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In this Issue

Military laser
DragonFire achieves
first successful
test firing
p.6

G&H profits as
outsourcing strategy
and acquisitions
bear fruit
p.10/11

*...plus the latest
product news*



**SPIE Defense + Commercial
Sensing to unite photonics
industry and business**
p.3

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WHITE PAPERS

SPIE Defense + Commercial Sensing to unite photonics industry and business

Three-day program in Washington DC to focus on funding, technology needs, and engagement with government agencies.

A program focused on building industry and government partnerships to advance technological and engineering innovations in optics and photonics is set to be a highlight of next month's SPIE Defense + Commercial Sensing ("DCS").

The full conference runs 21-25 April in National Harbor, Maryland. The industry-and-government-focused program, featuring multiple high-profile speakers as well as several panel discussions, will run 23-25 April, as part of the 250-plus company exhibition.

The three-day program leverages an increasingly photonics-aware US Government and will highlight specific ways that the optics and photonics industry and the government can partner productively in order to enhance technological advancements in many critical and emerging application areas.

Speakers and panelists will address topics such as funding opportunities; optimal ways to access government agencies' support; current technological and engineering requirements; and supporting and building an innovative and technologically skilled workforce.

Keynote speakers include:

- Director of the Joint Directed Energy Transition Office Mark F. Spencer on an overview of his office which funds basic research, applied research, and advanced technology development in optics and photonics with academic, industry, and government partners.
- The National Science Foundation's Director of Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Vincent Lee on "Accelerating Research to Impact."
- ARPA-E's Associate Director of Technology and Program Director Jenifer Shafer on "Opportunities for Innovative Sensing and Imaging Technologies at ARPA-E"; and
- NASA Industry Engagement Lead and Senior Technical Advisor Alexandra Hale on "Embracing the Aerospace Community Through Strategic Engagement"

Panel discussions

DCS Panel discussion topics will cover "Commercial Technology Transfer/Integration to Government," "Directed Energy: Industrial Base Readiness to Support Directed Energy

Programs of Record," and "Keeping National Security AI Trustworthy."

Featured panelists and speakers include: Exciting Technology's Paul McManamon; NDIA Emerging Technologies Institute's Wilson Miles; the US National Geospatial-Intelligence Agency's Robert B. Meltzer; Matthew Turek, of DARPA's Information Innovation Office; Office of Army Prize Competitions and Army Applied SBIR Program's Matthew Willis; the Office of the Under Secretary of Defense for Research and Engineering's Frank E. Peterkin; L3Harris Technologies' Teresa Pace; Element Aero's Sandra Biedron; and Leonardo's Robert Walker.

"Recent funding and policy decisions have shown that the US Government is becoming acutely aware of the critical and enabling qualities of optics and photonics technologies," says SPIE Director of Science and Technology Bob Hainsey.

"With SPIE Defense + Commercial Sensing located so close to Washington DC, it's an opportunity to bring the industry and key stakeholders together to ensure that both the optics and photonics industry and the US Government are positioned to take advantage of each other's strengths and ongoing programs. This year's industry program will play a key role in providing a venue for these discussions to take place."

Access to the exhibition and industry program is free, though registration is required. More information — including registration — can be found on the SPIE Defense + Commercial Sensing website.

<https://optics.org/news/15/3/11>



Doug Droege, senior director of IR&D and technology for the L3Harris Integrated Mission Systems Segment, speaking at SPIE Defense + Commercial Sensing in 2023.

Image: SPIE.

Fraunhofer ISE announces S Mile Solutions spinoff for African developments...

...while Microdisplays and Sensors business unit at Fraunhofer FEP integrated into Fraunhofer IPMS.



Photo: Smart Last Mile Solutions.

The prototype of a mobile supply platform in field tests; S Mile Solutions is targeting energy and water purification support for "last mile" connections in Sub-Saharan Africa.

No clean water, functioning electricity grid, nor primary healthcare. This a scenario that is not uncommon in remote areas of the sub-Saharan region of Africa. The founding of S Mile Solutions (Pty) Ltd., a spin-off of the Fraunhofer Institute for Surface Engineering and Thin Films (IST) and Institute for Solar Energy Systems (ISE), is aiming to change this.

The start-up, based in Stellenbosch, Western Cape, South Africa, provides smart, small-scale and off-grid infrastructure solutions that are

mounted on pick-up trucks, thereby enabling companies and institutions to access rural and remote communities with their services and products.

The aim of Smart Last Mile Solutions, ("S Mile", for short), is to enable infrastructure-based services along the last mile and, to improve the living conditions and prospects of remote communities in sub-Saharan Africa.

Examples include the supply of clean water and electricity, as well as their storage, the inclusion of hygiene measures and the provision

of telecommunications for the establishment of primary healthcare with telemedicine and data-management opportunities in the field.

"As a start-up company, the engineering and consulting company is currently focusing on the provision of self-sufficient preclinical platforms for primary healthcare," said Dr. Lothar Schäfer, S Mile founding member and former Deputy Director of the Fraunhofer IST.

Plans for the future include the expansion of the product range to also support other sectors such as wildlife and nature conservation, agriculture, mining, tourism, disaster relief and research platforms.

S Mile infrastructure solutions are to be further developed, adapted and deployed in the field. "Joint training and further education offers, for instance in cooperation with the Fraunhofer Academy, or the development of joint participation strategies," said Dr. Joachim Koschikowski, Group Leader in Water Treatment and Materials Separation at the Fraunhofer ISE and fourth S Mile founding member.

Fraunhofer FEP's Microdisplays and Sensors business unit integrated into IPMS

The Microdisplays and Sensors business unit at the Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology (FEP) has been integrated into the Fraunhofer Institute for Photonic Microsystems (IPMS), with retroactive effect from January 1, 2024.

Both institutes are closely connected, particularly within this business unit, and share infrastructure at the Dresden site. By pooling expertise and streamlining structures, we anticipate the creation of synergies that will strengthen the research field, expedite development and thus benefit customers and partners.

There is rapid development in the market for the microdisplays used in augmented reality (AR), virtual reality (VR) and mixed reality (MR) applications

continued on next page

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Fraunhofer ISE announces S Mile Solutions spinoff for African developments

and this will be an important growth market of the future, say the partners.

The integration of OLED and μ LED frontplane technologies in CMOS backplanes is not only the key to success in this sector but also the technological basis for near-to-eye visualization of information.

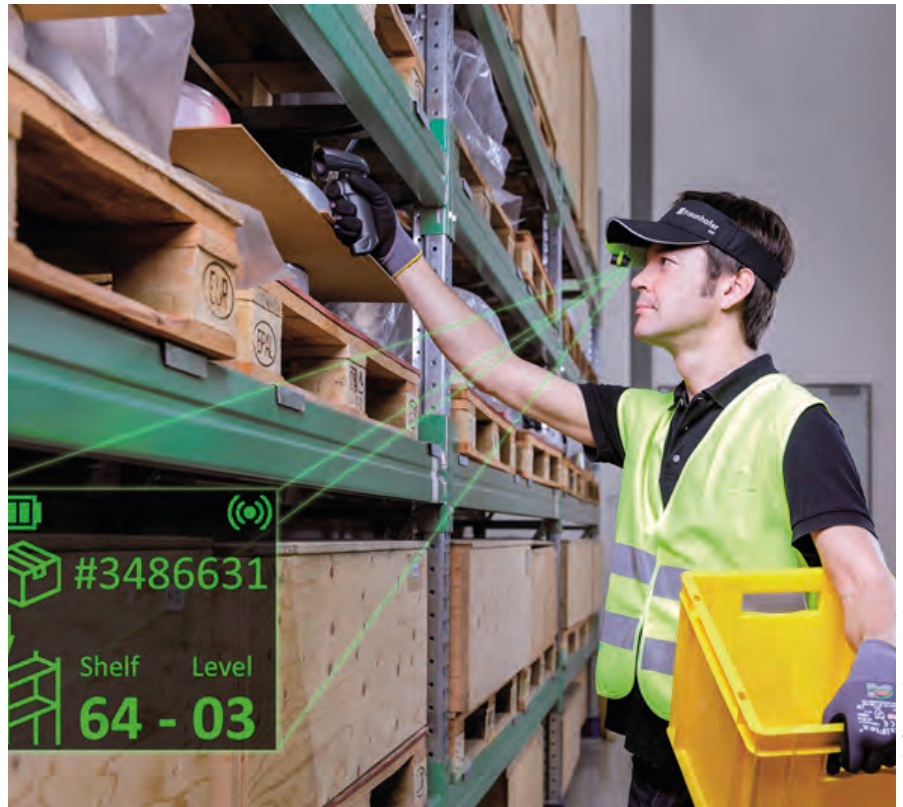
The two institutes decided, in consultation with the Fraunhofer-Gesellschaft, to integrate the Fraunhofer FEP Microdisplays and Sensors business unit into Fraunhofer IPMS. Their goal is to leverage synergies in the area of infrastructure, pool their expertise and establish a new profile.

"By integrating the Fraunhofer FEP Microdisplays and Sensors business unit into Fraunhofer IPMS, we are pooling our expertise and ensuring the best possible use of our infrastructure. This will also increase our chances to win projects with the Microelectronics group," said Prof. Holger Hanselka, President of the Fraunhofer-Gesellschaft.

Harald Schenk, Director of Fraunhofer IPMS, said, "In the future, Fraunhofer IPMS will increase its activities in this area and focus more on the heterogeneous integration of various chiplet technologies with CMOS microelectronics. This includes the integration of organic semiconductors (OLEDs) and novel emitter technologies (μ LEDs)."

Elizabeth von Hauff, Director of Fraunhofer FEP, said, "Transferring to Fraunhofer IPMS will open up additional development potential for the business unit and enable Fraunhofer FEP to focus on strategic topics in the field of electron beam and plasma technologies."

<https://optics.org/news/15/3/16>



The Fraunhofer FEP Microdisplays and Sensors business unit, which will be integrated into Fraunhofer IPMS, develops OLED and μ LED displays.



D microdisplay with a resolution of 1440 x 1080 pixels and the world's smallest pixels of 2.5 μ m.

© Fraunhofer FEP, photo: Claudia Jacquemin.

© Fraunhofer FEP, photo: Claudia Jacquemin.

Military laser DragonFire achieves first successful test firing

Energy weapon system is UK's first high-power source against aerial targets.

The UK military has developed a laser weapon that could support the country's Armed Forces with greater accuracy while reducing the reliance on high-cost ammunition has reached its next milestone.

During a trial at the UK Ministry of Defence's (MoD) Hebrides Range, the DragonFire laser directed energy weapon (LDEW) system achieved the UK's first high-power firing of such a weapon against aerial targets. The range of DragonFire is classified, but it is a line-of-sight weapon and can engage with any visible target, said the MoD statement.

"DragonFire exploits UK technology to be able to deliver a high power laser over long ranges," The MoD stated on January 19th, added, "The precision required is equivalent to hitting a £1 coin from a kilometer distant."

Laser-directed energy weapons can engage targets with an intense beam of light to damage it, leading to structural failure or more impactful results if a warhead is targeted.

Firing a laser weapon for 10 seconds is the cost equivalent of using a regular room heater for just an hour. Therefore, it has the potential to be a long-term low-cost alternative to certain tasks missiles currently carry out. The cost of operating the laser is typically less than £10 (&12.70) per shot, said the MoD.

The DragonFire development is led by the UK's Defence Science and Technology Laboratory (Dstl), on behalf of the MoD, working with its industry partners MBDA, Leonardo and QinetiQ.

The statement added, "This achievement demonstrated the ability to engage aerial targets at relevant ranges and is a major step in bringing this technology into service. Both the [British] Army and Royal Navy are considering using this technology as part of their future arms portfolio.

Defense capabilities

UK Defence Secretary, Grant Shapps commented: "This type of cutting-edge weaponry has the potential to revolutionize the battle space by reducing the reliance on expensive ammunition, while also lowering the risk of collateral damage.

"Investments with industry partners in



UK first: successful firing of a high-energy laser weapon.

advanced technologies like DragonFire are crucial in a highly contested world, helping us maintain the battle-winning edge and keep the nation safe," he said.

The capability builds on a series of highly successful trials, including the first static high-power laser firing of a sovereign UK capability and demonstration of the DragonFire system's ability to track moving air and sea targets with high accuracy at range.

Building on this research, the MoD recently announced its intention to fund a multi-million-pound program "to transition the technology from the research environment to the battlefield".

The latest trial was sponsored by the MoD's Defence Science and Technology (DST) organisation and Strategic Programmes and enabled by many other agencies across



LDEW research and technology is delivered in partnership and is a cost-effective way of meeting the needs of the MOD while maintaining UK industry's technology and skills base.

government, ensuring all regulatory and safety approval requirements were satisfied.

Dstl's Chief Executive, Dr Paul Hollishead commented, "These trials have seen us take a huge step forward in realising the potential opportunities and understanding the threats posed by directed energy weapons. With our decades of knowledge, skills, and operational experience, Dstl's expertise is critical to helping the armed forces prepare for the future.

The DragonFire weapon system is the result of a £100 million joint investment by the Ministry of Defence and industry. Together, the companies involved are supporting highly-skilled UK jobs in new cutting-edge technologies that are delivering a significant step-change in the UK's capability in LDEW systems.

In 2017 the MoD's Chief Scientific Advisor's Research Programme awarded a £30 million (\$38 million) contract to the DragonFire consortium to demonstrate the potential of LDEWs.

Dr Nick Joad, of Dstl said, "This is a really innovative application of science and engineering and is the fruit of sustained investment and effort. DragonFire uses cutting-edge science and technology and delivers much greater performance than other systems of a similar class. DragonFire provides a step-change in our ability to deal with high-performance and low-cost threats.

Shimon Fhima, Director Strategic Programmes for the MoD said, "The DragonFire trials at the Hebrides demonstrated that our world-leading technology can track and engage high-end effects at range. In a world of evolving threats we know that our focus must be on getting capability to the warfighter and we will look to accelerate this next phase of activity."

<https://optics.org/news/15/1/30>

Credit: UK MoD / Dstl.

nLight tempers 2024 growth expectations

High-power fiber and diode laser firm has won more than \$200 million in recent defense-related business.

nLight, the US-based maker of high-power fiber and semiconductor lasers, in February posted sales of \$51.9 million for the closing quarter of 2024 - down on the prior year, but a little higher than it had forecast three months ago.

That was largely the result of a "pulled-in" shipment to an earlier than expected date, and lifted the firm's full-year revenues for 2023 to \$210 million.

The annual figure was 13 per cent lower than the 2022 total, although thanks partly to its investment in automated production at its Camas, Washington, facility nLight's operating loss shrank from \$55.1 million to \$46.8 million over the same period.

CEO Scott Keeney told an investor conference call that thanks to the Camas facility and contract manufacturing in Thailand, the company's operations were now far less reliant on its site in China.

"Prior to 2023 we relied on our Shanghai facility to assemble the vast majority of our semiconductor lasers and a substantial proportion of our fiber lasers," he said. "Today we've reduced this exposure to below 10 per cent."

Additive hiccup

Although those operational improvements and more streamlined capacity should provide major benefits in the longer term, the relatively under-used Camas site will drag on nLight's margins in the opening quarter of 2024, for which Keeney and his team anticipate revenues to drop to between \$42 million and \$46 million.

And while the company now boasts a firm purchase order backlog of \$108 million and nearly \$220 million in contracts largely related to directed energy laser weapons development, 2024 is likely to see a slower rate of growth than had been expected until recently.

That appears largely due to weaker demand from the industrial side of the business, and additive manufacturing in particular after nLight customer Velo3D announced a strategic review towards the end of last year.

"That's not the plan we had hoped for," admitted Keeney on the Velo3D development. Further challenges in the industrial laser market include the continued price competition from Chinese fiber laser companies, although

the CEO said that nLight's programmable "Corona" lasers were still able to deliver an advantage over cheaper rivals.

Laser weapon activity

Turning to the laser weapons sector, Keeney said that demand was growing, and not just from the US Department of Defense. "We are finally seeing high-energy lasers moving out of the lab and into the field," he commented, pointing out that defense-related sales had risen year-on-year in 2023 despite the impact of supply-chain issues.

Highlighting nLight's 20-year involvement in directed energy weapons development, Keeney said that although the technology remained challenging there was a strong desire by the US and its allies to field systems in the next 18-24 months.

"In the past quarter we've seen a desire to deploy," he told investors, citing attacks on ships in the Red Sea as one evident location where the ability to disrupt drone and missile attacks with a laser would be desirable.

Keeney added that the level of directed energy weapons activity outside the US was "significant", with broad engagement around the world and "fairly advanced" developments in Israel.

- Following the firm's latest update, nLight's stock price dropped in value by around 6 per cent in pre-market trading on February 23rd as investors reacted to tempered expectations for 2024. Trading at around \$13 on the Nasdaq, the current price equates to a market capitalization in the region of \$600 million.

<https://optics.org/news/15/2/34>



The US Army's 4th Battalion, 60th Air Defense Artillery Regiment at Fort Sill, shown with the Directed Energy Maneuver-Short Range Air Defense (DE M-SHORAD) prototype laser weapons systems. nLight is contracted to provide a 50kW-class laser for the system.

Photo: US Army

Precision Optics picks out target applications in defense sector

US firm sees fast-growing opportunities emerging in drones, laser weapons, and satellite communications.



Photo: Precision Optics Corporation.

The executive team at Precision Optics Corporation is hopeful that its single-use cystoscopes - used as part of a larger robotic system to investigate the bladder and urinary tract - will go into volume production by the end of June 2024, and become the firm's largest manufacturing program. This image shows a single-use ophthalmoscope originally developed by Lighthouse Imaging, which POC acquired in October 2021.

Precision Optics Corporation (POC), the developer of high-specification micro-optics largely used in endoscopy applications, has outlined plans to expand its efforts in the defense and aerospace sector.

The Massachusetts company, which listed on the Nasdaq in late 2022, sees growing opportunities in three specific application areas.

In an investor conference call detailing the firm's latest financial results on February 14th, CEO Joe Forkey said:

"We have already identified three segments that require micro-optics and/or high-precision alignment, some of which are represented by our current production programs.

"They are unmanned aerial vehicles or drones; directed energy weapons or laser weapons; and satellite communications, especially among satellite constellations.

"Each of these segments is expanding at double-digit annual growth rates, making them ideal targets for future POC sales and marketing efforts."

Those efforts come as POC also works to bring a number of endoscope-related engineering programs to volume production over the next few months - including a single-use cystoscope that would typically be used to investigate the urinary tract and bladder.

Production shift

Reporting quarterly sales revenues of \$4.8 million for the December quarter - down nearly 20 per cent on the same period a year earlier - Forkey highlighted that the company's engineering revenue had jumped 33 per cent, indicating that stronger sales growth from a ramp in production should be in the pipeline.

"We have begun to see the rebound we expected with two new programs moving to production in the quarter and another restarting after a pandemic-related hold," he said.

"The growth we expect in the second half of fiscal 2024 [which ends in June] is supported by the strength of our engineering pipeline, a leading indicator of future production volumes."

The anticipated ramp in demand also means that POC may need to expand its manufacturing footprint, and the CEO told the investor call:

"With a large number of programs anticipated to move to production in the next few quarters, we have begun to critically evaluate our manufacturing infrastructure.

"We are considering various approaches to satisfy our requirements for manufacturing space, including a search for a potential new facility that will allow us to further expand and optimize manufacturing capacity to support both our near-term and longer-term growth objectives.

"Our technological capabilities are highly sought after. We are one of only a few companies in the world that can deliver the type of micro-optics and digital imaging that are supporting the next generation of medical devices."

Core competencies

Despite that future potential, the lower sales in the December quarter hit POC's profit margins, with the company posting an operating loss of \$0.7 million for the period.

According to its latest balance sheet, the firm held just under \$1 million in cash and equivalent liquid assets as of December 31 - down from close to \$3 million six months earlier.

However, the latest quarterly sales figure did represent an increase of 12 per cent on the September 2023 total, and POC's executive team is expecting a similar increase in the current quarter, along with better profitability.

"We anticipate volumes from production orders coming online to lift our overall revenue to new quarterly record run-rates in this fiscal year," said Forkey.

"Precision Optics' core competencies - micro-optics, digital imaging, 3D endoscopy, and single-use medical devices - uniquely position us at the center of market segments that are significantly outpacing the growth of the broader medical device and defense/aerospace industries.

"I look forward to an exciting second half of fiscal 2024."

<https://optics.org/news/15/2/29>

Teledyne snaps up Adimec

Eindhoven-based maker of industrial cameras set to become latest addition to Teledyne's sprawling portfolio of imaging brands.

Teledyne is to further expand its already extensive portfolio of imaging technologies, with a deal to acquire the Dutch industrial camera maker Adimec.

Founded in 1992 by Just Smit, Bas Heijn, and Jochem Herrmann, Adimec sells a wide range of cameras typically used in machine vision, healthcare, and defense applications, with products operating in the visible, infrared, and X-ray spectral regions - including custom options.

One example is the firm's 103 megapixel "DIAMOND D-103A12-T" camera for high-resolution metrology, which is aimed at the displays sector for LCD, OLED, and MicroLED inspections.

Another area of expertise is an active lens alignment system that uses real-time measurements to assist in the positioning of the image sensor to optimize the performance of short-wave infrared (SWIR) imagers used in defense applications.

Complementary technology

Those technologies will augment a Teledyne line-up that has expanded dramatically over the past decade through a series of acquisitions of camera and image sensor manufacturers.

Edwin Roks, the Massachusetts firm's CEO, said of the latest deal: "Adimec possesses uniquely complementary technology, products and customers in the shared strategic focus areas of healthcare, global defense, and semiconductor and electronics inspection.

"For decades, and from our own X-ray imaging business headquartered in Eindhoven, I have watched Adimec grow to become a leader in niche applications requiring truly accurate images for precise decision making in time-critical processes."

Alex de Boer, one of Adimec's two co-CEOs, commented: "As a leader in advanced imaging technologies for industrial and scientific markets, Teledyne is the perfect company to build further on the strong foundation the founders and

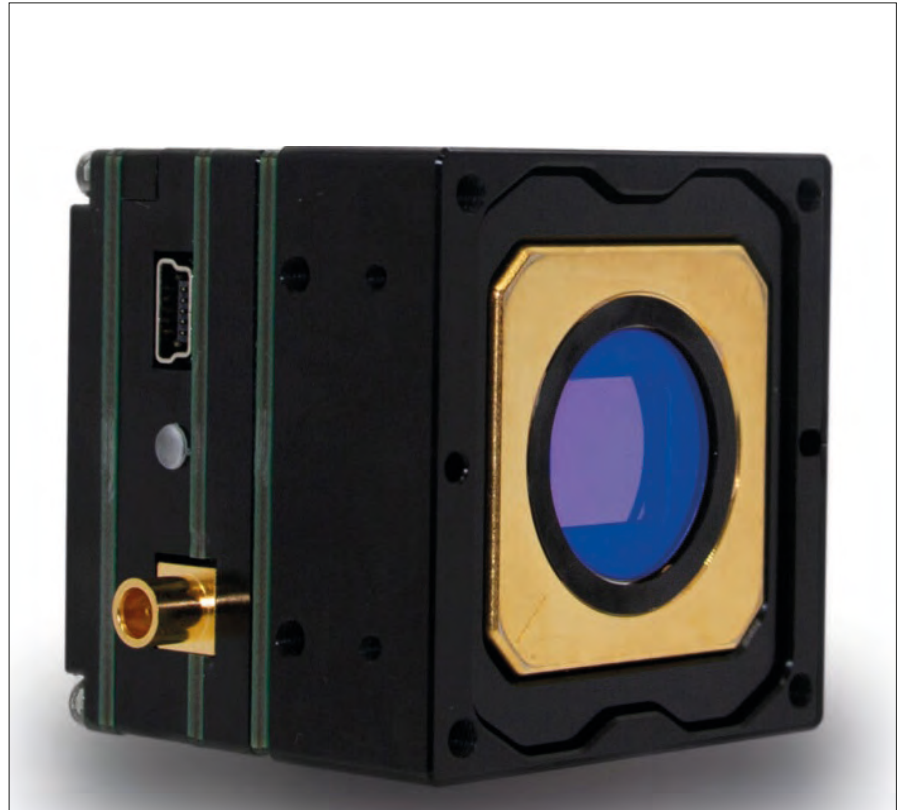


Image: Adimec

Eindhoven camera company Adimec has been selling its "TMX" series of products for 30 years. The latest version of the technology features an InGaAs SWIR sensor, and is aimed at applications in long-range, high-end security surveillance.

management have established over the past three decades.

"The entire Adimec team is looking forward to contributing to an exciting future with Teledyne while extending technical boundaries to support our customers with cameras - perfectly optimized to their application needs."

Joost van Kuijk, who has led Adimec alongside de Boer since 2014, added: "It is with great pleasure that we are able to announce publicly that Adimec will become part of Teledyne."

Imaging growth

Teledyne's most recent sales figures show that its digital imaging division posted annual sales of \$3.14 billion in 2023, accounting for more than half the NYSE-listed company's total revenues of \$5.64 billion.

In 2010, imaging represented only 7 per

cent of Teledyne's \$1.64 billion annual revenues, equivalent to just over \$100 million.

However, since then the company has acquired the likes of Dalsa, e2v

technologies, and the Roper subsidiaries Princeton Instruments, Lumenera, and Photometrics. Then in 2021 the firm completed its most significant move in the sector with the deal to buy thermal imaging giant FLIR, at a cash-plus-stock cost of around \$8 billion.

Speaking during Teledyne's most recent investor call, executive chairman Robert Mehrabian said that he expected the overall business to grow its sales revenues by around 4 per cent this year, with the FLIR division set to grow slightly more rapidly than its other imaging subsidiaries.

"FLIR defense especially, is experiencing really good order intake - and we expect the growth there to exceed that of the rest of the imaging [business unit]," he added.

<https://optics.org/news/15/2/17>

G&H profits as outsourcing strategy and acquisitions bear fruit

London-listed firm benefiting from demand for military countermeasures and use of fiber-optic splitters in lithography tools.

G&H (Gooch & Housego), the UK-headquartered maker of photonic components and subsystems, has posted sales of £149 million for the year ending September 30 - up nearly 20 per cent on the prior year.

Though partly reflecting exchange rate fluctuations and the recent acquisition of both Artemis Optical and GS Optics, that increase in turnover - alongside some site rationalization - was enough to send the London-listed firm back into profit.

CEO Charlie Peppiatt, who instigated a wide-ranging strategic review of G&H's operations and priorities earlier this year, revealed a statutory profit of £5 million for the year, in contrast with the £2.3 million loss posted a year ago.

"Having completed my first full year with G&H, I am pleased with the progress that has been made across the business through the collective hard work of the workforce harnessed more effectively through our new strategy that was launched in the summer," he observed.

"Over the last year many of my first impressions have been confirmed, that G&H is a company with outstanding products, enormous technical capability and highly talented people that required greater focus on operational execution, customer experience, employee engagement and better prioritization of valuable R&D technology investment."

Contract manufacturing

One of the outcomes of the strategic review has been a greater reliance on outsourcing the production of some key products to contract manufacturers in Thailand and the Czech Republic.

Peppiatt told an investor conference call that the aim was to pro-actively transition production to manufacturing partners at



Photo: G&H

Through recent acquisition Artemis Optical, G&H is now supplying the UK Special Forces, Royal Marine Commandos and Army Special Operations Brigades with battlefield laser protection, thanks to bespoke optical filter assemblies inside the new KS-1 assault rifle scope.

an earlier stage in the life cycle of certain products.

At the moment around 10 per cent of G&H sales are generated by outsourced production - largely acousto-optic products - but the aim is to increase that proportion to around 25 per cent in the future.

The CEO also highlighted what is expected to be a significant ramp in the production of high-reliability fused fiber-optic couplers next year, with their manufacturing now qualified at the Thailand-based contractor.

Those devices are used in sub-sea optical networks demanding faster communication speeds and greater complexity, with additional devices expected to move to contract production over the next couple of years.

Other recent developments have included the first deliveries of fiber-optic splitters used in cutting-edge lithography

tools, as well as some next-generation design wins for G&H's "Fiber-Q" coupled modulators.

Peppiatt also described the two recent acquisitions as a "great fit", with GS Optics' scalable precision polymer optics facility in Rochester, New York, now set to serve as the company's main base for life science and biophotonics markets in the region.

Divisional demand trends

Meanwhile, Artemis' expertise in optical coatings is finding use in Ukraine, where the Russian invasion has prompted increased demand for sighting systems offering robust laser protection.

"Lasers are in widespread use on the battlefield," Peppiatt told investors, adding that G&H had developed a bespoke solution for battlefield safety and won a contract to supply the UK's special forces with rifle-scope laser protection used in the new "KS-1" assault weapon.

Demand emanating from Ukraine was partly responsible for a 20 per cent year-on-year increase in sales for the company's "aerospace and defense" unit, although the division still posted an operating loss of £2.9 million on sales of £38 million. Peppiatt and his team will be looking to improve those margins in

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G&H profits as outsourcing strategy and acquisitions bear fruit

the future, potentially aided by emerging demand for high-power laser weapons.

“Our teams have continued to work on directed energy systems with a number of prime contractor customers,” added the firm in its annual review. “G&H’s expertise in coating the large optics that are positioned at the heart of these systems means that we are well positioned to secure recurring production revenues once development activities are complete.”

G&H’s largest division by sales remains its industrial business, which delivered an operating profit of £9.3 million as sales rose to £77 million.

“Demand for our germanium acousto-

optic modulator used in the Q-switching of solid-state lasers was particularly strong,” stated the firm, although some deliveries have since been paused as customers adjusted their inventory positions in response to what is typically a cyclical market.

Life sciences US expansion

Also in profit was G&H’s life sciences division, although at £3.2 million the latest operating surplus was slightly down despite a 6 per cent rise in sales to £33 million.

“We have invested into the GS Optics site in Rochester to establish our center of excellence for life sciences in North America,” G&H reported. “We will use the site to mirror many of the existing capabilities we have in Ashford, Kent, for the UK and European medical device market”

Ashford is home to G&H’s “ITL” division, which specializes in medical devices, including diagnostic tools. “We are growing our medical instrument design and development team at the Rochester

location and are now able to offer our OEM medical device customers significantly more capacity for production build in the US than was previously the case,” stated the firm.

Looking ahead, Peppiatt said that while he remained optimistic there remained some significant challenges, notably hiring personnel in a highly competitive labor market, especially in engineering and technical positions.

“While mindful of the increasingly uncertain macroeconomic and geopolitical landscape, G&H remains well positioned for growth with a robust pipeline across all our end markets,” the CEO noted.

“The business will invest to ensure G&H can capitalize on the accelerating deployment of photonics technologies into continuously expanding areas of the industrial, life sciences, and aerospace and defence markets.”

gandh.com

<https://optics.org/news/14/12/4>



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Aeva plans route to FMCW lidar ramp

CEO says it is now a matter of 'when', and not 'if', the automotive industry adopts the more advanced sensing technology.

Aeva, the Silicon Valley company specializing in frequency-modulated continuous-wave (FMCW) lidar, says it is now a matter of "when", and not "if", the automotive industry adopts the technology.

Those comments were made by Aeva co-founder and CEO Soroush Salehian during the Mountain View firm's latest investor call, during which he outlined plans to ramp production of FMCW sensors for key customers Nikon and Daimler Truck - with additional vehicle OEMs expected to make key purchasing decisions within months.

While Aeva's 2023 sales of \$4.3 million were only marginally higher than the 2022 total - and the company burned through around \$120 million of its cash pile - Salehian highlighted the significance of the recent series production agreement with Daimler Truck, describing it as a "massive validation" of the firm's FMCW lidar.

"This is a clear indication of the industry's growing appreciation and shift towards FMCW technology, to enable even more advanced ADAS, and highway autonomy functionality in vehicles," said the CEO.

2027 ramp

Based around a frequency-chirped laser source and silicon photonics, the optical core of Aeva's latest "Atlas" system-on-chip design can be used for both industrial and automotive applications, with different software used to address different requirements.

Unlike conventional time-of-flight lidar, the FMCW approach is able to determine the velocity as well as the position of other objects on the road, and can be scaled to chip-scale, low-power modules. Other companies working on the technology include Aurora Innovation, Baraja, Scantinel, SiLC Technologies, and LuminWave, as well as a research group at Intel.



Image: Aeva.

Aeva says that the innovations in its "Atlas" lidar have yielded a 70% size reduction and 4x lower power consumption, compared with the previous generation of its FMCW technology. The advances enable operation without active cooling, and allow for seamless, in-cabin integration behind the vehicle's windshield, on its roofline, or in the grille.

FMCW also supports ultra-long-range sensing - something of particular interest for heavy commercial trucks that take a long time to get up to highway speeds, and to slow down.

The down side of FMCW has always been its relative complexity - but Aeva appears to have solved that problem, with Salehian noting that Daimler Truck, which has particularly stringent requirements, has evaluated its planned manufacturing line and supply chain partners. "This is no small feat, especially for a company at our stage," noted the CEO.

Series production for Nikon's deployments in industrial automation is slated to begin by the end of this year, with Daimler scheduled to begin adopting the technology in 2026, followed by a ramp to potentially hundreds of thousands of units in 2027.

Fabless production strategy

In the meantime, Salehian said that other truck companies and makers of passenger vehicles were currently working through requests for quotations (RFQs), with decisions anticipated in 6-9 months' time.

The Daimler deal, announced during the CES event in January, has sparked wider interest among OEMs, added the CEO. "As OEMs deploy highway autonomy, we expect FMCW to play a central role," he told investors. "The feedback [we're getting] from OEMs is that not 'if' they are transitioning to FMCW, but 'when'."

As a result Aeva - which is a fabless company and so uses contract manufacturers to scale the technology - is working to ensure enough future production capacity is available to meet demand if it is able to secure the additional design wins it is pursuing.

Salehian and his team currently expect the firm's sales revenues to at least double this year while costs remain at roughly the same level, which will mean further significant cash burn in 2024. But they also stress that with close to \$350 million available in cash, other liquid assets, and via a credit facility, the firm remains in a strong position ahead of the planned ramp.

"The unique performance and maturity of Aeva's 4D lidar, along with our financial strength, position us to lead this [FMCW] adoption, as we progress on multiple additional automotive RFQs anticipated to be awarded this year."

[aeva.com](https://www.aeva.com)

<https://optics.org/news/15/3/7>

EPFL and Max Plank merge nonlinear optics with electron microscopy

Method yields new capabilities in material studies and control of electron beams.

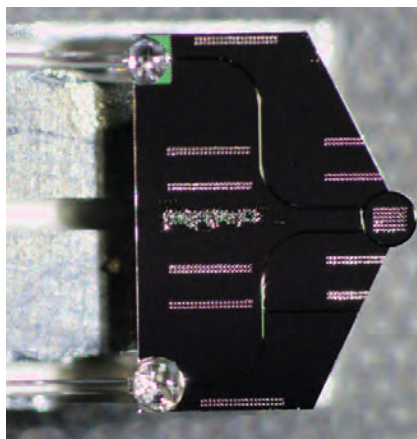
When light passes through a material, it often behaves in unpredictable ways. This phenomenon is the subject of “nonlinear optics”, which is now integral to technological and scientific advances – from laser development and optical frequency metrology, to gravitational wave astronomy and quantum information science.

In recent years, nonlinear optics have also been applied in optical signal processing, telecommunications, sensing, spectroscopy, light detection and ranging. All these applications involve the miniaturization of devices that manipulate light in nonlinear ways onto a small chip, enabling complex light interactions chip-scale.

Now a team of scientists at EPFL and the Max Planck Institute has brought nonlinear optical phenomena into a transmission electron microscope (TEM), a type of microscope that uses electrons for imaging instead of light.

The study was led by Professor Tobias J. Kippenberg at EPFL and Professor Claus Ropers, Director of the Max Planck Institute for Multidisciplinary Sciences. It is published in *Science*.

At the heart of the study are “Kerr solitons”,

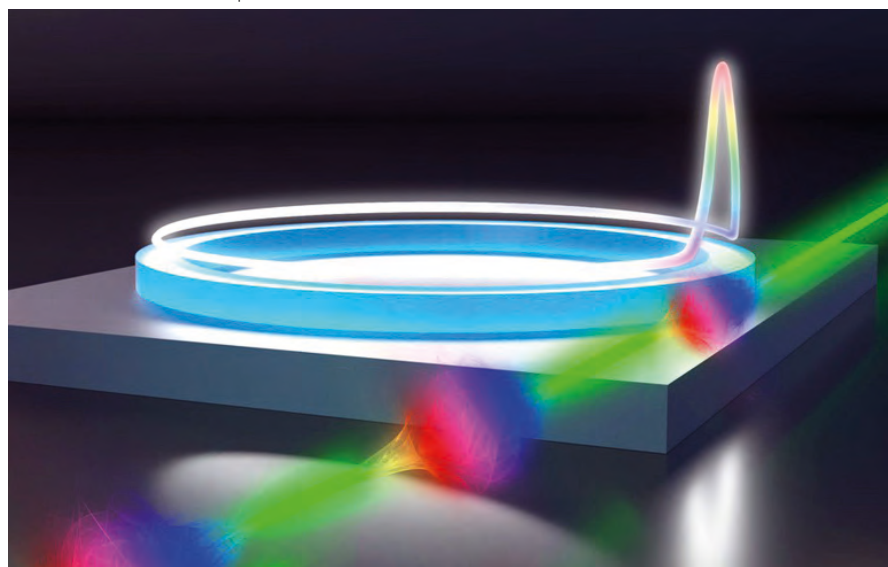


Photonic chip used in this study, mounted on a transmission electron microscope sample holder and packaged with optical fibers.

Credit: Yang et al. DOI: 10.1126/science.ad2489

waves of light that hold their shape and energy as they move through a material, like a perfectly formed surf wave traveling across the ocean.

This study used a particular type of Kerr solitons called “dissipative”, which



Credit: Ryan Allen / Second Bay Studios.

An artistic rendering of a beam of free electrons interacting with an optical pulse in a ring-shaped microresonator. Researchers at EPFL and Max Planck have merged nonlinear optics with electron microscopy, unlocking new capabilities in material studies and the control of electron beams.

are stable, localized pulses of light that last tens of femtoseconds and form spontaneously in the microresonator. Dissipative Kerr solitons can also interact with electrons, which made them crucial for this study.

Photonic chip, mounted on a transmission electron microscope sample holder.

Photonic chip, mounted on a transmission electron microscope sample holder.

Photonic chip

The researchers formed dissipative Kerr solitons inside a photonic microresonator, a tiny chip that traps and circulates light inside a reflective cavity, creating the perfect conditions for these waves.

“We generated various nonlinear spatiotemporal light patterns in the microresonator driven by a continuous-wave laser,” said EPFL researcher Yujia Yang,

who led the study. “These light patterns interacted with a beam of electrons passing by the photonic chip, and left fingerprints in the electron spectrum.”

Specifically, the approach demonstrated the coupling between free electrons and dissipative Kerr solitons, which allowed the researchers to probe soliton dynamics in the microresonator cavity and perform ultrafast modulation of electron beams.

“Our ability to generate dissipative Kerr solitons [DKS] in a TEM extends the use of microresonator-base frequency combs to unexplored territories,” said Prof. Kippenberg. “The electron-DKS interaction could enable high repetition-rate ultrafast electron microscopy and particle

accelerators empowered by a small photonic chip.”

Ropers adds: “Our results show electron microscopy could be a powerful technique for probing nonlinear optical dynamics at the nanoscale. This technique is non-invasive and able to directly access the intracavity field, key to understanding nonlinear optical physics and developing nonlinear photonic devices.”

The photonic chips were fabricated in the Center of MicroNanoTechnology (CMi) and the Institute of Physics cleanroom at EPFL. The experiments were conducted at the Göttingen Ultrafast Transmission Electron Microscopy (UTEM) Lab. Other partners included: EPFL Center for Quantum Science and Engineering.

<https://optics.org/news/15/1/21>

Ouster optimistic as revenues rise

The lidar firm continues to burn through cash but also reported strong bookings; plus updates from AEye and Cepton.



Photo: Ouster/Business Wire.

An example of Ouster's digital lidar sensors, seen deployed at a road intersection in the US. The company's stock price has nearly doubled in value since a recent financial update from the firm showed strong bookings.

Ouster, the California-based lidar company that merged with rival Velodyne a year ago, has posted sales of \$24.4 million for the closing quarter of 2023 - and says that its post-merger cost-cutting efforts are well ahead of schedule.

That and an optimistic outlook for 2024 reflecting strong bookings activity appeared to prompt a sharp increase in the Nasdaq-listed firm's stock price, which is now trading at its highest valuation since the merger.

Describing 2023 as a "transformative" year, CEO Angus Pacala reported \$83 million in annual sales.

Although that was accompanied by a net loss of \$374 million when including merger-related writedown costs, he also revealed bookings of \$142 million and noted that production costs had been reduced by outsourcing manufacturing to Thailand.

"We closed large multi-million dollar deals across all four verticals, including

production wins by May Mobility and Motional to supply lidar sensors for their autonomous vehicles," Pacala told an investor conference call.

"We also saw increased demand from mapping, inspection, and warehouse automation customers, who benefit from [our] REV7 [product's] dramatic improvements in range, precision, and accuracy."

Path to profitability

Unlike many of its peers in the lidar space, Ouster is targeting deployments across several industrial sectors alongside the emerging opportunities in automotive applications.

"Now with cloud-based software solutions, we are offering even more features, simplifying adoption, and expanding the use case for lidar," Pacala said.

"We have a proven ability to manufacture at scale with positive gross margins, and have demonstrated a strong track

record of growth with record revenue and bookings over the last year. Our REV7 sensors are driving increased demand from material handling, mapping, and robotaxi customers."

And although the San Francisco firm's net loss of \$39 million in the closing quarter of 2023 was only slightly down on the same period in 2022, Ouster's executive team says that its cash burn rate has halved since the start of last year.

They are targeting annual revenue growth in the 30-50 per cent range while maintaining operating expenses at or below current levels. "We expect 2024 results to show meaningful progress against this framework, putting Ouster on a path to profitability," Pacala announced, adding that first-quarter sales would likely be just over \$25 million.

Following that update, Ouster's stock price rallied for three successive days - rising from \$5 to close at \$9.82 on April 1, equivalent to a market capitalization of around \$400 million.

AEye of the storm

Meanwhile, recent results at two of Ouster's Silicon Valley rivals indicate the ongoing challenges in the industry.

AEye, which has built its business around long-range sensors using 1550 nm lasers, primarily for automotive applications, reported annual sales of only \$1.5 million in 2023 - down from \$3.7 million in 2022 - accompanied by a slight decline in operating losses to \$88 million.

On the plus side, the firm also said it had signed a letter of intent with a top-ranking provider of advanced driver assistance system (ADAS) sensors.

"[This] marks the beginning of a new relationship as part of our capital-light, automotive-first strategy," said CEO Matt Fisch. "We are also excited to unveil Apollo, the first member of our 4Sight Flex product family that delivers ultra-long-range performance in an incredibly compact form factor."

But AEye's CFO Conor Tierney warned: "The next one to two years will be a challenging time for the [lidar] industry given the scarcity of capital and resources needed to bridge to commercialization."

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Ouster optimistic as revenues rise

AEye's plan is to weather that storm with its capital-light business model, and the team expects to burn through between \$20 million and \$25 million of cash in 2024.

Cepton ponders Koito offer

Over at San Jose-based Cepton, CEO Jun Pei and his team are still evaluating an offer to acquire the startup from long-term partner and shareholder Koito Manufacturing, a Japanese provider of automotive lighting. That offer came shortly after the

cancellation of an ADAS project involving Koito and General Motors that had previously been expected to move into series production.

"On December 11, 2023, Koito informed us that GM has decided to re-scope its ADAS product offerings," reported AEye in its annual report filing with the US Securities & Exchange Commission (SEC).

As a result, all outstanding purchase orders from Koito to AEye that relate to the series production award have been cancelled. The same SEC filing added that AEye and Koito had been informed about a new series production effort, although details are yet to be finalized.

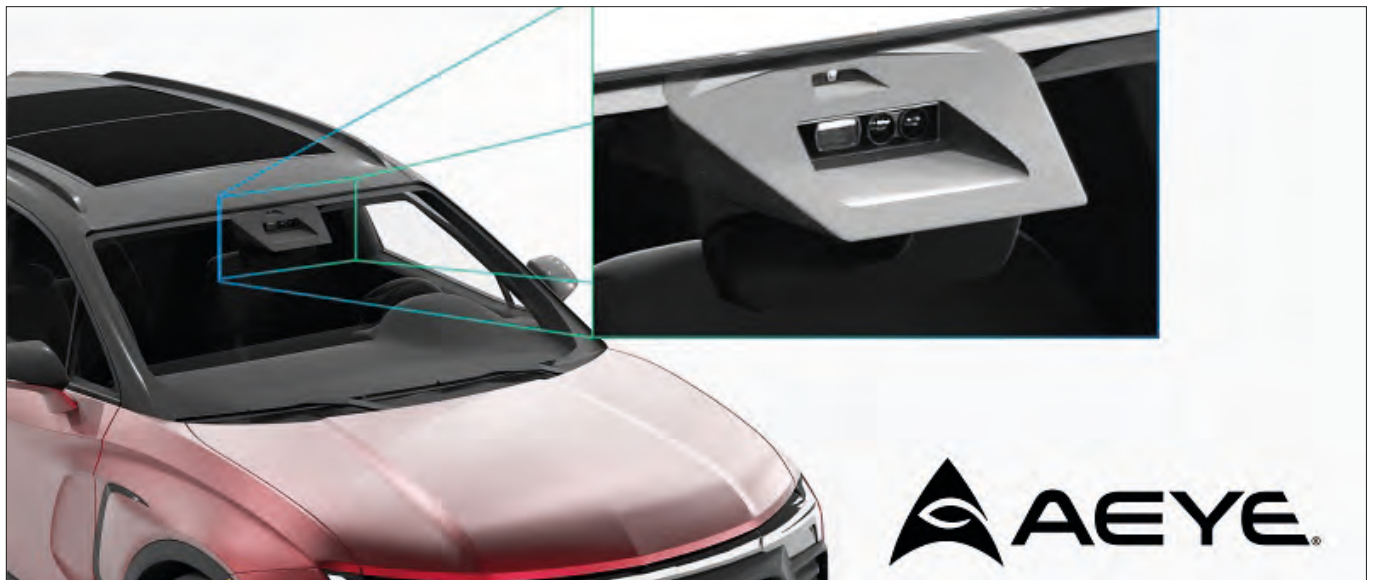
The firm's latest figures show that Cepton posted an operating loss of nearly \$51

million in 2023, as annual sales increased more than 75 per cent year-on-year, to \$13.1 million.

CEO Pei also said that the recent decision by the US Department of Defense to include rival Hesai Technology on its list of "Chinese military companies" - a move disputed vociferously by Hesai - represented a significant opportunity for Cepton and other US-based lidar providers.

"This development has prompted many US corporations to reassess their supply chain strategies and partnerships, aiming to mitigate risks associated with compliance, geopolitical tensions, and national security concerns," he told investors.

<https://optics.org/news/15/4/1>



AEye's new 'Apollo' sensor is said to deliver best-in-class range and resolution in a small, power-efficient, low-cost form factor, enabling both automotive and non-automotive applications.

Image: Business Wire.

Iridian Spectral Technologies

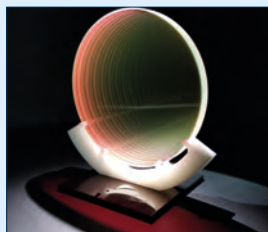
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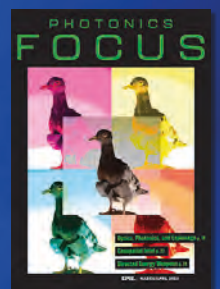
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