores and collagen, respectively.

Such a combination enables multimodal imaging to simultaneously detect different biomolecules that provide rich molecular signals for biomedical use. The label-free, non-destructive and non-invasive approach provides a perfectly suited alternative to histopathological staining, which remains the gold standard for cancer diagnosis.

But bringing multimodal imaging into clinical use remains a challenge as pathologists train with H&E-stained images. To obtain a pseudo-stained H&E-image, without actually doing the staining, a computational approach is required to convert the multimodal image into a similar colour space to the H&E image.

Deep neural networks were developed to transform multimodal images into pseudo-H&E images in both supervised and unsupervised manners, based on conditional

generative adversarial networks (CGANs) and cycle conditional generative adversarial networks (cycle CGANs), respectively.

The results demonstrated a good match between the prediction and the ground truth image, and without the need for paired H&E multimodal images, the cycle CGAN didn't require image registration.

Showing the promise of computational staining based on multimodal imaging for pathological annotation, the study showed the possible improvements that can be made to cancer diagnosis.

**Tissue classification**

Besides transforming multimodal images into pseudo-H&E images for pathological annotation, photonics can be deployed alongside data science for clinical use in a more straightforward manner. Here, the machine learning or deep learning models are developed to extract features from the image and translated into biological knowledge like disease status. Dependent on the application, the modelling can be pixel-to-pixel (full-annotation) or one single output for each image (weak-annotation).

Lately, head and neck cancer detection based on multimodal imaging and a convolutional neural network has been achieved. The multimodal imaging is performed with a newly developed endomicroscopy, which combines the three non-linear imaging modalities: CARS, TPEF

and SHG. To achieve cancer detection, parallel tissue sections were annotated by pathologies on histopathological images at pixel level. These annotations were then projected to the corresponding positions on the multimodal image with an image co-registration approach. Thereafter, CNN-based semantic segmentation models were constructed that input the multimodal images and output the tissue types.

The modelling was conducted in two cases. In one, the tissue was segmented into six groups: healthy epithelium, tumour, tumour stroma, necrosis, other tissue and background. The prediction demonstrated a good match with the annotation. In the latter case, to put the focus more on cancer detection, the tumour, necrosis and tumour stroma were merged into "tissue to resect" and the other two classes, except background, became "tissue to preserve".

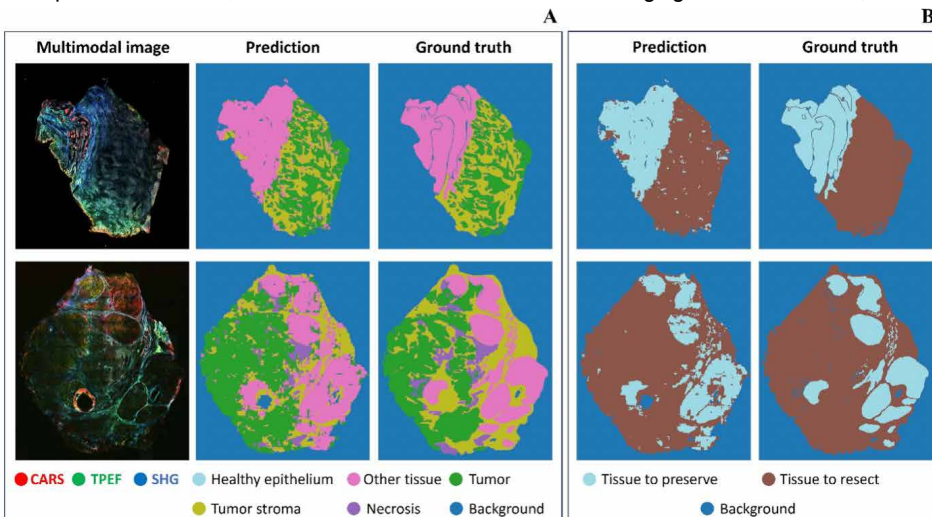
This formed a three-class segmentation CNN model with example predictions suggesting 92% accuracy – a satisfying figure for cancer detection. The study demonstrated the huge potential of endoscopic multimodal imaging when used alongside data science for the automated, in-situ detection of head and neck cancer.

Photonic technologies applied in combination with data science have become a powerful tool in biomedical investigations for three main reasons.

First, photonic data science brings the opportunity to speed up pathological diagnosis without the need to perform staining, but with pseudo-staining generated by computational approaches and photonic imaging used in non-destructive, non-invasive and label-free manners.

Furthermore, with powerful computational algorithms such as deep neural networks, subtle differences caused by changes in health status can be extracted, which enables the early diagnosis of diseases, a critical factor for survival rates. And, finally, data science brings huge conveniences to photonic technologies by reducing the inevitable artefacts from measurements, and taking control of image quality.

With continuous development of both photonic technologies and data science, substantial contributions of photonics to biomedical investigations and healthcare can be expected. EO



The results of GNN-based generation for computational staining

# From Shanghai to Europe: Why China matters in photonics



By Carlos Lee, Director General, EPIC

As I return from Laser World of Photonics in Shanghai, I reflect on how China might be relevant to the European photonics industry. Despite current geopolitical complexities, China remains one of Asia's most important markets. With more than 1,400 exhibitors (I counted 100-plus European companies) and around 50,000 visitors, the show demonstrated a dominant Chinese presence yet it maintained solid international visibility. The exhibition featured dedicated zones for lasers and laser systems for production, integrated photonics and optical communication, optical metrology, infrared and biomedical photonics. These are all areas that align

closely with Europe's traditional strengths in high-end components, systems and specialty manufacturing, so it was relevant for numerous members of EPIC.

China accounts for a significant share of global photonics manufacturing and serves as a major production base. It is equally important to look ahead and consider how this role may evolve.

Industrial lasers in China are now integral to sectors such as automotive, semiconductor manufacturing, medical devices and renewable energy. They are also becoming core tools in automated high-speed production lines. Growth in electric vehicles, battery manufacturing, electronics and infrastructure drives

continued demand for cutting, welding, marking, drilling, micromachining and surface treatment applications based on lasers and optical systems.

Moreover, China is investing in photonic chips as an alternative or complement to advanced electronic chips, targeting applications from AI computing and ultra-high-speed communication to quantum technologies. During this trip, I also had the opportunity to visit China's first thin-film lithium-niobate photonic chip pilot line (CHIPX), which aims to produce 12,000 six-inch wafers per year, possibly a sign of its growing ambition in integrated photonics. **EO**

[For more on China, see page 14](#)



Carlos Lee with Anke Odouli in Shanghai. Odouli is Deputy Executive Director for Business Unit New Technologies at Messe Munich



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# Scanning the future



**Holger Schlüter, who has been the Head of Business Development at Scanlab since 2018**

**Holger Schlüter** has navigated roles across continents and industries – from CO<sub>2</sub> lasers at Trumpf to eye surgery systems at Technolas – and now steers business development at Scanlab. He talks to EPIC’s **Antonio Castelo** about the company’s evolution, the endless promise of laser technology and why loving your work is the ultimate career strategy

**Antonio Castelo: What’s the background to your appointment as Head of Business Development at Scanlab?**

**Holger Schlüter:** After doing a PhD on laser ablation at the Fraunhofer Institute for Laser Technology, Aachen, I worked at Trumpf in Stuttgart, on diffusion-cooled CO<sub>2</sub> lasers. Trumpf then set up a laser development department in the US and, in 2003, I was appointed General Manager of Trumpf Photonics in Princeton, New Jersey. We made diode lasers for pumping solid-state lasers, and in 2006, I was appointed Vice-President of Laser Technology for Trumpf in the US.

In 2008, I moved back to Germany and became the COO and CTO of Technolas Perfect Vision, where I was responsible for the manufacture of excimer laser systems for LASIK treatment and femtosecond laser systems for flap and cataract surgery.

After five years, I moved to Highyag

in Berlin for a few months, as Managing Director, overseeing the development, production, sales and service of high-power beam delivery systems in the automotive industry. I then returned to Trumpf in Berlin, working as an R&D engineer on the development of high-power diode lasers.

In 2015, I joined Scanlab as a business developer, becoming Head of Business Development in 2018. Since then, I have been able – together with the team – to add a lot of new aspects to the Scanlab product portfolio, including XL SCAN, resonant scanners or control architecture for scanner and AOD control.

**AC: How has Scanlab developed?**

**HS:** The company was founded in 1990 to develop a scan head with integrated control. For the first five years, there were fewer than 10 employees. In 1996, it was located in Puchheim, near Munich, and SCANLAB

(decided to) expand into the US. (It) broadened its product range to include scan heads, control electronics and software, and went into a range of application markets such as marking, micro-structuring, welding, and medical.

Since then, Scanlab has grown to a workforce of around 550 and a turnover of €140 million, and we are a leading manufacturer of galvanometer systems for beam deflection in laser applications. We make scan systems for laser robots for car body welding, micro electronics manufacturing, battery manufacturing, medical treatments and for advanced applications in the watch, textile and food packaging industries.

**AC: Who are your main customers?**

**HS:** Historically, our main customers have been machine-builders and integrators of laser-processing equipment, but we also target OEMs in the semiconductor, automotive and medical sectors who require high-performance laser beam deflection/positioning systems. Other customers are R&D labs or institutions working on advanced laser applications.

**AC: Do you get involved in collaboration with laser companies?**

**HS:** We co-operate regularly with laser manufacturers developing suitable scan systems for their newest lasers. But we are reluctant to recommend a particular laser source to customers as it would be unfair towards the other laser manufacturers. We try to be as agnostic as possible.

**AC: What challenges did you face living in the US?**

**HS:** I was very excited about going there, so I only saw the positive sides. People were very friendly and what was really great for



**Product excellence: Scanlab intelliSCAN IV series scan heads**



You can find Scanlab's HQ in Puchheim, near Munich, Germany

**“We see new markets everywhere because even though it's 60 years old, laser technology is still at the beginning”**

us, because we had little children, was that the people are so friendly towards children and you get such positive feedback.

**AC: How did you find moving back to Germany and working for a small outfit?**

**HS:** A company like Trumpf with around 20,000 employees has a lot of rules that you have to comply with, such as writing reports, to make things work. Technolas was similar because we were ruled by medical regulations. Technolas had 150 people and I was the boss of at least 100 of them, but this was the same as Trumpf, where I had a small team and we functioned like a start-up within the company.

In both companies, it was a lot of fun because we could influence a lot of things, which got people enthusiastic about what we were doing.

**AC: How difficult did you find working in the medical market?**

**HS:** Technolas was my first venture into the medical market and I was fortunate in working with the founder of Technolas, who had been in the medical field for more than 20 years. He was a very strong leader and it was very helpful to have him as a mentor.

In the medical sector, you reach your customers in a completely different way. We had a VIP portfolio of doctors who used our equipment and they were used as multipliers to attract other doctors. This approach and the sales organisation was set up by Bausch & Lomb, our parent company, that also had a huge team for sales and regulatory affairs. So, we didn't have many problems.

**AC: What is your relationship with the R&D team at Scanlab?**

**HS:** We have a pre-development team with whom I work very closely. We define the pre-development topics that we work

on for next-generation technologies. I'm also closely connected to both the product management and development teams. I can make suggestions and these are then fed into the process. For new products and new software development, the process is a bit different, but I'm involved in both processes.

**AC: Are your products standard or mostly customised?**

**HS:** We have a range of different mirrors, lenses, cooling options, motors and coatings. There's such a variety of components that can be put together into one scan head that we have thousands of different options to satisfy our customers' needs. So, from a customer standpoint, it's a customised system, but from our standpoint, it's a standard system.

**AC: How do you anticipate Scanlab developing in future?**

**HS:** We are very successful and will outperform our goals for this financial year. But, of course, we face growing competition and monitor this closely. By staying closely attuned to market trends, we drive the development of innovative, high-performance premium products.

**AC: Do you see any new markets opening that you can take advantage of in the near future?**

**HS:** We see new markets everywhere because even though it's 60 years old, laser technology is still at the beginning. Additionally, price reductions of laser sources are enabling many new markets so we see opportunities for growth very positively.

**AC: Do you actively seek involvement in European projects?**

**HS:** The problem with both European, and German, projects is that you first have to apply for them, which means allocating your resources a year ahead from when you apply. If you are successful, you have to use these resources on a project that is probably long-term and we just don't have the people to support these kinds of projects – we need them for product development and pre-development of new technologies. So, no, we really try not to engage in these types of projects.

**AC: What's your advice for the next generation of entrepreneurs?**

**HS:** Because you are going to work eight hours a day, 40 hours a week – or even more – for the next 40 or 50 years, do something you enjoy. You will be more successful if you enjoy what you're doing. I've had some difficult times in my career, but because I enjoyed what I was doing – pushing the limits of the technology and trying out new things – I came out of them feeling positive and stayed positive. **EO**

# April/May 2026: Electro Optics products roadmap

Here are the most eye-catching photonics sector products to hit our mailbag during the past few months

To submit your next new product release for inclusion, please send product details and images to [james.wormald@europascience.com](mailto:james.wormald@europascience.com)



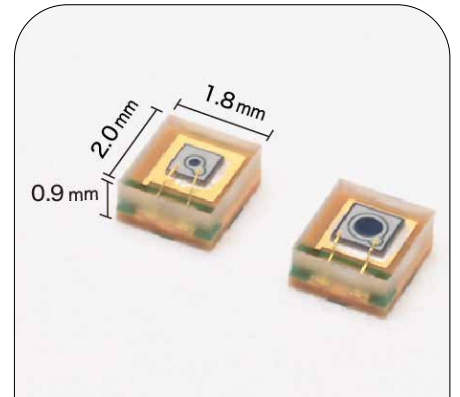
### Advanced Navigation Chimera Land 3D LVS

Chimera Land is a 3D laser velocity sensor (LVS), designed to support positioning applications in environments where GNSS signals are unavailable. Developed by Advanced Navigation, the system uses laser-based measurements of ground-relative velocity, fused with inertial navigation data to reduce drift. The photonics-based sensing approach helps the system maintain accuracy in low-light, high-dust conditions that are typical in underground mining, and is intended for use in any autonomous navigation, machine guidance or collision avoidance system.



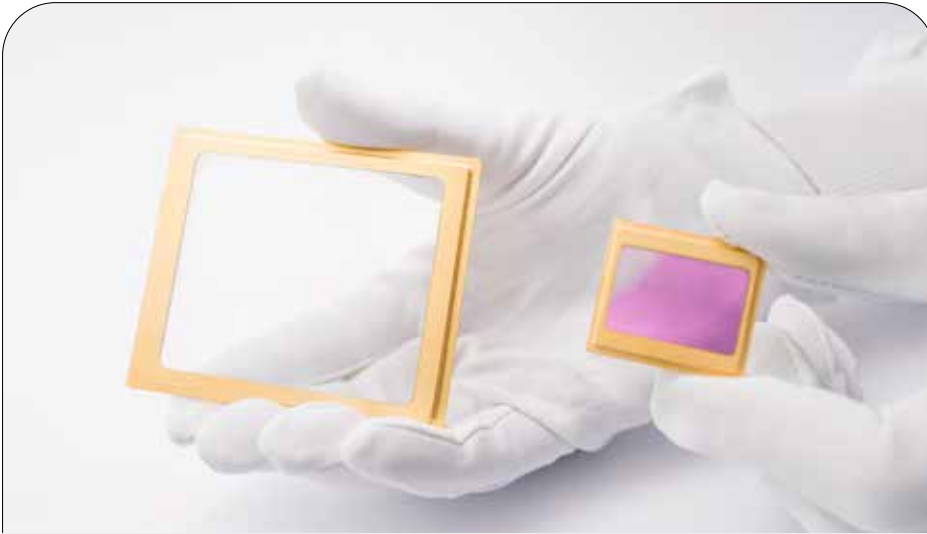
### Edmund Optics TECHSPEC Gemma beam expanders

TECHSPEC Gemma variable beam expanders offer continuous magnification ranges of between 1x-to-3x or 2x-to-8x without internal focusing, says Edmund Optics. They are intended to support stable operation in high-power laser beam conditioning applications. Designed for wavelengths including 355nm, 532nm and 1,064nm, the expanders feature anti-reflection coatings with high laser damage thresholds, and their large apertures and maintained wavefront quality support photonics applications across beam delivery, laser processing and optical system prototyping. It's another example of the company's focus on a range of market-leading solutions.



### Hamamatsu Photonics Silicon Avalanche Photodiode S17268 series

With a quantum efficiency of 82% at 450nm, Hamamatsu Photonics says that its S17268 silicon avalanche photodiode (Si APD) series supports detection systems such as lidar, optical range finding, flow cytometry and particle counting applications with low-noise, low-bias operation. With bandwidths of up to 2GHz and compact dimensions, the surface-mounted package is designed for high-sensitivity use in a range of space-constrained devices.



### **SCHOTT** Hermetic optical MEMS lids

Featuring optical glass windows up to 100cm<sup>2</sup>, SCHOTT's new line of hermetic optical MEMS lids is intended for optical circuit switching (OCS) and sensing systems. According to SCHOTT, the glass supports signal integrity in photonic systems due to its isotropic structure exhibiting zero birefringence. Available with ultra-large window sizes, the lids enable higher-density MEMS mirror arrays, increasing switching port counts for scalable optical networking and photonic integration in artificial intelligence data centres and cloud infrastructure. SCHOTT continues to innovate, with a range of more than 120 glasses, and a strong reputation for customisation. It prides itself on managing a complete value chain, offering customers peace of mind when making procurement choices.



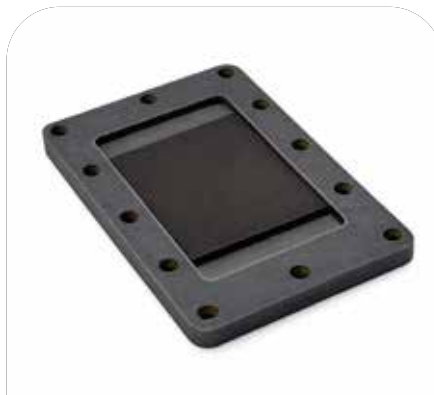
### **Ocean Optics** Spectrometer portfolio

A range of modular spectrometers from the impressive Ocean Optics, including compact micro spectrometers, process-integrated systems and high-resolution instruments, is now available via Edmund Optics. Recently designed for spectral analysis across research, industrial and process monitoring applications, the newly-launched devices are built specifically for integration into photonic workflows, supporting measurement in a range of areas, such as material analysis, optical sensing and laboratory spectroscopy.



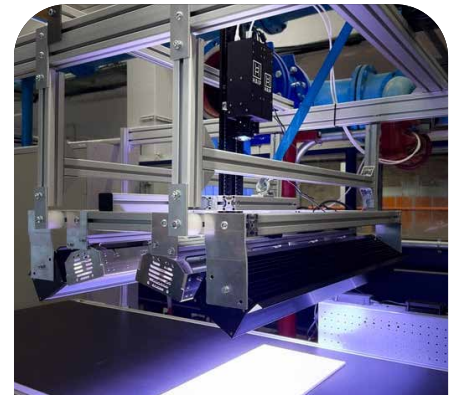
### **Omnisys** BRO optimisation platform

BRO is an AI-based optimisation platform from Omnisys, designed to support air and missile defence operations. It integrates data from sensor networks, including radar and electro-optical systems, to model threat behaviour and optimise counter-engagement strategies. With real-time inputs, the platform can improve resource allocation and decision-making across detection, tracking and engagement, generating AI-driven recommendations to support commanders.



### **Coherent** Thermadite liquid cold plates

Intended for thermal management in high-power AI- and photonics-based compute systems, Coherent has launched liquid cold plates (LCPs) made from Thermadite 800, a material that combines diamond with a silicon carbide matrix to achieve a reported thermal conductivity of 800W/mK. With internal microchannel architectures optimised for real chip heat maps, Coherent says the plates can focus cooling efforts on localised hot spots to minimise coolant use, providing more efficient heat removal and lower operational costs.



### **HAIP Solutions** BlackIndustry RGB camera

BlackIndustry RGB is a multi-line scan colour camera, designed by HAIP Solutions for synchronised operation with its accompanying SWIR hyperspectral sensors. Together, the resulting system enables the synchronised acquisition of RGB and shortwave infrared data on a shared scan line. With a line rate of up to 30,720 lines per second alongside integrated GPU-based preprocessing, the camera is intended for hyperspectral sorting applications in industries such as recycling and food processing.



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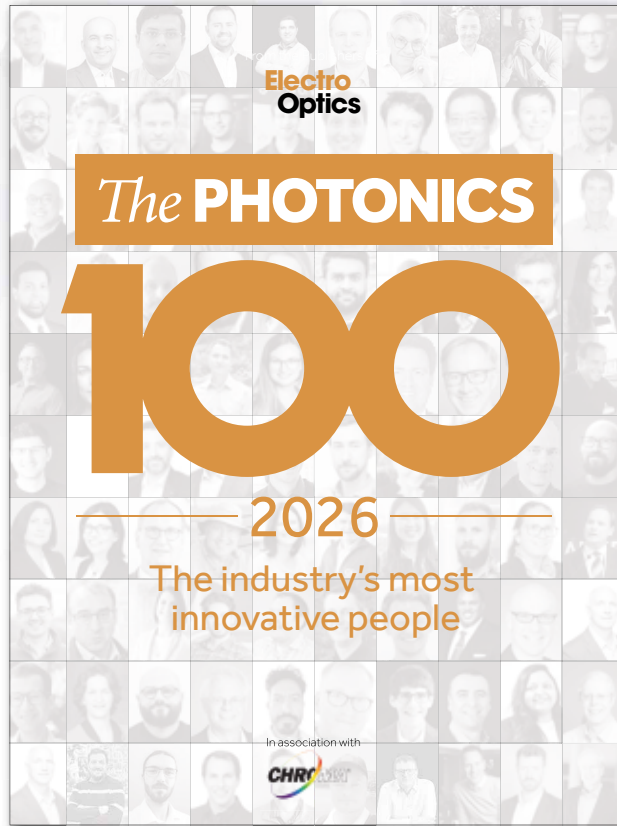
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