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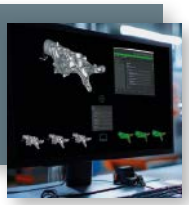

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Digital Events 2025

April 16, 2025:

Metrology & Precision Manufacturing

High quality standards and the optimization of production efficiency are at the heart of modern manufacturing processes. Both are crucial for manufacturers to remain competitive.
This event therefore revolves around measurement technology, production software and machine vision – in short: technologies that help to optimize your production.

June 4, 2025:

Machine Vision, Robotics, and AI combined

Only robots with the ability to see can perform complex tasks such as bin picking or handling unsorted objects on conveyor belts. Cameras provide this sense of sight. In combination with artificial intelligence, the range of applications is immense.

June 25, 2025:

Panel discussion: What were the biggest trends at Automate?

At Automate, the largest automation trade fair in North America, numerous innovative products were once again on display or even presented to the public for the first time. The expert panel discusses the highlights and technology trends that emerged at the trade fair.

September 17, 2025:

Protection & safety in automation with robots In co-op with GIT security?

Safe interaction between humans and robots increasingly requires new technologies and solutions. In addition, the closer man and machine get to each other, the higher the safety requirements. In our webinar, we look at the complete safety function so that safe human-robot collaboration can be guaranteed.

October, 2025:

Embedded Vision: From board-level through smart cameras to intelligent vision systems.

This technology day provides information on the latest technology and industry trends, introduces new products and answers the question of which applications require a customized vision system and when a ready-to-use vision solution is the better choice.

Beginning of December 2025:

Industrial Solutions for the Mobile Automation

Robust solutions are in demand in numerous sectors such as agriculture, marine and the construction industry. We present technologies and solutions that increase efficiency and productivity.

Register now and secure a place:

Do you have expert knowledge that you would like to share?

Do you want to speak on a big stage on relevant industry topics?

Do you have an exciting innovation that you would like to present to your target group?

Then the digital events from inspect and messtec drives Automation are just right for you. They allow you to reach over 200,000 machine vision users and integrators, engineers, automation specialists and machine builders worldwide.

Interested? Then get in touch with us.

In addition to these events, we will also be happy to plan an individual webinar with you at a time that best suits your marketing plan.

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From Europe to the Whole World

At a time when those at the helm are primarily concerned with their own power and wealth, there is an example in the machine vision industry that shows that there are other ways forward: the European Machine Vision Association (EMVA) has considered how the EMVA 1288 standard could best be further developed. "Best" here means in the interests of manufacturers and users. That is why the EMVA Board of Directors decided in fall 2024 to make the standard, which it developed and maintains itself, an ISO (International Organization for Standardization) standard.

The association has thus relinquished control over EMVA1288 in order to develop it further at an international level or have it developed further.

However, the EMVA is not entirely selfless. Rather, the association is now appealing to companies to get involved in the working group within the ISO. This is because each country has one vote in the committees. And Europeans are currently still underrepresented. With sufficient European participation, the standard, which was developed in Europe, could continue to benefit from the expertise available there and at the same time be further strengthened by input from non-European companies. This would give EMVA 1288 the opportunity to become even more widespread, even beyond the boundaries of industrial machine vision.

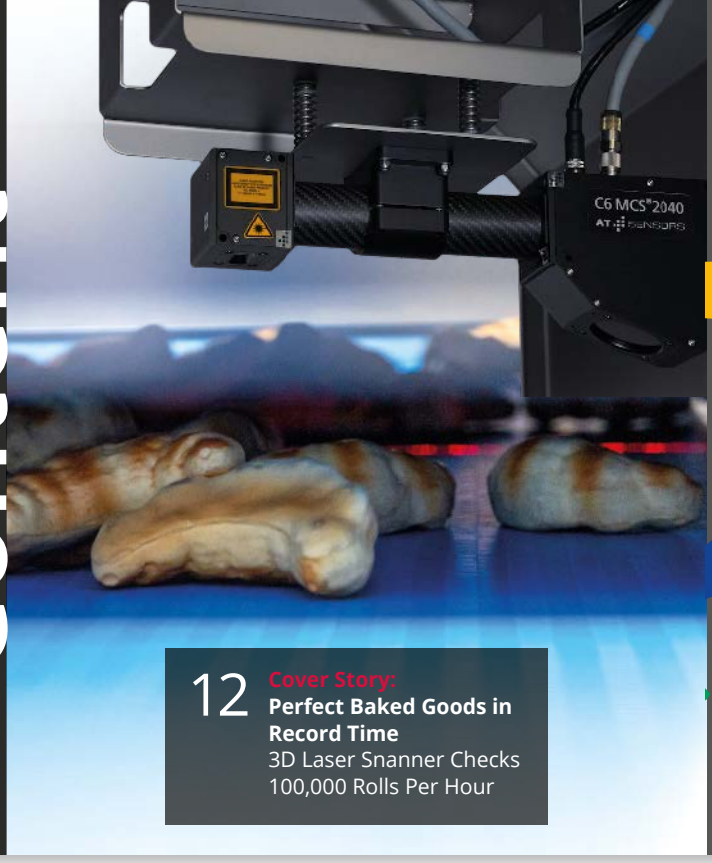
And that would also be good news. After all, uniform standards for cameras, regardless of their area of application (such as medtech, chemistry, security, agriculture, or science), benefit not only manufacturers but also users, because less time has to be spent creating interfaces for a device.

You can read more about the opportunities and benefits of the new ISO standard on page 16.

Enjoy reading this issue.

David Löh
Editor-in-chief of inspect
dloeh@wiley.com

Content



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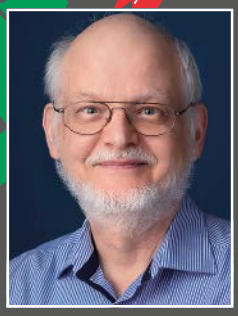

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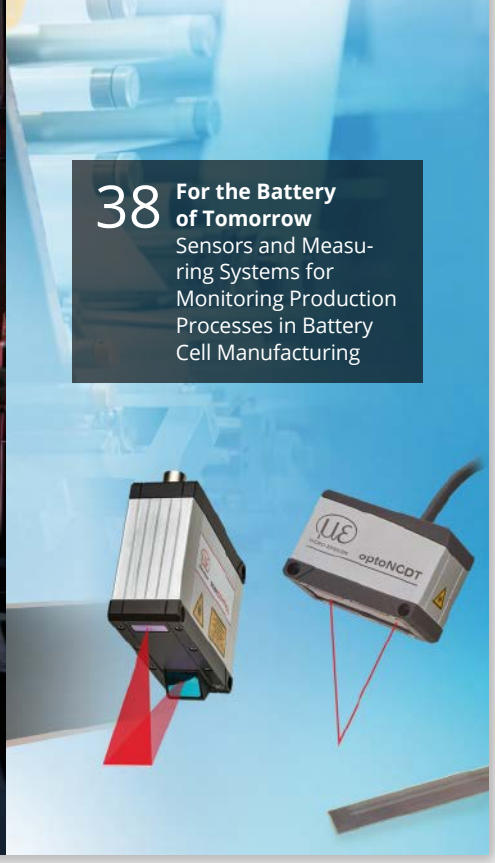


Control

Image: ifm

Start of construction for ifm Technology Suzhou. Ge Zhengguo, Zhang Jingcui, Zhang Biying, Caixia Liang, Ye Xin, Andrzej Durdin, Shaun Tang, Dr. Dirk Kristes, Jessie Jiang, and Tina Zhou (from left to right).

IFM builds a new plant in China

The IFM group has laid the foundation stone for a new factory in Suzhou, China, which will be built on a 40,000 square meter site.

Suzhou, located approximately 100 km west of Shanghai, is strategically important as China is IFM's third-largest sales market. The plant, registered under the name ifm Technology Suzhou, will primarily serve the Chinese market and will offer space for up to 1,000 employees. Completion is scheduled for the fourth quarter of 2026.

According to a company spokesperson, the modern industrial structure of the metropolis of Suzhou, with its 10 million inhabitants, offers ideal conditions for this innovative and sustainable greenfield project. Ifm has invited employees from around the world to participate in the construction of the plant in order to gain international experience and further their cultural and linguistic skills. Interest is high, and many see this as an opportunity for personal and professional development. **www.ifm.com**

Image: Edmund Optics

Edmund Optics relies on renewable energies in Japan and Germany

Edmund Optics has converted its manufacturing facilities in Akita (Japan) and Mainz (Germany) to 100 percent renewable energy. This measure is an important step in the company's global sustainability strategy and reduces indirect greenhouse gas emissions from the use of renewable electricity by 25 percent.

Akita specializes in precision optics, while Mainz processes polarization optics and colored glass from Schott. The Akita site now sources hydroelectric power, and Mainz uses a solar energy system and green electricity tariffs. This transition highlights Edmund Optics' commitment to sustainable manufacturing and reducing its environmental footprint. The company continues to work on energy efficiency and the use of renewable energies at all its global sites, maintaining the quality of its production and encouraging other companies to take similar initiatives. **www.edmundoptics.com**

Optimized production strategy for European companies


Image: Fortec

Ulrich Ermel

Fortec Group is expanding its production strategy to provide European companies with customers in the US with cost-effective and efficient delivery options. Local production in the US and pre-assembly in Egypt enable electronics companies to supply the US market more effectively. This coordinated production chain reduces high markups, as only regular customs duties of around 10 percent apply, ensuring more stable import costs and better planning security. Geographic diversification and local warehousing minimize the effects of trade sanctions and tariff adjustments, enabling European customers to benefit from shorter delivery times and high quality standards. Ulrich Ermel, COO of Fortec, emphasizes that this strategy ensures long-term competitive price structures and offers technological progress and added value along the supply chain. **www.fortecag.de**

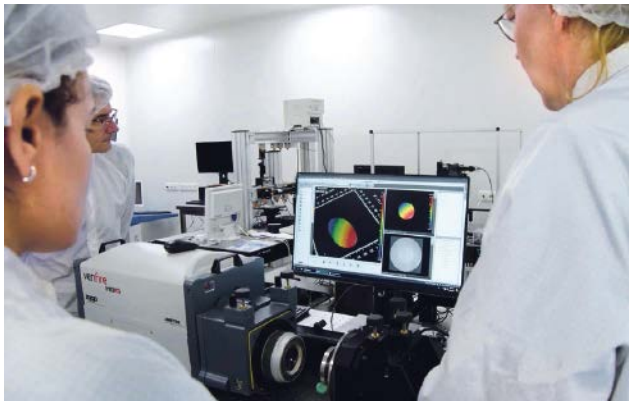


Image: VUB

EU Investment to Boost Photonics Integration

The European Commission is investing 15 million Euros in the PhotonHub Phactory initiative to support companies in integrating photonics into their products. This program significantly lowers the barriers to entry for photonics, offering EU subsidies that cover up to 85% of project costs, thus minimizing risk for businesses. With over thirty European partners, the initiative covers the entire value chain, from early concepts and prototyping to scaling. PhotonHub Phactory builds on the success of PhotonHub Europe, which has already supported over one hundred companies in generating more than €750 million in revenue and creating a thousand jobs. Professor Hugo Thienpont from Brussels Photonics emphasizes the program's importance in fostering innovation projects across various sectors and strengthening European sovereignty in the photonics industry. **www.photonhub.eu**

New reinforcement for the Vision Markets team

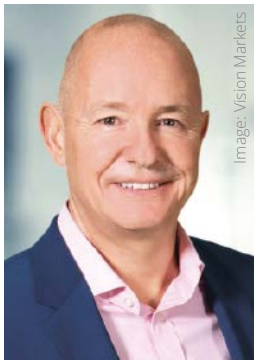


Image: Vision Markets

Marc Williamson

Mark Williamson, a British expert in machine vision, joins the Vision Markets consulting team. He will use his experience in sales, business development and product management to support Vision Markets' customers. Mark is a well-known figure in the machine vision industry, having founded Firstsight Vision in the UK, which was later acquired by Stemmer Imaging. He served as managing director and was responsible for corporate development as part of the management team. He was also involved in several industry associations. Mark is looking forward to using his experience in product strategy, market understanding and business development to help customers grow in the machine vision industry. Ronald Müller, founder and CEO of Vision Markets, emphasizes how Mark's expertise strengthens the company's consulting capabilities, particularly in the areas of sales and business development.

Exaktera buys Autovimation

Autovimation has been acquired by Exaktera. Exaktera, a portfolio company of Union Park Capital, opens up new opportunities for Autovimation to benefit from Exaktera's global platform and expertise, according to a company spokesperson.

Peter Neuhaus, founder and CEO of Autovimation, will remain on board and sees the acquisition as an opportunity for innovation and market expansion. "The collaboration with Exaktera will enable us to offer our customers even better solutions," said Neuhaus.

Autovimation will join Z-Laser, Prophotonix, Advanced Illumination and IIM as Exaktera's fifth machine vision company. The company, based in Rheinstetten, Baden-Württemberg, is known for its robust, precision-manufactured camera housings and special accessories. **www.autovimation.com**

Technological partnership between MVTec and Pepperl+Fuchs

MVTec and Pepperl+Fuchs have entered into a partnership in the field of machine vision, with Pepperl+Fuchs becoming part of the MVTec technology partner program. The aim is to improve the integration and handling of their products in order to increase customer benefit through common industry standards.

Both companies want to drive the development of standards such as GenICam to make it easier to combine their technologies. Customers benefit from easy product combination and access to customer services. Pepperl+Fuchs offers high-performance sensors that can be combined with MVTec's machine vision software products. MVTec offers software such as Halcon and Merlic that combines reliability and ease of use. MVTec's technology partner program promotes interoperability and strategic partnerships to improve machine vision technology. **www.mvtec.com**

Sick relies on industrial AI and innovative strength

The company achieved solid results despite a difficult financial year 2024. Turnover fell by 8.9% to 2,103 million euros, influenced by negative currency effects. EBIT fell by 51.4% to 91.9 million euros. The decline in sales was stronger in Germany and Asia-Pacific, while regions such as EMEA and the Americas remained more stable. Sick invested heavily in research and development, particularly in Industrial AI, in order to strengthen its market position.

The focus is on the further development of sensor solutions and the integration of AI in order to increase productivity and efficiency. The strategic partnership with Endress+Hauser led to a restructuring of the workforce. Sick expects economic challenges to continue in 2025, but is relying on automation and AI to remain profitable. Automation remains a growth market, driven by technological advances, according to a Sick spokesperson. **www.sick.de**

Steady growth of PI technologies despite economic challenges

PI technologies, including Profibus and Profinet, are showing moderate growth despite global economic uncertainties. Supply chain issues led to bottlenecks in 2022, but the situation stabilized in 2023 due to increased delivery of IO-Link devices. This led to 9.7 million newly installed nodes in 2024, with IO-Link growing to 61 million nodes. PROFIsafe also saw growth, reaching 28.7 million devices. Profinet maintained its position as the leading technology with 9.5 million new nodes, for a total of 78.8 million products installed. Profibus also remains relevant, with 1.1 million devices sold in 2024, 800,000 of them in the process industry.

A total of 70 million Profibus devices are in use. Xaver Schmidt, Chairman of PI, emphasizes the positive outlook for the future through continuous technology development and the importance of digital transformation for market success. **www.profibus.com**

Decline in sales and focus on innovation at Beckhoff

The company reported a turnover of 1.17 billion euros for 2024, which corresponds to a decrease of 33% compared to 2023. The decline had been expected after a boom in the years 2021 to 2023, when the company recorded growth of over 80 percent. Hans Beckhoff, the managing owner, sees the crisis as an opportunity for innovation and optimization. The company invests 80 million euros annually in research and development and is planning numerous product launches in control technology. Beckhoff is represented in over 75 countries and is strengthening its market presence, particularly in the field of energy systems. Despite global uncertainties, incoming orders are showing signs of recovery. **www.beckhoff.com**

New VP Sales at AMS Technologies


Image: AMS

Michael Lee

Michael Lee succeeds Klaus Maier as the new VP Sales at AMS Technologies, who will retire after a transition period in 2025. Lee brings extensive experience in sales and leadership roles in optical technologies and is known for his sales growth and building strong customer relationships. He looks forward to leading the sales team during a period of growth and innovation, delivering best-in-class solutions for customers. Jan Meise, CEO of AMS Technologies, praised Lee's expertise and dynamic approach, which will be valuable in expanding market presence and enhancing customer offerings. He also thanks Klaus Maier for his twelve years of successful service to the company.

AMS Technologies serves over two thousand European customers in technology sectors such as life sciences, infrastructure, industry, research and science. **www.ams.de**

Susana Gonzalez becomes Chief Sales Officer at B&R


Image: ABB

Susana Gonzalez

ABB has appointed Susana Gonzalez as the new Chief Sales Officer of B&R's Machine Automation Division. She succeeds Luca Galluzzi and brings expertise in growth strategies and customer experience. She was previously Head of Sales EMEA at Rockwell Automation and held leadership positions in the USA, Asia, Europe, the Middle East and Africa.

Jörg Theis, President of the Machine Automation Division, emphasizes Gonzalez' strategic approach and international experience as an ideal fit for B&R to drive customer-centric innovation. Gonzalez looks forward to supporting B&R's development and working with R&D to exceed customer expectations. She holds degrees in Business Administration from Asturias Business School and an MBA from San Francisco State University. **www.abb.com**

Qualcomm Technologies acquires Edge Impulse

Qualcomm Technologies has reached an agreement to acquire Edge Impulse. According to an Edge Impulse spokesperson, this acquisition marks a significant step for the company, which was founded in 2019 by Jan Jongboom and his co-founder to make machine learning on edge computers accessible to developers.

Edge Impulse offers a platform that automates and simplifies the development process of Edge AI models. The user base includes Fortune 100 companies as well as innovative start-ups. With over 170,000 developers, a strong community has formed.

The integration with Qualcomm Technologies gives Edge Impulse developers access to Qualcomm's powerful Dragonwing platforms, which provide advanced AI inference, computer vision and graphics processing. Qualcomm, a leading innovator in connectivity and semiconductor solutions, is expanding its reach in Edge AI. **www.qualcomm.com**

Finn, Hajo, Lennart Schulenburg

Handover of management at Visiconsult

After almost 30 years, Hajo Schulenburg handed over the management of the company to his sons Lennart and Finn Schulenburg. The handover, which was prepared over a decade, secures the company's succession in family hands. VisiConsult, founded in 1996, has developed from a software company into the world market leader in industrial X-ray technology. Milestones such as the expansion into the USA and India are proof of its growth. Lennart and Finn Schulenburg, both of whom have been with the company for many years, bring experience and fresh impetus. They emphasize the continuation of values such as innovative spirit and customer focus.

Hajo Schulenburg remains active as a consultant and takes on a key role in India to expand the market there. VisiConsult focuses on tradition and innovation to continue to deliver the highest quality and drive technological progress in the industry.

www.visiconsult.de

Christoph Siemon (left) and Stephan Straka (right) jointly assume responsibility for the day-to-day business and the future of the company.

New dual leadership at Imago Technologies

Imago Technologies has appointed Christoph Siemon and Stephan Straka as its new operational management. Siemon, who has been with the company since 2021, brings experience from the automotive industry and heads up sales, marketing and development. Straka, an experienced financial expert, is responsible for finance, HR and purchasing. Together they will optimize operational processes. Carsten Strampe, long-standing Managing Director and co-founder of the German machine vision industry, is moving to the Advisory Board after 30 years. Gianluca Mazzantini, CEO of the Antares Vision Group, will support the strategic development. Imago continues to focus on innovative embedded vision solutions that combine hardware with user-friendly software and integrates AI and specific coprocessors for high-performance, energy-efficient technologies. With the new leadership and advisory board support, Imago is well positioned to capitalize on international market opportunities.

www.imago-technologies.com

Jan-Erik Schmitt (Vision Components, left) and Martin Klahr (Phytec, right) agree on a cooperation between the two companies for embedded vision projects.

Phytec and Vision Components work together

The two companies have entered into a partnership to integrate MIPI cameras into embedded systems. This cooperation enables the use of over 50 VC MIPI cameras with Phytec embedded imaging processor boards, as the drivers are included in the Linux BSP of the Phytec modules. At embedded world, the companies presented the phyBOARD-Pollux Kit with NXP i.MX 8M Plus processor and VC MIPI IMX900 camera. Customers can choose from a wide range of image sensors and benefit from seamless integration and support in the development of their vision projects. **www.vision-components.com**

Imec and Zeiss strengthen partnership for semiconductor innovations

Imec and Zeiss have signed a renewed strategic partnership agreement extending their collaboration until 2029. This partnership supports the further development of key semiconductor technologies, in particular High-NA-EUV lithography, and contributes to European technological sovereignty in line with the European Chips Act. Zeiss invests in Imec's pilot line, which is operated in Leuven, Belgium, and provides access to advanced semiconductor technology for research and development.

The collaboration focuses on the development of more powerful and energy-efficient microchips, which are crucial for technologies such as artificial intelligence and autonomous driving. The partnership strengthens Europe's leading position in the semiconductor ecosystem and demonstrates the importance of cross-industry networking in the global semiconductor market. **www.zeiss.com**

Zebra Technologies and Merck cooperate

Zebra Technologies and Merck have announced a cooperation around the M-Trust platform, a cyber-physical solution that is linked to a new hand scanner. This platform uses Web 3.0 technologies to ensure the verification and authenticity of products and offers flexible adaptation to new regulatory requirements. Zebra brings expertise in mobile computing and identification technologies, while Merck contributes patented authentication methods.

Together, they aim to ensure a high level of security and trust along the value chain and provide high-quality data for AI systems. The new handheld scanner combines Zebra's TC58 mobile computer with Merck's SEC reader and enables the scanning of products and the synchronization of data with the M-Trust platform. The prototype was presented at Hannover Messe 2025. **www.zebra.com**

Investment in AI strengthens digital transformation

Gefran acquires stake in Italian software company 40Factory, which specializes in industrial IoT and generative AI solutions. With an investment of four million euros, Gefran is acquiring 22 percent of the share capital to further develop its data-based process solutions. 40Factory offers IT solutions for optimizing industrial processes and operates a platform for collecting and analyzing machine data. It also has a generative AI system.

Founded in 2018, the company achieved sales of 1.5 million euros in 2024 and grew by 50 percent between 2021 and 2024. For Gefran, 40Factory is an important partner in industrial automation. Together, the two companies will develop new systems for data utilization to strengthen Gefran's role in the digital transformation. CEO Marcello Perini emphasizes that the investment supports the growth strategy and enables value creation from collected data, which is crucial for optimization and efficiency gains in production. **www.gefran.de**

New industry meeting place for the process industry

Messe Frankfurt and Dechema cooperate on new Achema Middle East. Achema Middle East, a new trade fair for the process industry, is set to take place for the first time in Riyadh, Saudi Arabia, in 2026. Supported by the Ministry of Industry and Mineral Resources of the Kingdom of Saudi Arabia, the event is in line with the Saudi Vision 2030 program for economic and social development. The trade fair is expected to attract around 400 international exhibitors and offer a comprehensive conference program.

Dr. Björn Mathes from Dechema emphasizes the partnership with Messe Frankfurt, which is strengthened by the latter's expertise in the international trade fair business and Dechema's industry knowledge and experience. Wolfgang Marzin from Messe Frankfurt is delighted about the expansion of the Achema brand into a new region. The aim is to create a global meeting place for companies, political decision-makers, and experts to present and discuss innovations and technologies. **www.dechema.de**

New Sales Manager for Image Processing Solutions

Michael Alteg

Michael Alteg takes over sales at Autovimation and focuses on smart housing and mounting solutions for industrial image processing. As Account & Marketing Manager, he supports customers in integrating vision components into various applications, whether in harsh industrial environments or with special protection requirements. With many years of sales experience and expertise in automation and robotics, Alteg focuses on practical solutions that increase the functional reliability of vision installations and offer real added value.

He emphasizes the importance of individual consultation in order to find the optimal solution for every application. Autovimation develops installation technology for vision applications, including protective housings for cameras and modular mounting systems. The product range includes products for industrial and hygienic applications, such as in food production, to ensure lighting, cleanliness, and climate control. **www.autovimation.com**

New guidelines strengthen Omlox standard in the industry

PI and the Fraunhofer Institute in Lemgo have published two practical guides on the Omlox localization standard, which was developed specifically for industrial applications. The standard enables cross-vendor integration of different location technologies to ensure seamless location tracking in production and logistics. The guides "Locating Technologies Reimagined" and "How to Build Omlox Products" are available free of charge on the omlox website. The former provides an introduction to the benefits of location solutions, while the latter is aimed at technical developers and describes how products can be made omlox-compatible.

The guides offer valuable insights for technical experts and decision-makers and provide impetus for future developments in location technology. PI and the Fraunhofer Institute emphasize the importance of Omlox for Industry 4.0, as it offers interoperability and new opportunities for data analysis and AI optimizations. **www.profibus.com**

China invests 138 billion USD in robotics and high-tech

China has announced the establishment of a state-backed venture capital fund focusing on robotics, AI and innovation. The fund is expected to attract nearly 1 trillion yuan (138 billion US dollars) in capital from local governments and the private sector over 20 years. This project aims to continue China's technology-driven manufacturing success story. In the last ten years, China's share of global industrial robot installations has increased from one-fifth to more than half. Chinese robot manufacturers have significantly increased their domestic market share, with local suppliers already supplying 54% of industrial robots for the domestic market in 2023.

China plans to integrate robotics with emerging technologies such as artificial intelligence. Europe is being urged to invest in humanoid robotics to remain competitive. The announcement was made as part of the 14th National People's Congress, which covers China's strategic plans for the robotics industry. **www.ifr.org**

Image: jitthanant - stock.adobe.com

Perfect Baked Goods in Record Time

3D Laser Scanner Checks 100,000 Rolls Per Hour

3D sensor technology together with intelligent software at ultra-modern baking lines manage to inspect 100,000 baked goods like croissants or rolls per hour. Because in industrial bakery production there's no room for error.

In the federal state of Schleswig-Holstein, Germany, a normal sliced bread roll currently costs between 0.40 and 0.60 Euros on average. The prices for special rolls such as grain rolls or pretzel sticks are sometimes significantly higher. This price trend has led to a massive increase in expectations of the quality of industrially produced baked goods. Both producers and consumers demand consistent results in terms of appearance and taste. While supermarket chains want to retain their customers through consistent product quality, consumers are increasingly paying attention to every detail as prices rise. Today, a bread roll should not only be fresh and crispy, but should also always look and taste the same.

With this in mind, system integrator ISW and technology company AT Sensors joined forces to develop a high-performance application for the automated quality control of baked goods. The aim was to create a solution that can simultaneously detect and evaluate a wide range of quality characteristics at high throughput and without a clocked process. The initial impetus for the project came from Ilapak, an internationally active machine manufacturer headquartered in Europe that develops and produces packaging lines and baking lines for large industrial customers. These are used by retail giants such as supermarket chains.

As a long-standing manufacturer of baking lines, Ilapak is a key partner for many large bakeries worldwide. The company's systems are characterized by their high robustness, scalability and speed. Ilapak was founded in Switzerland in 1970 and has since developed into a global supplier of packaging machines. Its specialization in flexible packaging solutions has made Ilapak a partner to many food manufacturers who value not only productivity but also quality. In order to set new standards in quality assurance, Ilapak wanted to upgrade its systems with modern 3D machine vision.

Previously, only line scan cameras with 2D technology were used there. These only provided simple shadow images of the baked goods and could not provide any information on the exact geometry, surface structure or distribution of details. However, this is precisely what end customers are increasingly demanding: Detailed information about shape, structure, elevations, volume distribution or topping placement. A requirement that could only be met with 3D sensor technology.

The Challenge

The baked goods are inspected directly on the conveyor belts of the Ilapak systems – without a timed process sequence. Several quality parameters have to be checked at the same time: These include dimensions such as height and size, cutting characteristics and specific surface properties such as the distribution of cheese on lye pastries. Such complex inspection tasks exceed the capabilities

Each conveyor line is equipped with its own sensor, which has since enabled high-precision measurement of the baked goods during operation.

Company in Detail

AT Sensors

AT Sensors – a northern German company specializing in 3D laser triangulation sensors with over 25 years of experience – had the right technology. The company develops and manufactures its sensors in Germany and specializes in solutions that require both speed and high precision. The sensors are used in the automotive, packaging, food and electronics industries, among others. In addition to the high resolution, their unique selling points are above all the flexibility in customization and the large number of integrated functions that make it possible to solve even complex measuring tasks.

The captured 3D data is processed using the software developed by ISW, which is based on the Halcon image processing library. The processed information is forwarded directly to the programmable logic controller (PLC), where it controls the sorting mechanisms of the packaging system.

of conventional 2D machine vision systems and therefore require the use of advanced 3D sensor technology.

„The production lines pass up to 100,000 bread rolls per hour, which are neither organized nor all next to each other, but rather partly on top of each other. The conveyor belts are also wider than one meter, so the sensor we were looking for had to have a wide field of view and a high resolution," reports ISW Managing Director Tobias Wichmann. He also explains that the inertia of the conveyor belts was a difficult factor during application development. „The industrial baking lines operate 24/7 and must not be interrupted. The large baking lines are programmed in such a way that they sometimes have an hour's lead time if changes need to be made," mentions Wichmann.

An industrial baking line is a finely tuned interplay of several process stages that interlock seamlessly. From the raw dough to the packaged product, the entire production process is automated and continuous. As soon as a dough piece enters the line, it moves through proofing chambers, oven modules, cooling units, inspection systems and packaging lines. This continuous movement ensures a constant throughput. If the line is stopped, the entire material flow jams. The oven can overheat, dough pieces overcook or cool down, packaging units get out of sync. To prevent all of this, a line stop must be initiated with great care and a precisely calculated lead time of at least one hour. This is the only way to avoid losses and system damage. The following therefore applies to every system used, especially for quality control: it must function with absolute reliability.

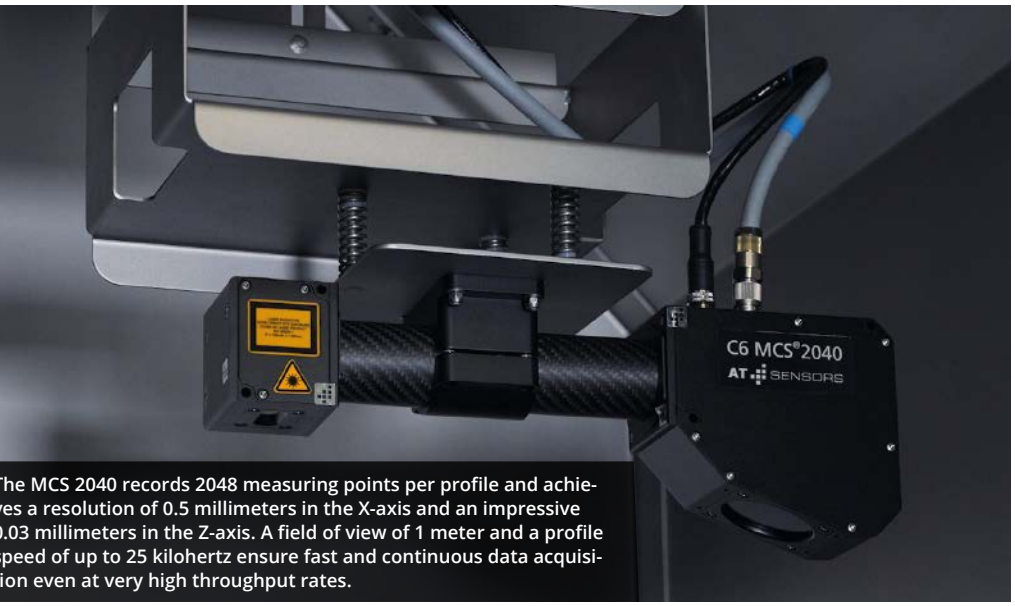
The Solution

The requirements of Ilapak and ISW were therefore correspondingly high: to find a sensor manufacturer that not only met the technical requirements, but could also be used reliably in industry. And this is where AT Sensors came into play, offering the solution with its modular MCS 2040 3D sensor.

A key feature of the MCS series is its modular design, which makes the sensors a solution for a wide range of applications. „The MCS stands for high flexibility: thanks to many configuration options, we build sensors that are precisely tailored to the respective application – whether cost-optimized or high-performance. Our aim is not to supply just any sensor, but exactly the right one. Because once you've worked with AT, you stay with AT," reports AT Sensors Head of Sales Dr. Athinodoros Klipfel.

In fact, with the MCS series, each sensor can be individually adapted to the specific requirements of the application – without additional costs, without minimum purchase quantities and without long delivery times. At the same time, the sensors have standardized interfaces such as GigE Vision, which considerably simplifies integration into existing systems.

Each conveyor line was therefore equipped with its own sensor, which has since enabled high-precision measurement of the baked goods during operation. The MCS 2040



The MCS 2040 records 2048 measuring points per profile and achieves a resolution of 0.5 millimeters in the X-axis and an impressive 0.03 millimeters in the Z-axis. A field of view of 1 meter and a profile speed of up to 25 kilohertz ensure fast and continuous data acquisition even at very high throughput rates.

records 2048 measuring points per profile and achieves a resolution of 0.5 millimeters in the X-axis and an impressive 0.03 millimeters in the Z-axis. A field of view of 1 meter and a profile speed of up to 25 kilohertz ensure fast and continuous data acquisition even at very high throughput rates.

A red laser with a wavelength of 660 nanometers is used, which delivers a particularly high intensity to the detector and therefore enables extremely sensitive and precise measurement. In addition, the Multipeak and Multipart functions developed by AT Sensors enable the simultaneous detection and evaluation of several quality features, allowing a comprehensive geometric and structural analysis of the products in real time.

The captured 3D data is then processed using the software developed by ISW, which is based on the Halcon image processing library. The processed information is forwarded directly to the programmable logic controller (PLC), where it controls the sorting mechanisms of the packaging system. This allows the baked goods to be packaged specifically according to defined quality and quantity specifications for the retail trade.

Why Supermarket Chains Rely on Quality Control

The stakes are high for large supermarket chains. Their brand image is closely linked to the quality of the products they sell. Especially when it comes to fresh foods such as baked goods, customers expect a uniform appearance, fresh taste and consistent texture. Deviations are quickly noticed and can lead to shopper churn. Supermarkets also have clear specifications for product quantities per pack. If a pack is delivered with too many or too few rolls, there is a risk of complaints or even contractual penalties. This makes it all the more important that quality control not only detects errors, but also controls processes intelligently.

The baked goods are inspected directly on the conveyor belts of the Ilapak systems – without a timed process sequence.

Long-Term Partnership Through Reliability

This quality control of baked goods has now been implemented successfully and reliably for several years and is used by numerous end customers in Europe. ISW recently placed another order with AT Sensors for a large number of sensors to equip further baking lines. AT Head of Sales Klipfel comments: „As the company used to be an integrator itself before it shifted its core business to the manufacturing of sensor technology, AT understands exactly what its customers are looking for. We know what is important in practice and I think that gives us a huge advantage in the development of our products."

ISW has also been working with Ilapak for many years, which quickly resulted in a suitable cooperation with which the partners were able to make a name for themselves internationally.

Conclusion

Because of AT Sensors' 3D sensor technology, ISW's software and Ilapak's packaging lines, it has been possible to establish efficient and reliable quality control for baked goods. This ensures that large supermarkets, for example, receive consistently high-quality products while minimizing economic losses due to production downtime. ■

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Company in Detail

ISW

ISW has been an established system integrator for industrial machine vision solutions for over a decade. Just like AT, based in northern Germany, ISW serves customers from various sectors, with a focus on the food, automation and packaging industries. The company specializes in the integration of hardware components such as cameras and sensors into existing production processes as well as the development of tailor-made software solutions for industrial image evaluation. ISW is one of the few providers on the market that can supply complete systems from a single source.

All images: AT Sensors

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1288

EMVA Standard Compliant

Image: EMVA

Further development of an EMVA standard at ISO level

Transformation of EMVA 1288 into ISO 24942

In autumn 2024, the EMVA Board of Directors decided to convert the EMVA 1288 standard into an international ISO standard. The latest Release 4.1 is now being further developed at ISO level. As an official working group of the International Organization for Standardization (ISO), the standard now has a platform to become a binding standard for measuring and presenting specifications for image processing sensors and cameras in other sectors far beyond traditional industrial applications.

Clearly, ISO offers the standard greater visibility for related industries and specialist disciplines. "At the same time, however, this also means that other nations and groups outside the field of machine vision can place their interests very prominently through active cooperation and thus possibly also assert them," says Dietmar Wüller. The Managing Director of Image Engineering has a lot of experience with ISO standardization processes and has been asked by the EMVA to lead the new ISO working group as a so-called convenor; a position comparable to that of the chair in the EMVA 1288 standards committee. Together with the EMVA, Wüller is recruiting as many new members in the machine vision industry for the ISO group as possible. "Participation in this working group is of great interest to all companies involved in the measurement and presentation of specifications for image processing sensors and cameras. In other words, hardware developers of image sensors and cameras as well as distributors of machine vision components find here the platform to place their views on the future development of the standard. Of course, not only companies that have already been involved in EMVA 1288 previously are invited to contribute."

Voting rights and membership of the ISO Group

ISO is a network of 172 national standards organizations. As such, ISO membership consists of the leading standardization organizations in their respective countries and there is only one ISO member per nation. The respective national standards organizations are entitled to nominate experts for the various ISO working groups. These experts are, for example, companies from the machine vision industry who wish to participate in the ISO-TC42-WG28 working group. After having registered at their national standardization body the experts/companies may be nominated as member of the ISO working group. "All standardization organizations that have delegated an expert are entitled to vote in the ISO working group. When voting on a new standard release, for example, each

Image: Image Engineering

» Participation in this working group is of great interest to all companies involved in the measurement and presentation of specifications for image processing sensors and cameras.

Dietmar Wüller, Managing Director of Image Engineering


Image: EMVA

Participation through collaboration

By participating in the ISO 24942 working group, European companies can play a decisive role in shaping the future development of the standard. After all, it would be in the interest of all machine vision players who are already successfully using the EMVA 1288 standard or planning to do so to get involved here. The largest possible number of machine vision companies participating in the ISO working group via their national standardization body means greater weight for the machine vision industry and, geographically, for the continent of Europe. There are standardization institutes in all European countries. For Germany, this is the German Institute for Standardization (DIN), in Spain the UNE – Asociación Española de Normalización, the British Standards Institution BSI in Great Britain or the Ente Italiano di Normazione (UNI) in Italy. EMVA supports interested companies with the necessary registration steps.

» The idea behind EMVA 1288 is to specify various image quality parameters and the associated measurement methods and display formats in a uniform manner. This means that the standard may be applied far beyond image processing to all possible fields of photography.

Thomas Lübkemeier,
Managing Director of EMVA

country vote only counts once, regardless of how many experts from a country are in the working group," explains convenor Wüller. The standardization bodies, such as BSI in the UK or AFNOR in France, charge a fee that varies depending on the country.

From EMVA to ISO – a logical step

For EMVA, as the long-standing hosting association of the EMVA 1288 standard, it is a logical step to now establish the standard at ISO level. This means, however, that the standard is no longer under the direct influence of the association, but its further international development and dissemination is much more important. "The idea behind EMVA 1288 is to specify various image quality parameters and the associated measurement methods and display formats in a uniform manner. This means that the standard may be applied far beyond image processing to all possible fields of photography, including new camera-based applications in constantly growing areas of application such as automotive and smartphones," emphasizes EMVA Managing Director Thomas Lübkemeier. "The visibility of the standard for new fields of application as well as geographically beyond Europe to Japan, the USA and China is now guaranteed at ISO level.' In addition, with ISO as the new host, there is a greater obligation to pull together internationally and national solo efforts are minimized.

Future of the EMVA 1288 working group

But what will happen to the EMVA 1288 standard working group under the umbrella of the EMVA? Its chair, Prof. Dr. Bernd Jähne, explains: "'We are planning to continue the EMVA 1288 working group in coordination with the EMVA. This will allow us to continue to offer and license the standardized data sheet based on the ISO standard, provide technical support to the ISO group and carry out test measurements." Although the EMVA 1288 group as such no longer has any direct influence on the further development of the ISO standard, it does maintain influence via the individual membership of the companies in the ISO working group TC42-WG28. To date, only Belgium, Germany, the United Kingdom and Spain are represented there with experts in addition to the USA, Japan and China. "For a stronger representation of European interests in the future technological design of the standard, there is an urgent need for more machine vision experts from various European countries to actively participate in the ISO working group in order to exercise the voting rights of their respective countries," emphasizes Jähne. ■

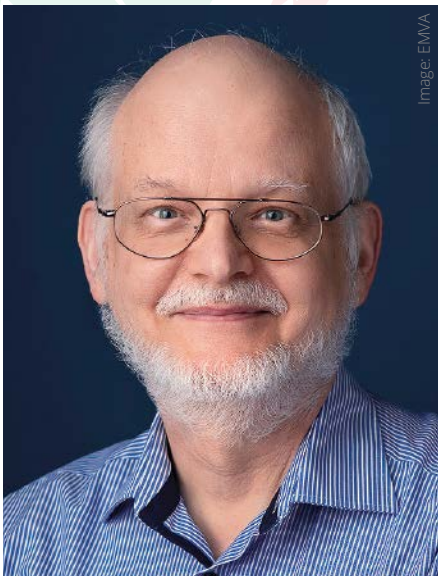
Image: EMVA

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Prof. Dr. Bernd Jähne, chair of
EMVA 1288 standard working group

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The 10GigE vision camera of Eros series is small – 29 × 29 mm – and power-efficient – 3 W with SFP+ and up to 4.8 W with PoE.

Real-Time AI for Egg Quality Inspection with 21 cameras

Multi-Camera Vision Systems with 10GigE

A compact and energy-efficient 10GigE camera is used in the quality assurance of chicken eggs. Because it is important to inspect the eggs from multiple angles, 21 cameras were installed above the conveyor belt. Despite this high number of cameras, the system requires only one switch and image processing with three GPUs.

For years, engineers in industrial imaging have struggled to build scalable, high-performance multi-camera systems that operate reliably in real-world, 24/7 environments. Applications demanding real-time analytics and AI-based processing introduce additional complexity. Systems that look good on paper often suffer in practice: frame drops under load, cameras drifting out of sync, or thermal issues that cause shutdowns. At Emergent Vision Technologies, we've spent more than a decade engineering solutions that address these challenges head-on. The result is a portfolio of vision tools that integrate seamlessly from sensor to insight – built for performance, reliability, and scale.

Compact and power-efficient 10GigE camera

The Eros camera series is designed with demanding embedded and high-density applications in mind. At 29 × 29 mm, Eros is a small 10GigE vision camera – and it's power-efficient: Depending on the interface, power consumption is as low as 3 W with SFP+ and up to 4.8 W with PoE. This low power footprint means reduced thermal output, which is crucial for compact systems where heat management is a challenge. Fewer watts mean fewer fans, less vibration, lower acoustic noise, and greater system stability.

The camera series also supports active lens control (EF, RF), offers both RJ45 and fiber (SFP+) connectivity, and features Sony and Gpixel sensors from 0.5 to 24.7 megapixels – giving engineers flexibility.

Solving the Multi-Camera Problem

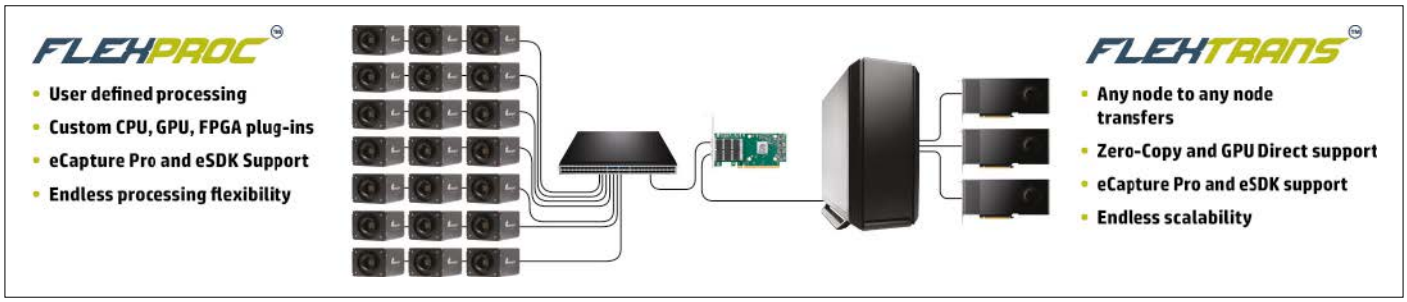
Building multi-camera systems – 8, 16, or even 100+ cameras in perfect sync – often leads to hard technical limitations. Frame drops appear under load, camera sync fails over time, and CPUs become saturated. Many systems break down due to:

- Interfaces like USB3 or CoaXPress that don't scale well
- Poor sync strategies using unreliable GPIO triggers or partial PTP implementations
- Host systems unable to handle multi-gigabit data across multiple channels

What makes Emergent different is our deep integration of hardware and software to optimize data movement from sensor to storage:

- Optimized GVSP implementation with zero-copy transfer, allowing direct (GPU) memory access and dramatically reducing CPU load compared to traditional buffer-copy approaches
- Hardware-based PTP (IEEE1588) synchronization for deterministic frame timing across all cameras
- Full support for GPU Direct on both Windows and Linux platforms
- Flexproc and Flextrans for offloading processing tasks to multiple compute nodes (CPU, GPU, Cloud)
- Scalable architecture verified in setups with 48+ cameras operating at full bandwidth

This tight coupling between interface hardware, optimized transport, and processing pipelines enables reliable and high-throughput performance that generic systems often fail to deliver.



Data processing with Flexproc & Flextrans

Case Study: Egg Quality Inspection with AI Support

A client in the egg processing industry approached us after multiple failed attempts to build a robust, AI-powered, real-time inspection system. Their goal: inspect each egg from multiple angles using synchronized high-speed imaging and process it live with AI. Previous vendors had proposed multi-camera solutions that theoretically fit the requirements, but in reality could only support 4 to 5 low-speed cameras before dropping frames or falling out of sync. Systems overheated, CPUs overloaded, and their internal teams were left troubleshooting unreliable performance.

We worked closely with them to specify and build a tailored setup:

- 21 × HR-series 10GigE 5MP cameras (initial deployment)
- A single 10/25GigE switch
- One mid-size workstation with 3 GPUs
- Ecapture Pro software with custom plug-in support for their AI pipeline

The entire system was fully tested before shipment. We validated performance under full load, ensured consistent frame sync using PTP, confirmed zero-frame-loss capture to disk, and verified plug-in operation for inference. The user now has a deployed system in production, analyzing every egg in real time with high-resolution imaging, synchronized angles, and fast AI feedback - without bottlenecks or instability.

After validating the system and seeing the performance benefits, the customer is now planning to upgrade the full solution to Eros cameras to benefit from reduced power consumption, smaller footprint, and further simplified integration. ■

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Images: Emergent

Advertorial

Eurotech-Reliacor Series Embedded PCs

Fanless Embedded PCs for AI-Supported Optical Inspections

The Eurotech Reliacor series, equipped with Nvidia Jetson Orin and Arm-Cortex-CPU, is the optimal solution for AI-supported optical inspections. The embedded PCs combine energy-efficient AI performance with a robust, fanless design for 24/7 operation in demanding environments. Thanks to the "security-by-design" approach in accordance with ISA/IEC 62443-4-2, the systems provide a secure basis for industrial applications. With up to 275 TOPS of computing power, the series enables the development, execution and OTA update management of multiple AI models. Features such as advanced remote access, zero-touch provisioning and no-code edge-to-cloud configuration make it easy to implement and scale. In addition, a variety of interfaces, including PoE, ensure flexible connectivity options.

Image: Inonet

High Level of Cybersecurity

For critical infrastructures, the Reliacor series relies on device-level security: a multi-layer security architecture, advanced encryption and authentication mechanisms, as well as device lifecycle management, ensure maximum protection and long-term operational reliability.

The embedded PCs offer best in class cybersecurity: it leads the market with ISA-secure/IEC 62443-4-1/-4-2 SL2. Protection starts at the hardware level, with full support for TPM 2.0, Secure Boot and an always-on physical antitampering monitor/logger that is active even when the system is removed from power. For most demanding customers, special production-only images can be configured with full hardware hardening (interface disabling) to further reduce the attack surface.

In IoT Platform Integrated

The Eurotech-Reliacor Series comes with Everyware Software Framework (ESF), a commercial, enterprise-ready edition of Eclipse Kura, the open source Java/OSGivmiddleware for IoT Edge Gateways. Distributed and supported by Eurotech, ESF supports ready-to-use field protocols, MQTT connectivity, web-based visual data flow programming and deep configuration. ESF is also integrated with Everyware Cloud (EC), Eurotech IoT Integration Platform (separately available), enabling advanced diagnostics, provisioning, and full remote device access and management. **www.inonet.com**

Industrial cameras are just one component on the way to a machine vision solution. There is a wide range of components and suppliers on the market that have to be tested, procured, integrated, wired, serviced and replaced in the event of discontinuation. With a new camera concept a manufacturer is taking the opposite approach: one component instead of many – optimally matching each other, highly integrated and with IP 67. The goal: making machine vision much easier.

The IXG cameras bridge the gap between high-performance PC systems and smart vision cameras. With this approach the camera series won the inspect award 2024.

Making Machine Vision both Easy and Flexible

Compact camera system bridges gap to smart cameras

The realization of image acquisition is not only complex in terms of technology. There are further challenges in procurement, integration, installation, system costs and long-term availability. Consequently, a tempting idea are smart solutions in image acquisition with just a single hardware similar to smart vision. Image processing takes runs on a conventional high-performance PC providing all degrees of freedom – including optimum selection or use of even company-specific software.

Smart vision applications show that all-in-one is most often an appropriate compromise. Baumer is now taking this approach for PC systems in order to combine the advantages of both worlds: Simplicity, performance and flexibility. The main advantage of the concept is that mounting and image acquisition are reminiscent of the simplicity of vision sensors, while the powerful evaluation is handled by PC systems.

New product class enables easy installation without expert know-how

The Baumer IXG is an all-in-one camera integrating further to the image sensor also lens (6, 8 or 16 mm), autofocus and white LED lighting in a compact IP67 housing of 5 cm edge length. Display and LEDs provide user-friendly setup and operation. The IP 67 design is compatible with common photoelectric sensors without the need for complex enclosures.

The major benefit of a closed system is the simple installation less prone to errors of a single, tested component – even without expert know-how. Entire parameterization by GigE Vision commands would protect against unauthorized lens access, enables protected installation and provides the basis for tracking any change made, which means high-level process safety.

The GigE Vision interface opens the door to the world of camera systems, image processing PCs and software. This does enable using performant PCs for image processing with high flexibility. Multi-camera systems or additional cameras as retrofit are quickly and easily implemented.

Compact integration of lighting and electromechanical autofocus

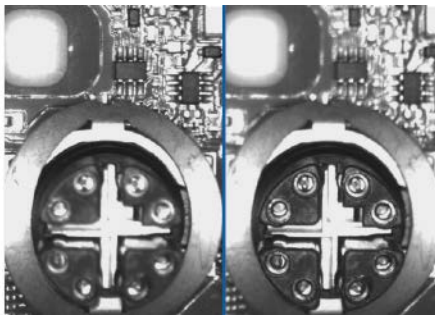
Segementable lighting for optimum illumination supports applications up to 1.000 mm operating distance. Control of external specialized lighting for better flexibility in the application is another benefit. The electromechanical autofocus is designed to be thermally insensitive for long-term stable focusing. It simplifies initial set-up and supports changing distance in different production batches. It is not intended for applications with short-term focus on individual objects – these are reserved to liquid lenses.

The optional polarization filter would suppress reflections from shiny objects made of metal or foil for improved evaluation reliability. The IXG is suitable for most varied applications across all industries, such as quality inspection, presence and completeness checks or identification. The all-electrical configuration used with appropriate software allows for parameter logging, as required for example in the pharmaceutical industry.

The compact, space-saving design ensures a small system footprint – important for machines in clean rooms. Besides OEM the camera is ideal for system upgrades like track & trace retrofit in positioning tasks in the pharmaceutical and food industries.

PC performance and smart vision simplicity combined

Image processing requires a PC with third-party PC-based software. This enables broad scalability in terms of flexibility and evalua-



Lens access for authorized persons only: The integrated autofocus with long-term stability can be adjusted by commands only to support process safety.

The All-In-One GigE Vision cameras of IXG series are integrating lighting and autofocus in a compact housing.

tion speed, including AI processing power. The free choice of software opens up many possibilities, application-specific user interfaces, backup solutions, access rights, logging and, last but not least, deep integration into own commands. This is supported by the IXG hardware since every change in configuration is made in the form of commands.

This concept becomes even more interesting when an existing application has already been implemented using a PC and now needs to be expanded. A typical use case: additional Track & Trace task in the form of object detection at a specific position with Datamatrix code. In this application, IXG adds like a satellite and becomes an integer part of the application via GigE Vision. The existing Vision PC is used. Identification utilizes the existing user interface or software. It may be possible to use existing software licenses. This is economical under several aspects.

Limiting factors

Of course, the compact design and selected components have their pros and cons. Thanks to the compact dimensions, IXG fits into installation space that previously was too tight for GigE Vision cameras and lighting. Lighting is limited by the front surface. A limiting factor is using polarizing filters absorbing 75 percent of light and shortest exposure time. Here, workarounds such as tilting the camera without filter or additional lighting should be considered. The technology, which differs from other Baumer cameras, cannot quite keep up with their values in terms of trigger delay and jitter, which is not critical for a large number of applications, but should nevertheless be taken into consideration.

Overall, the IXG cameras add a mainstream solution to the Baumer portfolio – where appropriate, users are provided with the mentioned benefits. Where not appropriate, the Baumer portfolio provides alternative solutions.

Conclusion

The cameras of the Baumer IX series are capable of many mainstream applications. They bridge the gap between high-performance PC systems and smart vision cameras. Users benefit from a compact plug & play product easy to integrate without expert know-how. A single component replacing several ones simplifies procurement while reducing space requirements and cost in parallel. Ultimately, a shorter time-to-market is achieved and in-house development resources are freed up for core tasks. Besides high performance, the PC allows a certain degree of freedom in the choice of software, application-specific modifications and logging. Of course, the pros and cons need to be weighed against each other. Where the camera having won the inspect award 2024, can be deployed, it will significantly reduce the image acquisition effort. ■

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More Efficient Processes with Multi-Strobe Imaging

Fast lighting control in complex applications

The high speeds at which many industrial processes run today leave vision systems with little time to accurately capture all the necessary information. Multistrobe imaging with sequence functionality – where two or more images are captured in a single pass – can be a solution here, as it allows multiple features to be inspected using different lighting scenarios.

Various defects on test parts may require different lighting methods depending on the type of defect. For example, front lighting generally provides a good basis for detecting scratches or other surface defects, while the dimensional accuracy of geometric shapes is often easier to assess with backlights. When components need to be inspected for multiple types of defects simultaneously, using different lighting setups in parallel can lead to interference. Therefore, sequential inspection is often unavoidable, which increases cycle time. This is particularly significant for line scan cameras, as the same object must be scanned multiple times under different lighting conditions.

An efficient alternative to this approach was demonstrated by Rauscher at last year's Vision trade fair. A key component of the showcased system is an Ipulse lighting controller from Rauscher's partner Icore, explains Thomas Miller, one of the company's Managing Directors: "Ipulse controllers enable highly efficient lighting control by generating precise current pulses of less than 1 µs and currents of up to 200 A. This allows for stable and precise strobe lighting even with high-power LEDs." The main advantage of this approach is the ability to consolidate multiple sequential inspections, leading to more efficient and cost-effective processes.

Compared to conventional lighting controllers, Ipulse controllers offer two key advantages: First, the extremely fast current pulses significantly reduce response times when activating the connected lights. Second, the short pulse duration with high currents ensures that the lights are active only for the required time, delivering their full performance – up to ten times the nominal LED current. This enables a faster strobe rate, which is essential for multi-strobe technology.

Fast switching between scenarios

Using the IP-2P2S-5C controller, the Rauscher experts have developed a system that enables versatile, fast, and highly accurate machine vision with multi-strobe technology. The key to success is rapid switching

Based on the IP-2P2S-5C lighting controller from Icore, the experts at Rauscher have developed a system that enables versatile, fast, and highly accurate machine vision with multistrobe technology. The key to success here is the ability to switch quickly between different lighting scenarios.

between different lighting scenarios, Miller emphasizes: "An Ipulse lighting controller allows for very fast changes between multiple lighting conditions by operating different connected lights with different intensities or lighting angles. Depending on the setup, it is also possible to vary the wavelengths to set different spectral distribution focuses in multispectral systems. This technology can be applied in both area scan and line scan applications."

This makes it possible to create highly flexible vision systems capable of capturing dynamic scenes, high-speed imaging, strobe applications with reduced motion blur, or multi-angle imaging for capturing depth information in 3D. With multi-strobe technology, cost-effective image acquisition of user-defined sequences can be achieved, which can also be adjusted in real time.

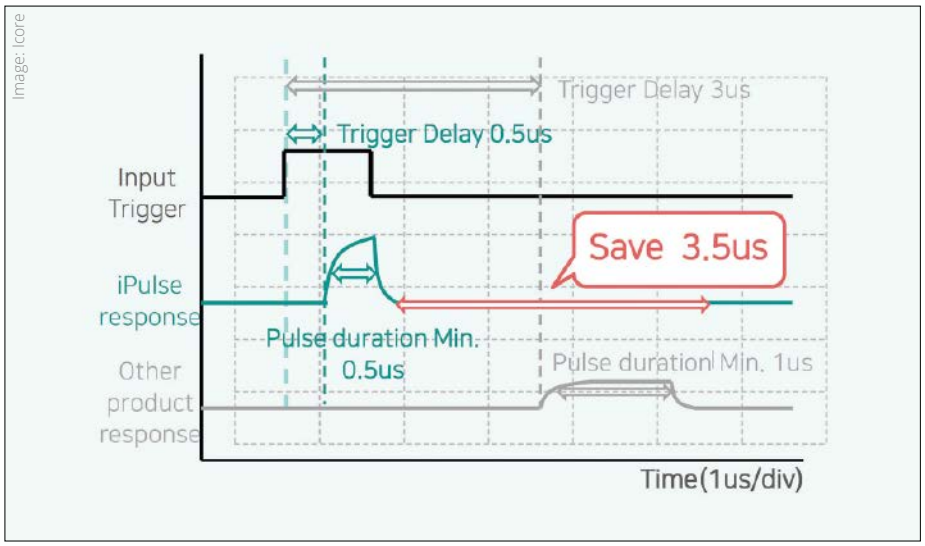
The following graphic illustrates the basic functionality of multi-strobe technology: In this example, four LED lights positioned at different locations are triggered sequentially at very short time intervals. The four resulting images can be combined into a single image using the software, merging information from all lighting conditions. Defects visible in only one of the individual images will be included in the composite image, ensuring a more

Technology in detail

Lighting controller with up to eight channels

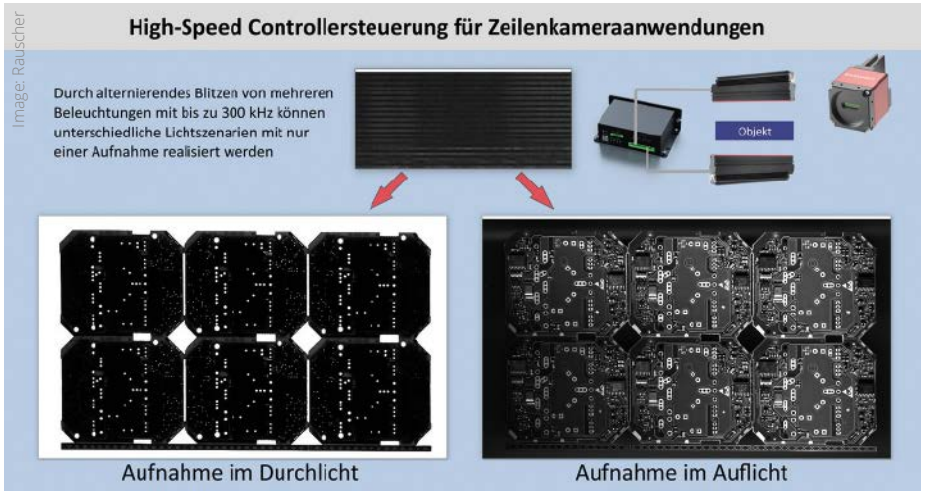
The Ipulse family of lighting controllers from Icore currently includes 20 models with one, two, four, or eight channels, offering continuous currents between 0.2 and 20 amperes, or between 2 and 200 amperes in strobe mode. Depending on the model, the controllers cover an output range per channel of 60 to 500 watts and a total power range of 60 to 1,000 watts. These versatile technical features enable users to select the most suitable model for each task. The experts at Rauscher provide professional support in choosing all vision components, including the appropriate controller.

Image: Icore



The speed and height of the current pulses from Ipulse controllers enable efficient control of lighting, which is a prerequisite for multistrobe technology.

Image: Rauscher



Screenshot of the demo system used by Rauscher to demonstrate the basic principle of multistrobe technology at Vision 2024.

Image: Rausc

reliable identification of undesired object features. Thanks to the extremely precise and fast control of lighting in the sub-1 µs range, systems equipped with Ipulse controllers can capture images of inspection objects in nearly the same position, even when the objects are moving at high speeds, such as on a conveyor belt.

One camera, multiple perspectives

To demonstrate the capabilities of such systems at a trade show, Rauscher's technical team combined the Ipulse lighting controller from Icore with a Vieworks VL series line scan camera, along with front and back lighting from Advanced Illumination. The Zebra Aurora Imaging Library was used for image processing.

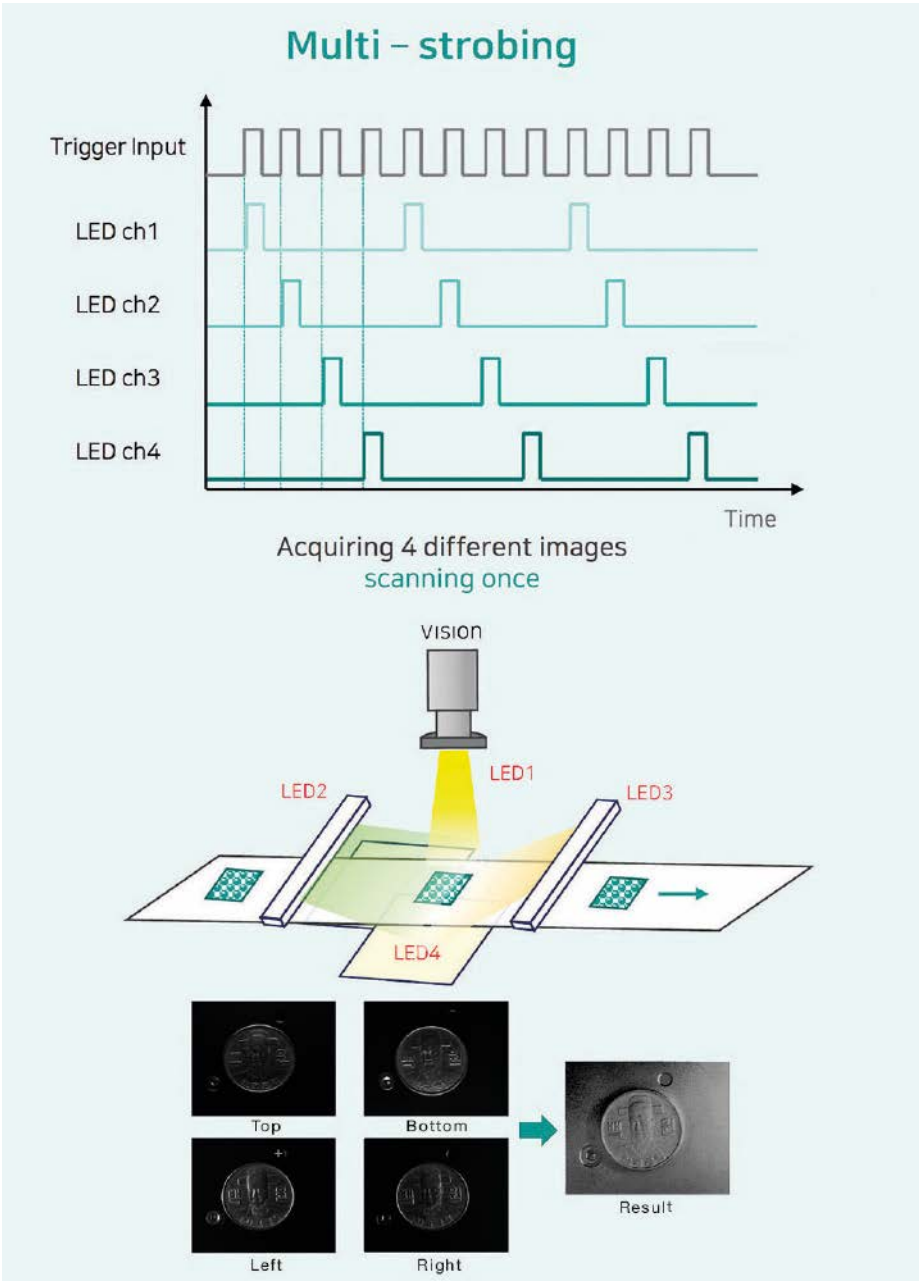
"With each capture by the line scan camera, two images are generated," Miller explains. "The controller activates the two lights in such a way that one image row is taken during frontlight and the next during backlight operation. Each image row is thus captured under different lighting conditions. The software then separates the even and odd rows to create two complete images."

For flawless system operation, a light barrier is mounted on the horizontal axis where the test object – an unpopulated PCB in this case – is placed. This serves as a frame trigger to activate the camera's capture process. The motor driving the horizontal axis is coupled with an encoder that measures its speed and generates the necessary line trigger signals for the camera to start capturing each row. Each time the camera exposes, it sends an exposure active signal to the lighting controller, which then generates a predefined sequence to activate the connected lights one after another.

"For our Vision demo, we operated the camera at double the line rate to illuminate each row twice and then separate two complete images from the captured data," Miller continues. "Our goal was to demonstrate the basic principle of multi-strobe technology. However, thanks to the extremely precise Ipulse controllers, two images per row are far from the limit. Depending on conditions, defect types, and the integrated lighting, multi-strobe systems can capture virtually unlimited amounts of information in a single pass and convert it into meaningful images using the software."

Multi-strobe imaging in industrial applications

According to Miller, multi-strobe imaging presents a cost-effective option in many industrial applications for inspecting test objects for various features and defect types using a single vision system instead of multiple sequential systems. "Of course, this technology is not a one-size-fits-all solu-



The graphic illustrates the basic principle behind multistrobe technology: In this example, four LED lights mounted at different positions are triggered in quick succession. The software combines the four resulting images into a single image that combines the information from all the shots taken under different lighting conditions. Errors that were only visible in one of the individual images are thus included in the overall image, enabling more reliable identification of unwanted object features. Because the lights can be controlled precisely and quickly in the range of less than 1 µs, systems equipped with Ipulse controllers can still capture images of the test objects in almost the same position even when the objects are moving through the process at higher speeds, for example on a conveyor belt.

tion. However, when multi-strobe imaging is feasible for a given task, it can significantly reduce hardware costs for users and lead to more efficient, cost-effective inspection processes." Miller sees particular potential for this technology in applications such as material inspections, surface inspections, or 3D shape analysis. "Our experts are happy to assist in evaluating whether the multi-strobe approach offers advantages for a specific application," Miller adds. ■

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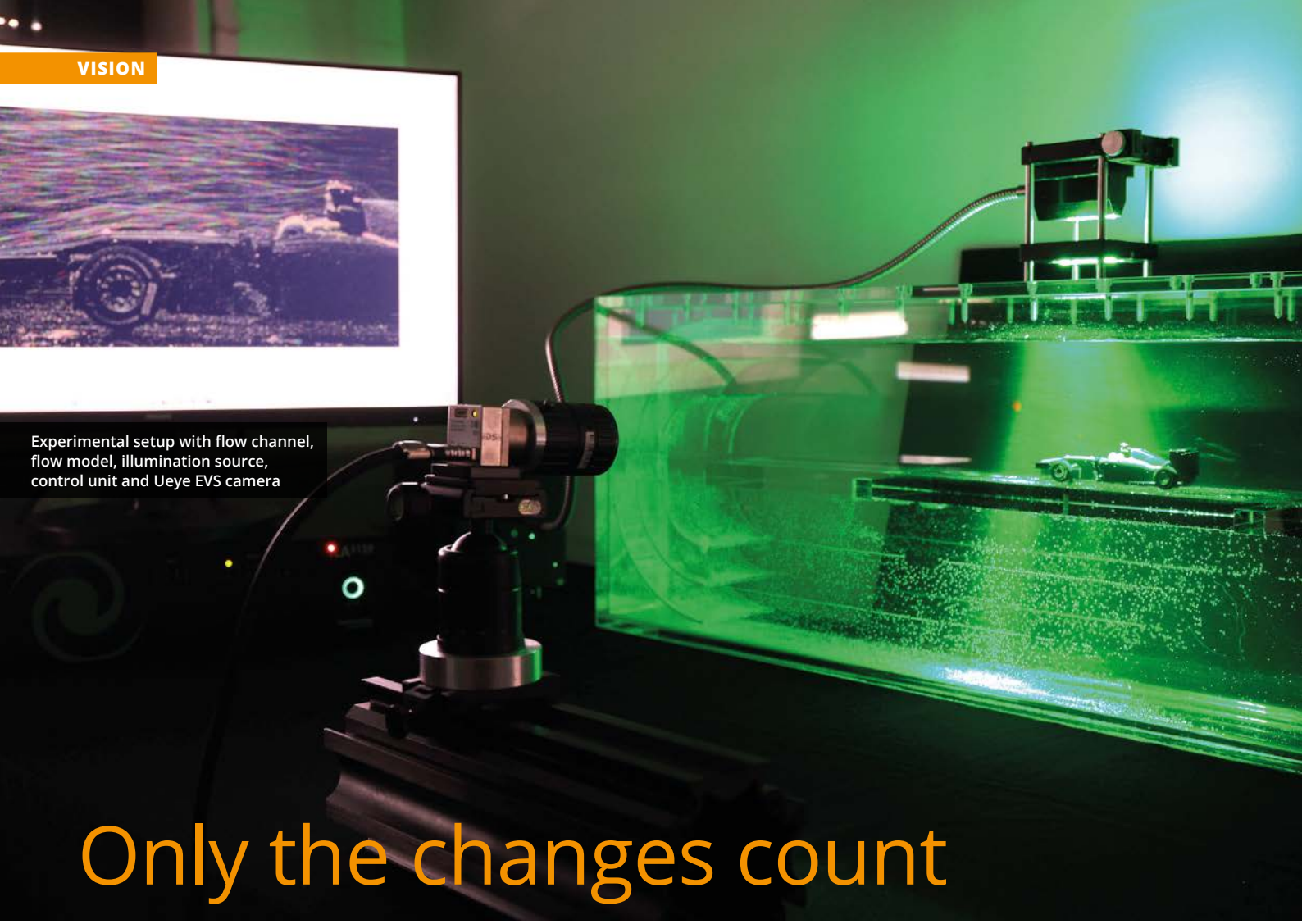


Experimental setup with flow channel, flow model, illumination source, control unit and Ueye EVS camera

Only the changes count

Event-based cameras optimise flow analysis in science and industry

Event Based Particle Image Velocimetry (EBIV) combines traditional PIV techniques with event-based cameras to efficiently capture and analyse fluid flows. This method reduces data volume and enables the visualisation of fast and turbulent movements with high temporal resolution.

Today, modern measurement technologies enable high-precision detection of the movement of liquids and gases – and thus provide valuable data for numerous applications. How does the air flow around an aeroplane? How does the blood move through our veins? And how can pollutant emissions in combustion processes be minimised? For this purpose, speed, direction, pressure and turbulence within a flow are analysed in order to increase efficiency, ensure safety and drive innovation in a wide variety of areas.

A range of methods are available to measure these flows, including visual ones such as particle image velocimetry (PIV). High-resolution cameras are used to track marked particles within a flow and analyse their movement. The company ILA_5150 from Aachen (Germany) now also relies on Event Based Particle Image Velocimetry (EBIV). This is an optical method for the qualitative and quantitative visualisation of flows and flow velocities. It combines PIV with event-based cameras, here with a uEye EVS from IDS Imaging Development Systems GmbH. The innovative sensor technology of the industrial camera enables highly dynamic and energy-efficient detection, especially of fast and turbulent movements.

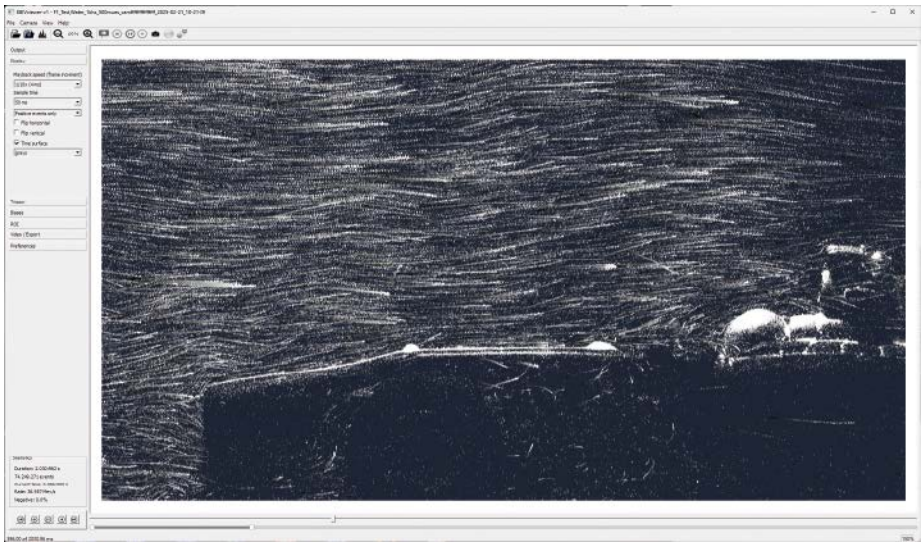
Only „Change Events" Generate Data

In the EBIV method, tiny particles are added to a flowing fluid and illuminated in a plane, the so-called light section plane. They generate individual light pulses as they enter and exit the LED light section. This change in local brightness is recorded independently by the camera pixels and transmitted to the PC as a data stream of „change events". In contrast to conventional cameras, event-based models therefore only react to the changes in brightness registered in the image field. Stationary scattered light, such as background or a non-changing illuminated surface, does not generate a measurement signal. This reduces the amount of data considerably.

Up to 10,000 Frames per Second

The data stream essentially contains information about what happens, when and where. In detail, these are the pixel coordinates on the sensor, microsecond time stamps of the pixel events and the information about the events: ON or OFF. This allows a distinction to be made between increasing intensity (ON event) and decreasing intensity (OFF event). Using suitable software, the stream can be converted into an image matrix in which both the spatial information and the linear time base of the stream are available. The result is comparable to the frame rate of a high-speed camera.

"The EBIV measurement method differs fundamentally from conventional imaging methods. They usually generate very large amounts of data and require powerful peripherals that can process them. For frame rates of 1,000 Hertz and more, the image-based cameras required are themselves very complex and expensive. With the help of event-based camera technology, comparable frame rates of 10,000 frames per second are possible, whereby only standard PC interfaces such as USB with a few gigabits per second are required. The price of the event-based models themselves is significantly lower than that of corresponding high-speed cameras



In the qualitative visualisation of the flow in the EBIV-View, particles are continuously illuminated so that they are visible as luminous traces. The method is therefore very well suited to visualising the flow.

The Ueye XCP-E camera from IDS is a small, lightweight industrial camera with an event-based sensor in a robust die-cast zinc housing (29 × 29 × 17 mm) with screw-on USB Micro-B connection.

and is therefore also very interesting for smaller teaching and research institutions," explains Dr André Brunn, Head of Development at ILA_5150.

Analysing the events

The data stream is converted into image data and displayed in a front end – the so-called EBIV viewer – for direct online flow visualisation. The user can also select the integration time, which corresponds to the exposure time of an image camera, as well as the time increments of the sequence, i.e. the period between two consecutive shots. Classic image filters can also be used. With the help of these settings, the user can optimise the display of the movement paths and adapt them to individual examination objectives. Both fine flow details and large-scale patterns can be made more clearly recognisable. This ability to readjust the measurement results is another advantage of the event-based approach.

In the qualitative visualisation of the flow in the EBIV-View, particles are continuously illuminated so that they are visible as luminous traces. The method is therefore very well suited to visualising the flow. However, it does not provide exact measurements of its speed or direction. For a precise, numerical analysis of the flow properties, individual particles are illuminated for a moment using short, time-defined light pulses.

This allows their exact position to be recorded and their movement quantified. By comparing the particle positions in successive images, the speed and direction of the flow can be precisely calculated using PIV, for example. The result is a transient 2D vector field that changes over time – in other words, the vectors do not remain constant. As with classic PIV, the image sequences of the event-based camera can also be statistically analysed, for example to determine mean values and fluctuations in the flow velocity.

The Event-based Camera and Software used

On the camera side, ILA relies on a Ueye XCP-E from IDS. The small, lightweight industrial camera offers event-based sensor technology in a robust die-cast zinc housing (29 × 29 × 17 mm) with screw-on USB Micro-B connection. It is compatible with all standard C-mount lens sizes. This makes it suitable for both industrial and non-industrial areas. The integrated event-based vision sensor (EVS) was developed by Sony and Prophesee. It is supported by the Metavision SDK, a seamlessly integrated suite of software tools and models, APIs and other training and development resources from Prophesee for efficient analysis, visualisation and customisation. Building on this, the EBIV viewer from ILA_5150/PIV Tec is specially tailored to flow visualisation applications.

High Temporal Resolution without a High-speed Camera

The optimisation of fluidic systems and processes requires detailed knowledge of the flow conditions. A qualitative flow visualisation is often sufficient to understand effects and develop suitable control mechanisms. Until now, however, imaging fast flows with high temporal resolution was usually only possible with expensive high-speed cameras. Event-based camera technology offers a cost-effective alternative that requires significantly less technical effort. These simple methods have been lacking in teaching and research in particular. Because of the extreme data reduction, this technology also enables the use of several cameras or large camera arrays without the periphery becoming a limitation for data transfer. The compact design of the Ueye EVS models also makes them suitable for mobile applications. This means that real application environments can be analysed directly for the first time – without having to rely on artificial flow models or channels.

In short: Event-based cameras enable efficient, cost-effective and high-resolution visualisation and quantification of flows. Due to the small amounts of data generated, many processes can be analysed almost in real time, which also makes them interesting for use in fully automated systems. Established flow measurement methods such as Particle Image Velocimetry (PIV) can be seamlessly integrated and expanded. The technology can be used wherever flow information is captured by changes in scattered light intensity – be it from moving particles or vibrating surfaces. ■

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All images: ILA_5150

The AS-DT1 LiDAR depth sensor measures 29 x 29 x 31 mm and weighs 50 g.

Small and lightweight lidar sensor for robotics and drone applications

Lidar Depth Sensor Provides Precision Measurement Accuracy, Distance Resolution and Measuring Range

A compact Lidar depth sensor uses dToF technology to deliver accurate 3D measurements, even in challenging environments both indoors and outdoors. Its lightweight, robust design makes it ideal for drones, autonomous robots, and other space- or weight-constrained applications. Availability is planned for spring 2026.

Sony Image sensing Solutions is announcing commercialization of the AS-DT1 LiDAR depth sensor. This Lidar Depth Sensor structure measures 29 x 29 x 31 mm (approximately 1.14 inch width x 1.14 inch height x 1.22 inch depth), excluding protrusions, and weighing 50 g (approximately 1.76 ounces). The AS-DT1 leverages miniaturization and optical lens technologies from Sony's machine vision industrial cameras making it suitable for applications where space, and weight constraints are paramount including, drones, robotics, and more.

The sensor utilizes ‚Direct Time of Flight (dToF)' Lidar technology, which delivers fast and accurate measurement, distance resolution, and measuring range. The proprietary dToF ranging module equipped with a Single Photon Avalanche Diode (SPAD) sensor, utilizes multiple ranging points for distance measurement, and can accurately measure distances in three dimensions: length, width, and depth.

The AS-DT1 can even measure distances to low-contrast subjects and objects with low reflectivity, which are more difficult to detect with other ranging methods. This enables accurate measurement of distances even in environments such as retail stores, where various objects, including people and fixtures, are expected. In addition to its ability to accurately measure distances both indoors and outdoors, the sensor's compact, lightweight design and rigid aluminum housing allow for integration into a wide range of devices, such as food service robots in restaurants, autonomous mobile robots in warehouses, and drones used for inspections and surveys.

The sensor's compact, lightweight design and rigid aluminum housing allow for integration for example into drones used for inspections and surveys.

High Measurement Accuracy and Distance Resolution

Sony's proprietary dToF ranging module, equipped with a SPAD sensor, achieves accurate measurements and distance resolution. It can measure at various distances, for example at 10 meters (approximately 32.8 feet) with a margin of ±5 cm (nearly 2 inches) both indoors and outdoors. Additionally, it is capable of measuring distances to various objects that are difficult to detect with other

Company in Detail

Sony Image Sensing Solutions

Sony Europe's Image Sensing Solutions as division of Sony Europe B.V. designs, develops and manufactures an range of component cameras and image sensing products that you can depend upon, also in demanding applications. Industry products include 4K & Full High Definition cameras; standard definition colour and monochrome video cameras for analogue and digital (USB3.0, GigE 2.0 & Cameralink) vision systems and the latest Global Shutter CMOS cameras, all of which cover numerous market sectors and applications.

The compact housing makes it easy to integrate into various devices, such as food service robots in restaurants, autonomous mobile robots in warehouses.

ranging methods. This includes low-contrast subjects, objects with low reflectivity, and floating objects, making it suitable for integration into robots used in environments such as stores and warehouses.

Measurement Range

The AS-DT1 is accurate also at distances of 40 meters (approximately 131.23 feet) indoors and 20 meters (approximately 65.6 feet) outdoors under bright summer conditions (assuming 100,000 lux), which can be challenging when inspecting infrastructure such as bridges, highways, and dams.

Compact, Lightweight, and Robust Housing

By utilizing an aluminum alloy for the structure, it balances lightweight design and robustness. The compact housing makes it easy to integrate into various devices, such as autonomous mobile robots with limited space for depth sensors and drones where weight can impact flight time and distance.

The AS-DT1 is expected to be available in Spring 2026. It will first be exhibited in Germany at Automatica 2025 in Munich, June 24-27, 2025. ■

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All images: Sony

Image: Autovimation

Affordable and Robust Camera Protection Solution

Autovimation introduces the Sparrow, an IP66-rated camera housing offering cost-effective protection for standard image processing cameras with cross-sections of 29 x 29 mm and 30 x 30 mm, and lens diameters up to 40 mm. The housing's interior length is 160 mm. It includes a flat front cover and a 40 mm housing extension for easy lens adjustment. Without the extension, the flat cover is ideal for cameras with S-mount lenses. The cable gland features a closed seal insert for self-drilling, accommodating one or multiple cables and connectors up to 21 mm in diameter. Complementing the straightforward housing concept, the manufacturer also offers a simplified pan-tilt mount, which, although less robust than traditional milled versions, is adequate for applications with lower mechanical stress. **www.autovimation.com**

Image: Haip Solutions

Advanced Hyperspectral Imaging with Unmatched Spatial Resolution

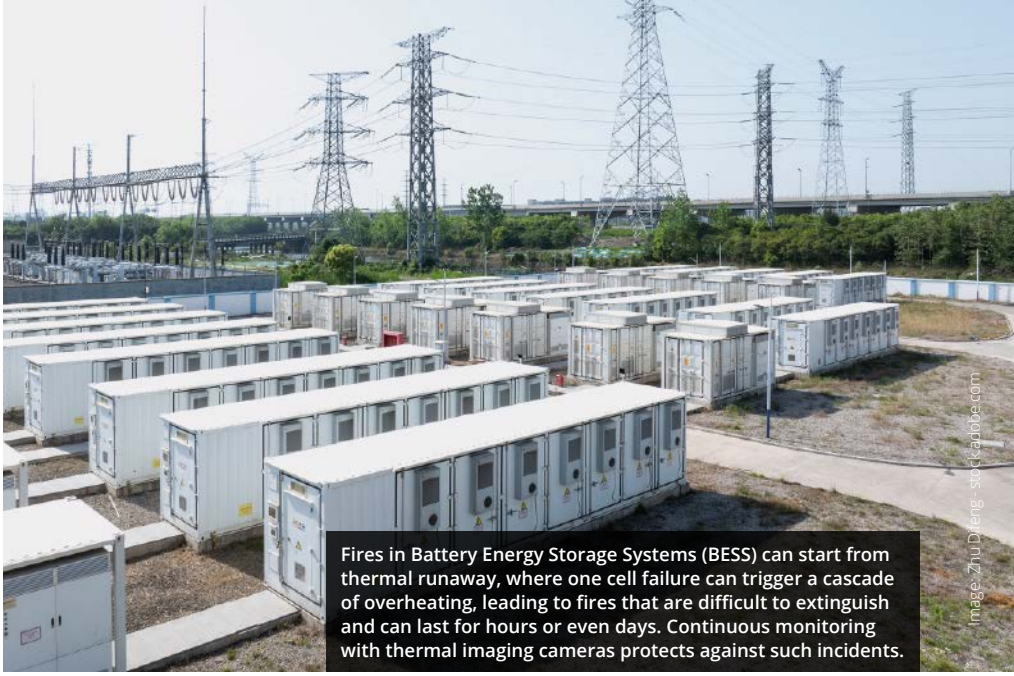
Haip Solutions has launched the BlackIndustry SWIR 1.7 Pro Max, a hyperspectral camera boasting the highest spatial resolution in the SWIR range with 2560 pixels. It spans wavelengths from 900 to 1730 nm, making it ideal for applications requiring detailed spectral information, such as geology, mining, recycling, and advanced material analysis. Featuring a spectral resolution of less than 3 nm FWHM and a 5 µm slit entrance, the camera can detect subtle absorption features previously unseen. The integrated Nvidia GPU allows for real-time data processing, ensuring efficient operation in environments demanding quick and precise results. This combination of high spatial and spectral resolution positions the BlackIndustry SWIR 1.7 Pro Max as a valuable tool for both industrial and research-focused hyperspectral imaging applications. **www.haip-solutions.com**

Image: MVTec

Enhanced Integration in Machine Vision Software

MVTec's Merlic 5.7 enhances the usability of the Merlic Runtime Environment (RTE) and optimizes communication interfaces. By streamlining the integration process, the need for additional processes is eliminated, improving usability and deployment. Two RTE instances can now run in parallel without manual port configuration, and plugin messages are logged directly, simplifying debugging. Merlic's frontend is now available for Linux, allowing visualization of processing results on Linux systems, and can operate as a remote frontend, offering flexible system architecture. Version 5.7 includes example Dockerfiles and scripts for containerized deployment, facilitating seamless integration into existing workflows and enhancing flexibility in application management. **www.mvtec.com**

Battery Energy Storage Systems are essential for storing renewable energy and ensuring grid stability. However, their implementation comes with inherent risks, particularly related to lithium-ion battery fires. Continuous monitoring with thermal imaging cameras protects against incidents.



Fires in Battery Energy Storage Systems (BESS) can start from thermal runaway, where one cell failure can trigger a cascade of overheating, leading to fires that are difficult to extinguish and can last for hours or even days. Continuous monitoring with thermal imaging cameras protects against such incidents.

Image: ZhuDifeng - stock.adobe.com

Ensuring Safety and Preventing Fire Battery Energy Storage Systems

Thermal Monitoring for Renewable Energies

Fires in Battery Energy Storage Systems (BESS) can start from thermal runaway, where one cell failure can trigger a cascade of overheating, leading to fires that are difficult to extinguish and can last for hours or even days. Should a fire breakout, hazardous gases would release from the batteries, posing health risks to nearby communities and causing environmental damage through soil and water contamination. In severe cases, BESS fires have the potential for huge disruptions to locals through property damage and even evacuations.

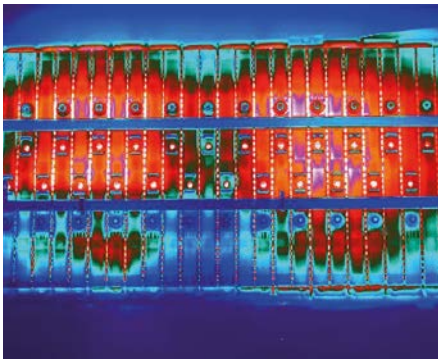
Traditional detection methods such as flame detectors often fail in the early stages of a BESS fire due to their reliance on visible flames or smoke, which might not be immediately present. Where flame detectors fall short, thermal imaging cameras can significantly improve protection and prevent fires before they ever reach combustion.

Advantages of Thermal Cameras for BESS

Thermal cameras detect the heat signature from the onset of thermal runaway long before visible flames or smoke appear, allowing for preemptive action to mitigate risks. While flame detectors react to events that have already happened, a fixed thermal camera such as the Flir A700F Advance Smart Sensor provides 24/7 surveillance by continuously monitoring for temperature anomalies that could indicate an impending fire, thus enabling early intervention. Flir cameras are designed for easy integration into broader safety and control systems, allowing for automated responses such as activating suppression systems that enhance response times and efficiency.

A fixed thermal camera such as the Flir A700F Advance Smart Sensor provides 24/7 surveillance by continuously monitoring for temperature anomalies that could indicate an impending fire, thus enabling early intervention.

Images: Flir



Thermal imaging cameras can detect abnormal heat rise in a cell and intervene before the problem cascades.

Comparison with Other Detection Methods

While flame detectors are designed to detect visible fire, they may miss smoldering or hidden fires—meaning an alert may not be tripped until the fire has escalated to a dangerous level. Thermal imaging cameras can detect abnormal heat rise in a cell and intervene before the problem cascades. This early detection can prevent escalation or at least minimize damage by providing critical time for action before fires get out of control. Another advantage of thermal cameras is their ability to monitor large areas or multiple battery racks simultaneously, providing comprehensive coverage which is often challenging for point-specific flame detectors. ■

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Image: Optris

Advancing Process Automation with Enhanced Connectivity

Optris has introduced new digital interfaces for its infrared temperature measurement devices, enabling seamless integration into industrial automation systems. The latest pyrometer models from the CT, CT Laser, CT Ratio, and CS Vision series, along with ethernet-based infrared cameras from the Xi series, now support industry protocols like Profinet, Ethernet/IP, Ethernet TCP/IP, and Modbus TCP. These interfaces ensure reliable real-time temperature data transmission, enhancing process control and monitoring. The robust industrial Ethernet interface modules feature IP67 protection and are easily installed using standardized network cables. Separate interface boxes are available for CS Vision and Xi series devices with various cable lengths. **www.optris.de**

Image: Jai

Enhanced Imaging Capabilities with New High-Resolution Cameras

Jai has expanded its sweep series with four 4K bilinear and monochrome camera models, featuring 5 Gige and Coaxpress interfaces. These cameras boast a 4,096 pixel resolution on a 14.3 mm wide sensor, with pixel sizes of 3.5 µm x 3.5 µm. Bilinear models achieve scan rates up to 42 kHz, while monochrome models reach up to 84 kHz, making them ideal for precision-demanding applications like battery inspection, food sorting, and waste management. The cameras utilize advanced integrated sensors for precision, employing minimal spatial compensation and FPGA-based binning technology to enhance sensitivity and image quality in low-light and high-speed environments. The new models minimize keystone and spatial compensation needs. **www.jai.com**

Image: Lucid Vision Labs

Precision with New 3D Camera Technology

Lucid Vision Labs has introduced the Helios 2 Narrow, expanding its 3D time-of-flight camera lineup. Featuring Sony's IMX556 depthsense sensor, this camera provides real-time 3D point cloud data with high accuracy and minimized multipath interference. Its 31 x 24 degrees field of view enables precise depth measurements, ideal for applications requiring accuracy in confined spaces. The Helios 2 Narrow retains the robust IP67-rated design of the standard model, optimized for distances between 30 and 60 inches. Lucid's Arena SDK offers intuitive controls, enabling real-time scene visualization and adjustments. The cameras adhere to Gige Vision 2.0 and Genicam^3 standards, supported by the Arena SDK compatible with multiple operating systems. **www.thinklucid.com**

Image: Ximea

High-Resolution Cameras with Sony Sensors

Ximea introduces new models in the XIX-XL family, featuring medium format 4.1 inch Sony IMX811 sensors, offering a resolution with 245.7 Mpix. These cameras utilize backside illuminated technology, achieving over 80 % quantum efficiency for superior image quality, even in low light. Key features include a PCIe Gen3 interface for real-time data transfer with low latency, supporting demanding applications like surface inspection and city mapping. The MX2457 models deliver 19,200 x 12,800 pixel resolution, transferring over 10 frames per second via a 32 Gbits high-speed interface. Despite the sensor size, the compact design facilitates easy integration. The sensor head reduces noise and heat, enhancing image quality in tight spaces. Cooling options include a fan module and optional liquid cooling. Various lens mounts provide flexibility in aperture, focus, and stabilization control. **www.ximea.com**

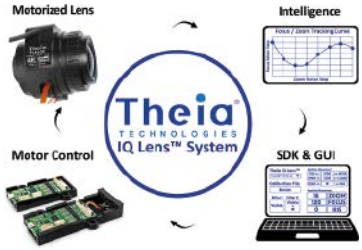


Image: Theia Technologies

4K Multi-Spectral Lens System Enhances Versatile Applications

Theia Technologies expands its lens system series with new 4K resolution, multi-spectral lenses. These motorized 4-10mm varifocal lenses provide 300 lp/mm resolution in both visible and NIR light, featuring motorized zoom and focus with optional NIR filters. Designed for flexible applications, they support factory automation, mobile logistics, agricultural monitoring, and law enforcement. The system includes a Python-based SDK and a user-friendly GUI, simplifying development and reducing costs. The calibration data optimizes image quality by addressing focus/zoom curves, geometrical distortion, and illumination. The motor control board supports USB, UART, or I2C protocols, and the purchase includes a royalty-free software license. This high-performance system enhances AI applications, offering a cost-effective and intelligent solution that accelerates time to market. **www.theiatech.com**

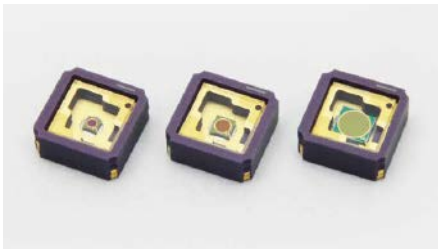


Image: Hamamatsu Photonics

InGaAs Photodiodes for Extended Wavelengths

Hamamatsu Photonics introduces the G1719X series, a new line of extended InGaAs photodiodes designed for longer wavelength ranges. These near-infrared sensors combine high sensitivity with low dark current, and are suitable for lead-free reflow soldering processes. Available in four wavelength ranges and three active areas, they cater to diverse applications such as gas sensing, pyrometry, and laser applications. The compact design makes them ideal for portable devices. Luigi Ghezzi, Technical Marketing Engineer at Hamamatsu, highlights the compact size and SMD solderability of the new photodiodes, which enhance integration and improve measurement system reliability and performance. Key advantages include high sensitivity across four wavelengths (1.7 – 2.6 µm), low dark current comparable to conventional products, and compact ceramic housing for easy integration. **www.hamamatsu.de**

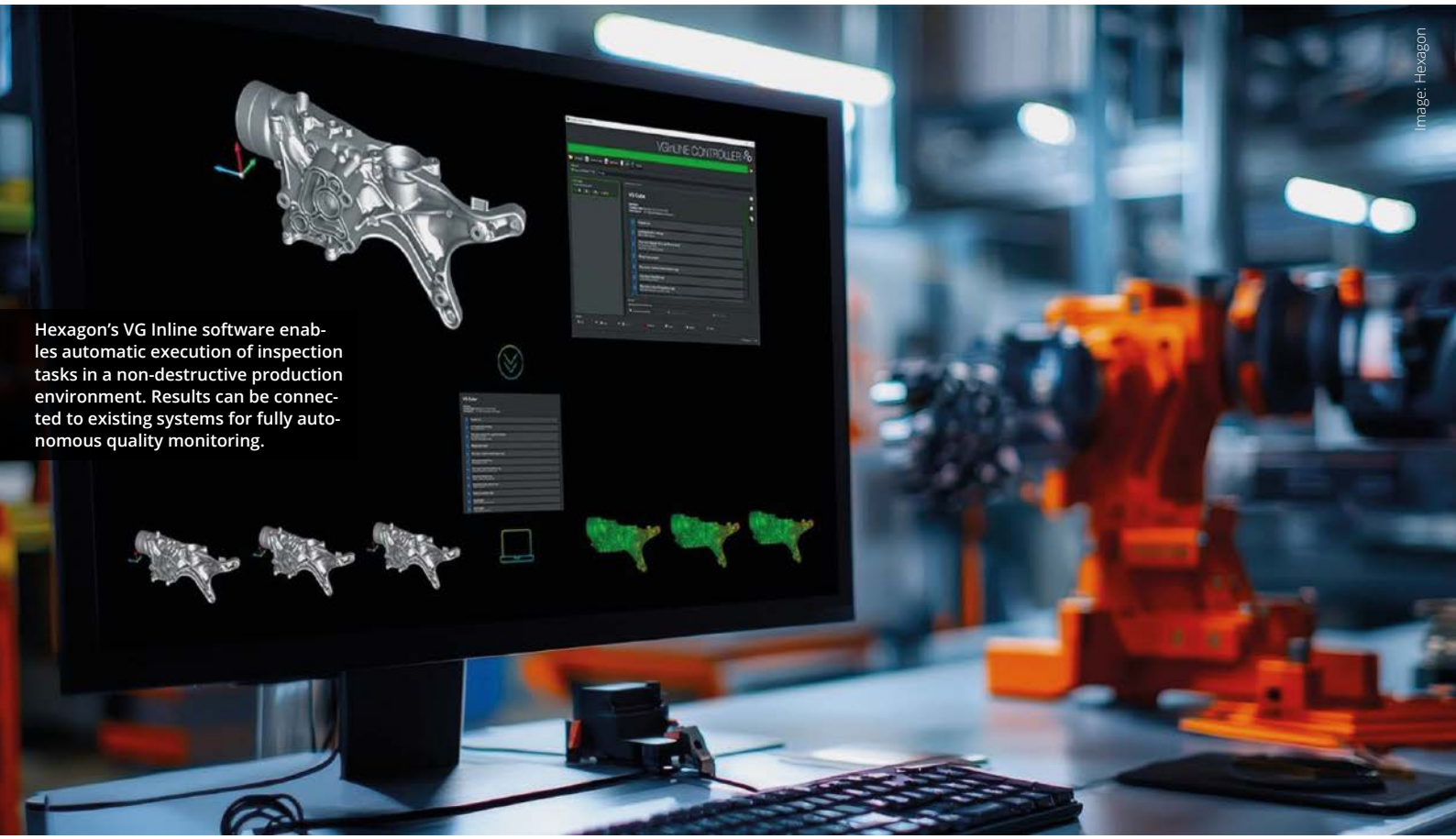


Image: Hexagon

Hexagon's VG Inline software enables automatic execution of inspection tasks in a non-destructive production environment. Results can be connected to existing systems for fully autonomous quality monitoring.

In-line CT Delivers Real-time Quality Feedback at BMW facility

Computed tomography and AI combined

Scanning systems and AI supported CT analysis software provide the German automobile manufacturer BMW with crucial information for producing housings for electric motors of their IX model EVs.

The moving assembly line has proven its worth since Henry Ford introduced the industrial time-and-motion breakthrough in his Michigan automobile factory in 1913. The addition of robots (by GM in 1962) alongside human workers has further increased efficiencies. But the success of the assembly line is tied to the quality of the components fed to it from production.

Thus, as the complexity of modern vehicles has risen dramatically in recent decades, particularly in the case of electric ones (EVs), the value of pre-assembly quality checks at key stages during active production has become increasingly apparent. In addition to various methods of surface scanning, some of the leading automotive are using computed tomography (CT) to inspect deep inside complex components to ensure they are fit to send to the assembly line.

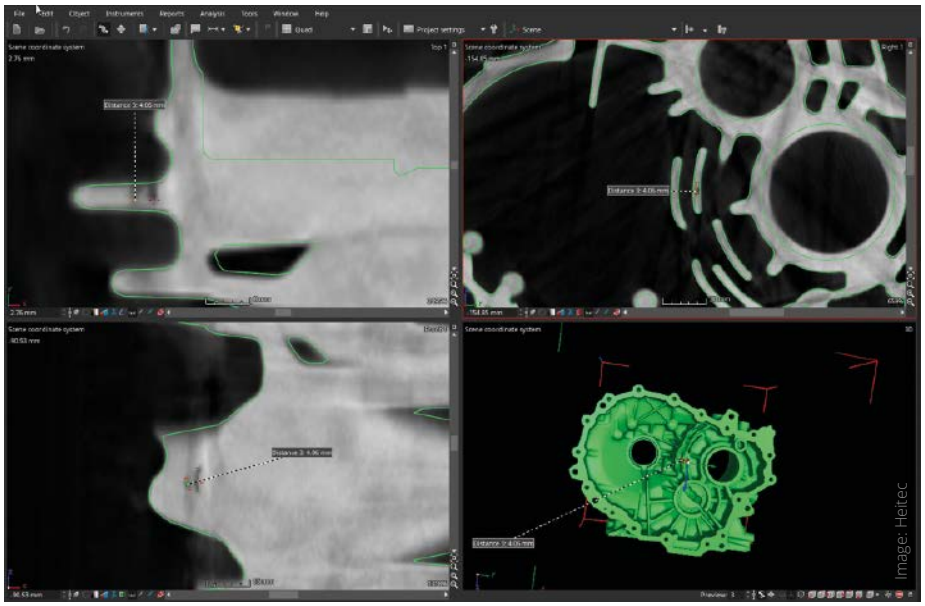
Now, CT scanning is expensive. But so is only finding out that costly components are defective after a vehicle rolls off the assembly line. The savings achieved in time and resources when valuable automotive parts are inspected for quality before they are installed in a vehicle can be significant. That's what German luxury automaker BMW has concluded – which is why they are CT scanning the engine housings of every single one of their advanced IX model EVs.

In contrast to the company's other current electric vehicles, the IX is based on an independent platform. But it uses the same drive unit (motor, inverter, transmission) known as "Heat" (Highly-Integrated Electric Drive Train) that is employed in the other BMW models. Ensuring the consistency and quality of this valuable drivetrain is clearly a priority for the automaker.

Technology in Detail

How in-line CT quality inspection works

During quality testing with in-line computed tomography (CT), an X-ray source emits radiation that penetrates objects and is attenuated depending on the material and geometry of the workpiece to be tested. A detector attached at the opposite side of the source creates a shadow image of the workpiece from the remaining radiation; the varying grey tones of the shadow images represent the differences in the nature of the test specimen. Control software then generates a 3D model of the object from the 2D X-ray image stacks. Finally, holistic analysis and visualization software is used to view and analyze the digital model from a variety of specific perspectives to either detect potential faults or to certify acceptable quality.



Examples of CT-scan-data analysis of an automotive part

Robots and scanners and software – on the line

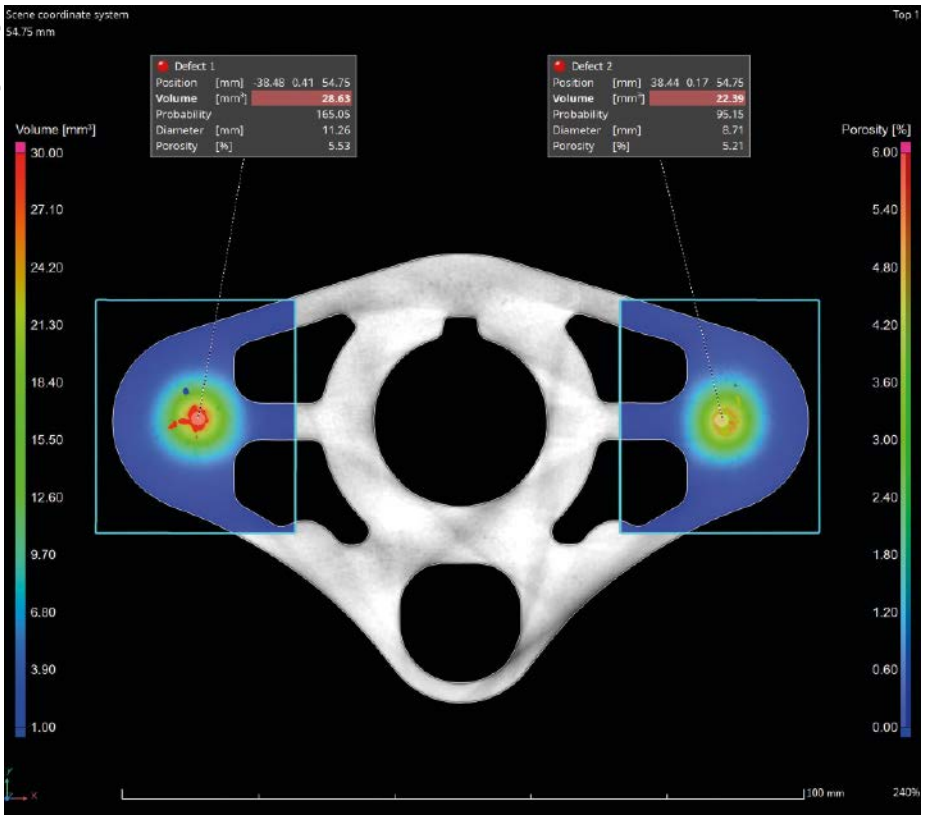
At its Landshut, Germany, facility, BMW is using a combination of in-line robotics, CT scanning and detection, and analysis and visualization software, to inspect their "Heat" e-engine housing during active production. The entire system was installed and integrated into their production line by Heitec, a global engineering solutions provider for a broad range of industries. Heitec's installation delivers a continuous-flow process in which a robot plucks an aluminum housing off the production line, deposits it on a platform that feeds it into a Heidetect Inline CT scanner, then shifts to the other side of the scanner to retrieve an already-scanned component and move that one back to the line. Each scan takes place in 50 seconds.

Post-scan, Heitec's proprietary software, quickly generates a digital model of each housing from the CT data, then transfers the model to Hexagon's VG Inline software for rapid segmentation and analysis. Viewable onscreen by engineers, graphic-and-colored alerts are automatically generated to call out any significant porosity, cracks, geometric inconsistencies, or other production or material flaws that deviate from BMW's specific metrics requirements – and might impact quality.

"Doing all this in the cycle time of the production line is the challenge," says Heitec co-founder Christian Abt. "You have to speed everything up to stay within that time – or even several seconds less than that."

Christian Abt, co-founder of Heitec, in front of the CT system that helps BMW in Landshut to inspect their "Heat" e-engine housing during active production.

Image: Hexagon



CT analysis software enables grey-value-based, shape-based, or machine-learning-based segmentation of 3D data. These defined regions of interest (ROIs) can be used to perform further analyses.

Interpret Low Resolution Scans with AI

The solution to the time crunch? Employing lower-resolution industrial CT scans that need significantly less time to capture an image – plus Heitec's scanner-integrated software designed to process this "less-heavy" information and reconstruct the component's volume data into a 3D computer model. This data is then loaded into holistic analysis and visualization software that queries the digital model, employing algorithms and, most recently, deep learning – to reliably identify, interpret and report potential quality issues despite the noisy images – within a much shorter time window.

"For the kind of advanced data processing software that would deliver the metrology results our customers were asking for, we found our way to Hexagon's VG Studio MAX and VG Inline," says Abt. "The complete infrastructure of VG Inline is a ready-to-use software package that allows us to easily integrate our own modules and functions, enabling us to combine accepted standards with flexibility. We just drop out a volume and VG starts to analyze it. This process is also easy to parallelize to more than one computer to speed things up in case the time for analyzing the data is slightly longer than the time to scan the part."

The VG CT-data analysis and visualization software has undergone over a quarter century of evolution and development, with process automation and, most recently, deep- and machine-learning, increasingly being integrated into its offerings. Says Hexagon's general manager for VG products, Dr. Daniela Handl, "The huge quantities of design and engineering data that can be captured by CT need a holistic approach, coupled with robust computational capabilities, to be most valuable. Rapid results delivery is critical for engineers looking for real-time insights into production-line quality as well as how manufacturing-parameter variations might be affecting outcomes."

Key to determining which data is significant in the scan of a component is the process of segmentation – the extraction of regions of interest (ROIs) from the 3D image data. Abrupt discontinuities in voxel grey-values typically indicate edges that define a region. By partitioning a scan into discrete regions, the software can more rapidly focus on and catalogue the characteristics of the voxels in each segment. Segmentation thus enables the processing of only the important portions of a dataset – which takes a lot less time.

Customizing proprietary solutions with machine learning

But how do you determine which segments are the important ones? Especially since, in a lower-resolution CT scan obtained on a production line, the less-crisp image slices can be more challenging to understand. This is where deep- and machine-learning, forms of artificial intelligence (AI), comes into the picture: using trainable algorithms, AI can be harnessed to process and make decisions based on noisy CT data as accurately as on hi-resolution data.

"Trainable" is the key word here. The algorithms compare what they see against an existing database of all known identifiable defects that have been customized to each manufacturer's product geometries (which is where the training comes in). The algorithms learn to identify specific manufacturing flaws by interpreting what the less-crisp voxels show.

Over time, deep learning gets even better at what it does; by comparing what it sees against real-world product data for which the solution is known, it learns to recognize patterns and features and call out deviations from the norm. In this way, it can provide highly accurate snapshots of what's actively happening on a particular production line – supporting confident decision-making about whether to accept or reject a part. This in turn informs production-variable changes, the effects of which can be captured, collated, and statistically examined. EV batteries are another area in which machine learning can be used in this way.

How to optimize this kind of AI methodology is what BMW is now exploring. Working closely under NDAs, with innovators such as Heitec and Hexagon, these companies are creating and curating their own internal data sets with which to train in-house deep learning systems. "Training a deep learning system to one's proprietary data understandably takes some time," says Handl. "But it pays off by saving highly valuable time and resources on the production line." Actionable insights into what's happening on one's own factory floor are contributing to the further evolution of smart manufacturing, enabling companies across many industries to identify ways to improve quality while making their products more competitive. ■

Watch the Video

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The miniature hexapod H-811.I2 achieves both high speeds and high precision values.

Miniature Hexapod for Demanding Applications in Industry and Research

Fast and Precise Positioning System

The H-811.I2 miniature hexapod from Physik Instrumente (PI) has a small footprint and a high reliability in applications with high numbers of cycles, such as in optical manufacturing, automation, silicon photonics, and micro-assembly. With six degrees of freedom (6DoF), this positioning system offers a balance between size, payload, and performance. The compact hexapod can be integrated into demanding applications and complex systems.

Six synchronously controlled actuators enable the hexapod H-811.I2 from Physik Instrumente to position and align loads with precision in all degrees of freedom – three translational and three rotational. Applications such as the positioning of tools or workpieces in micro-assembly, the alignment of optical fibers in silicon photonics, or the simulation of movements for functional tests benefit from ultracompact hexapods. This means the H-811.I2 can boost the productivity of complex production processes and measuring procedures. The freely definable center of rotation provides a high flexibility in various fields of application.

The miniature hexapod reaches velocities of up to 20 mm/s and high precision values: minimum incremental motion down to 0.08 µm and a repeatability of ±0.06 µm. The maximum travel range is ±17 mm or ±21°, respectively. Furthermore, the system enables reliable positioning over long operating times and is designed for a payload of 5 kg. The compact system is designed for a lifetime of up to 20 million motion cycles, while providing the highest performance in the smallest possible space. For special application environments, vacuum-compatible versions up to 10-6 hPa are available.

Control of the Parallel-Kinematic System

The hexapod controller enables simple integration and intuitive control of the parallel-kinematic system: All target positions can be commanded in Cartesian coordinates. The position and alignment of both the reference coordinate system and the center of rotation can be defined in the software and adjusted to the application. To simplify implementation, a simulation program can be used which enables the calculation and depiction of the workspace. ■

Company in Detail

Physik Instrumente (PI)

PI with headquarters in Karlsruhe, Germany, manufactures high-precision positioning systems for the market segments of industrial automation, photonics, semiconductor, and microscopy & life sciences. PI employs over 1,900 people. PI's portfolio ranges from components to subsystems to tailor-made complete solutions. The company holds more than 560 granted and pending patents in the fields of precision positioning and piezo technology. PI operates on a global scale, with nine production sites in Europe, North America, and Asia, as well as sixteen sales and service subsidiaries.

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Image: Physik Instrumente

Time of Flight Method Ensures Depth Perception

Shape Recognition, Object Positioning, and Distance Measurements in Logistics

Time-of-Flight (ToF) is much more than a sensor technology–it functions like an additional, precise pair of eyes in industrial manufacturing. But what exactly is behind it, what advantages does ToF offer, and how is the technology evolving?

Who doesn't know this situation? After a big shopping trip or a vacation, you stand in front of the car and wonder: How do I get all this into the trunk? Suitcases, shopping bags, maybe even a stroller–it seems impossible to fit everything in. But with a bit of spatial thinking and clever stacking, everything suddenly fits.

This ability to optimally arrange objects in a limited space is crucial not only in everyday life but also in industry. In factory halls, machines must precisely recognize, grasp, and place materials–and do so as error-free as possible. While we can improve our spatial thinking through practice, machines are helped by Time-of-Flight (ToF) technology. It gives them exact depth perception, allowing them to capture their surroundings in three dimensions and make optimized decisions–a key factor for the automation of the future.

Spatial Thinking and the wTime of Flight Method

The goal is clear: fully automated robots that quickly detect objects and work efficiently. With the ToF method, this is possible: it measures the distance between the sensor and the object, providing precise 3D images. Three components make this possible: a light source emits modulated infrared light pulses, an image sensor captures the reflected light, and a computing unit calculates the time difference between the emitted and returning light. The principle is similar to a bat's sonar – only with light instead of sound. The camera emits a laser beam, which is reflected by an object. The sensor measures the time it takes for the light to travel to and from the object, determining the exact distance to the object. A depth value is calculated for each pixel, creating a detailed depth map or point cloud.

Especially in logistics, the combination of ToF and 3D cameras offers decisive advantages. Unlike conventional 2D cameras, they capture not only the structure of an object but also its volume, shape, distance, and position in space. A vivid example of this is pallet picking: ToF cameras recognize not only the number of packages but also their dimensions and volume, allowing the available space to be optimally utilized. They work reliably regardless of contrasts or specific markings and function even in difficult lighting conditions, such as poorly lit rooms. Even moving objects are captured without problems. Compared to other 3D cameras, ToF systems are more compact, cost-effective, and less complex, making installation and integration significantly easier.

For an Improved Warehouse Automation

Among the pioneering models are the ToF cameras from Delta Electronics: The latest generation includes the ToF smart camera DMV-T and the RGB-D ToF camera DMV-TM, which are particularly well-suited for various applications and enable precise positioning, identification, and measurement for improved warehouse automation.

The ToF smart camera of the DMV-T series uses depth recognition technology to enable three-dimensional coordination in a space. The camera performs distance measurements, shape recognition, and object positioning even in complex environments such as poor lighting or cluttered spaces. With a range of up to 6 meters, a field of view of 67 degrees by 51 degrees, and 60 frames per

Image: Delta Electronics

Hardware meets intelligent software: Thanks to the ARM Dual Cortex-A53 CPU and FPGA technology, Delta's ToF cameras DMV-T can process complete 3D image data without the need for external industrial PCs.

second, the DMV-T camera is the standard model from Delta Electronics. With an integrated dual-core CPU, the camera is ideal for time-critical tasks such as pallet recognition on automated forklifts and positioning of objects in AS/RS systems. It features high accuracy (less than 1 % error probability), a detection time of under 80 ms, and robust protection class IP67. Seamless integration into existing systems is ensured by the Ethernet interface.

Small Dimensions in Automated Guided Vehicles

The DMV-TM camera is specifically designed for an integration into AGVs (Automated Guided Vehicles) and stacker cranes. Its lightweight and adaptable design, combined with precise navigation functions, enables collision avoidance and optimized performance in dynamic warehouse environments. It is 10 centimeters long, 3.5 centimeters high, and has a significantly wider field of view (FOV) of 105 degrees by 78 degrees compared to the standard model. This feature is crucial–after all, AGVs should primarily recognize the path ahead but also need a broad view of their surroundings for efficient use. For a 360-degree view, multiple mini-cameras would need to be installed on the AGV. For comparison, the human field of view is around 180 degrees–depending on age and person. The DMV-MT camera has a frame rate of 30 frames per second and a range of up to 4 meters. A key difference from the standard model is that the DMV-MT camera does not have an integrated processor. The image processing and corresponding computing power are therefore installed in the AGV or at the respective location–a reason for the smaller dimensions.

Automotive Industry, Logistics, and Hospitals

Warehouse optimization, reduction of pick and place tasks, fewer downtimes, increased flexibility and efficiency: ToF cameras have their core application area in the logistics industry. The automated takeover of pallet picking, container filling, or other logistics tasks relieves specialists and provides room for more demanding work. This is possible because cobots or AMRs can work fully automatically with the use of ToF cameras and can also be programmed to meet safety standards. Both the DMV-T and the DMV-TM are suitable for a wide range of applications in the areas of food and beverage packaging, electronics, automated production, and robot vision, demonstrating their versatility in various industries. ■

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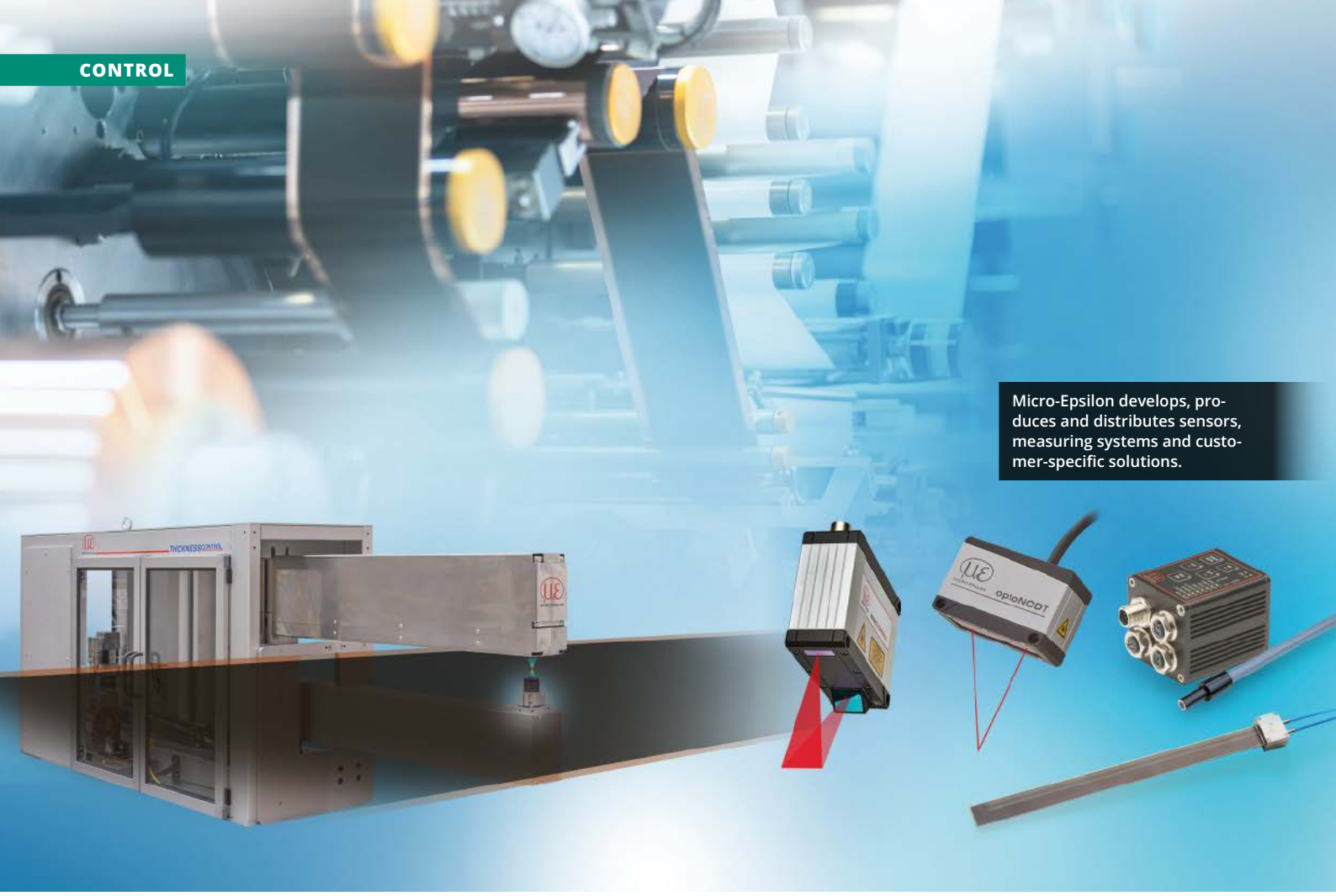
Image: wetzkaz - stock.adobe.com



Micro-Epsilon develops, produces and distributes sensors, measuring systems and customer-specific solutions.

For the Battery of Tomorrow

Sensors and Measuring Systems for Monitoring Production Processes in Battery Cell Manufacturing

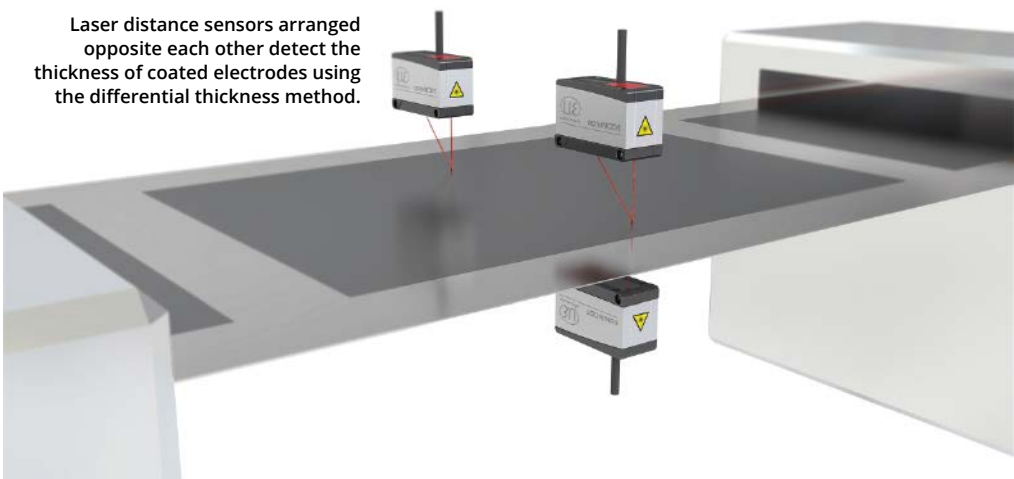
Modern battery technologies play an important role in numerous fields of application, from electric vehicles and energy storage systems, to mobile devices such as smartphones. A high-precision battery production process is essential to meet the increasing demand and to keep the performance at a high level. In this context, state-of-the-art sensor technology is used.

Sensor specialist Micro-Epsilon offers high-precision solutions for numerous applications in battery production. These range from individual sensors to complete sensor systems, from inline thickness measurement and precise machine monitoring, to 3D surface inspection. The measurement technologies are used by leading battery manufacturers and automotive groups. The sensor signals can be calculated, evaluated or analyzed using turnkey solutions.

Sensors and measuring systems are used in automated processes in all production steps of anodes and cathodes, separators and active material. They measure with high precision during coating, calendering, assembly and even forming. Micro-Epsilon offers numerous solutions for electrode film coating lines in particular. The sensor systems are used for both wet and dry coating processes. Coated copper film can be monitored in the same way as aluminum film. Process-critical parameters are the coating thickness, thickness of the films, web edge position and coil unwinding, as well as the monitoring of the coating application at the edges.

Thickness Measurement of Battery Film

Capacitive sensors have proven themselves in inline thickness measurement of battery film. These have a larger measuring spot, which means an inhomogeneous structure can be compensated for via the area integration of the sensor. In addition, the capacitive sensors



Laser distance sensors arranged opposite each other detect the thickness of coated electrodes using the differential thickness method.

can be used at high process temperatures of up to 200°C. Thanks to integrated temperature compensation, they deliver stable measurement values in the sub-micrometer range. Capacitive sensor technology was previously used primarily in the semiconductor industry for clean room applications. After further development and adaptation to industry requirements, they are now deployed in distance and thickness measurement tasks.

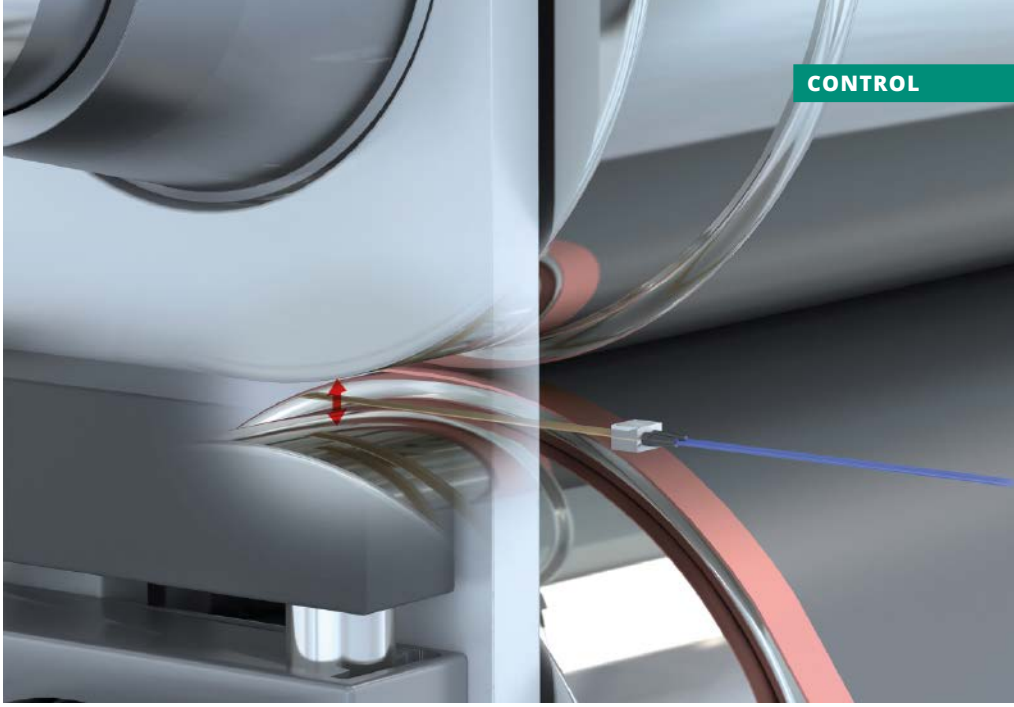
In addition to capacitive sensors, confocal chromatic sensors, white light interferometers and laser sensors are also used. These are typically used to monitor and control wet coating processes, but are also suitable for dry processes.

Two-sided Thickness Measurement for Electrode Coating

With double-sided thickness measurement, two sensors from the Optoncdt 1900 LL series are arranged opposite each other, each one measuring the distance to the battery film. Based on synchronization combined with the precise sensor alignment, high measurement accuracy and measuring rates are achieved. The thickness values can be used to control the coating application and for quality assurance. Its laser-line beam design makes this sensor suitable for inline thickness measurements in battery cell production. The electrode coating is a dried paste (the so-called slurry), which is applied on both sides of an aluminum film (for the cathode) or on a copper film (for the anode). Subsequent drying and calendering forms a partially very porous surface. Specially designed for measurements on rough surfaces, the small laser line fits for this application since it compensates for surface irregularities. The thickness values of the coated film obtained in this way are used for quality assurance. Thanks to its accuracy and compact size, the Optoncdt 1900 LL is ideal for these measurement tasks. Another advantage is the possibility of solving measurement tasks with laser class 2.

Distance Sensors for Roller Gap Control

State-of-the-art inductive sensors are normally used to monitor and control calender and coating rollers. Instead, Micro-Epsilon uses capacitive sensors, which are available in various designs and detect the roller gap with micrometer accuracy. These compact sensors can be integrated into confined installation spaces to measure directly against the rollers or the roller suspension. Direct gap measurement is possible via integration on the roller, e.g. with a flat sensor only 0.9 mm thick. The sensor can measure on both sides and therefore detects two distances. Another option is indirect gap measurement via integration on the shaft using an extremely compact 4 x 3.5 mm capacitive sensor. Its robust design and high temperature stability allows the sensor to be used in high ambient temperatures.



Capacitive flat sensors are used for monitoring and controlling calender and coating rolls. These are available in various designs and detect the roller gap with micrometer accuracy.

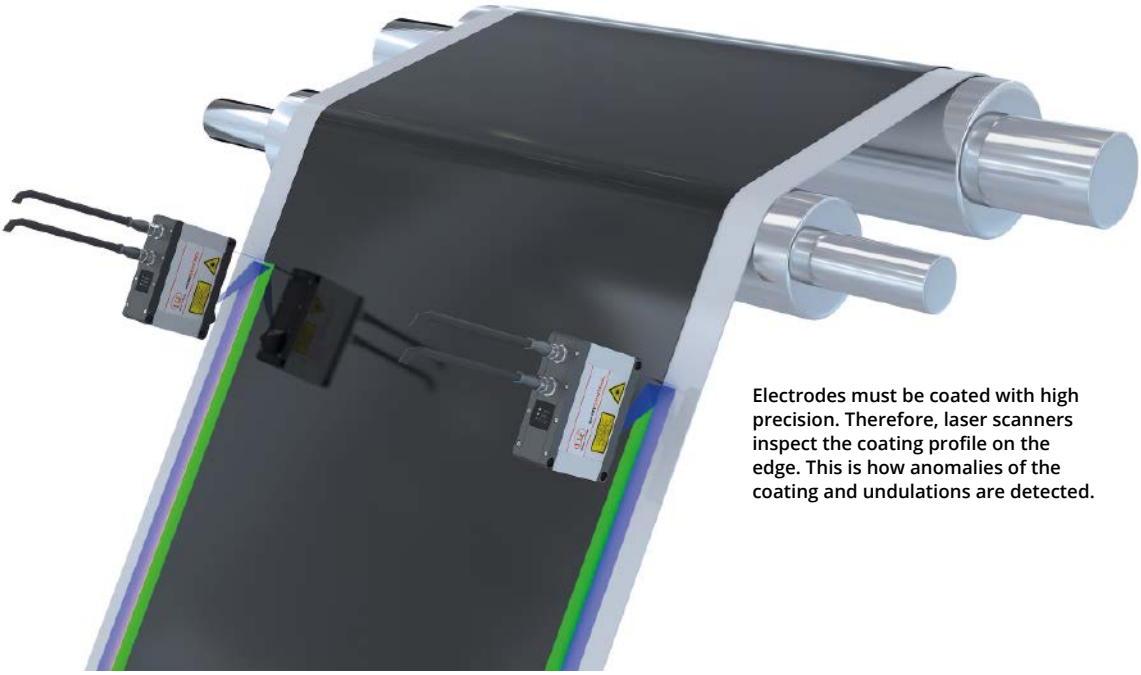
Process-reliable Distinction of Black Tones

In the manufacturing process of lithium-ion batteries, carrier films are combined with an anode and a cathode to form an energy cell. The anode consists of a copper film coated with a graphite layer in deep black. The cathode has an aluminum film with a deep black lithium metal oxide coating. The two shades of black can hardly be distinguished from each other. However, this is of great importance to ensure the proper functioning and reliability of the batteries. The Colorsensor CFO200 color measuring system in conjunction with the CFS2-M11 circular sensor reliably solves this measurement task and makes it possible to distinguish fine color nuances. The measurement takes place in real-time, with high precision and high speed.

2D/3D Sensors for Electrode and Battery Production

3D sensors from Micro-Epsilon are used for assembly monitoring and for 3D inspection of coated films. 3D laser scanners are used for continuous belt inspection, while 3D snapshot sensors are used for stop-and-go measurements with extremely high precision. The 3D sensors allow stable measurement with high resolution and detect flaws on the smallest of shapes, such as spalling and inclusions. Optical micrometers that reliably check sheet travel are used to monitor the edges of strips.

In the production of lithium-ion batteries, the precision in the distinction of black tones is essential. The Colorsensor CFO200 color measuring system makes it possible to distinguish color nuances.



Electrodes must be coated with high precision. Therefore, laser scanners inspect the coating profile on the edge. This is how anomalies of the coating and undulations are detected.

3D Monitoring of the Coating Application on the Belt Edges

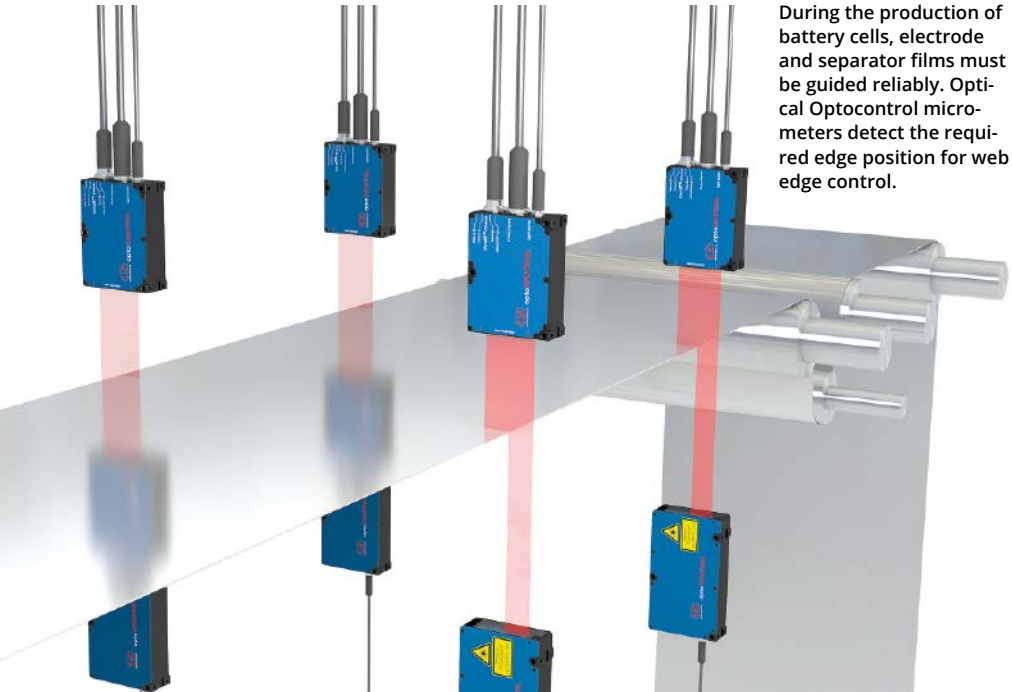
Electrodes must be coated with extreme precision. Therefore, laser scanners from Micro-Epsilon inspect the coating profile on the edge. This is how anomalies of the coating and undulations are detected. These 3D laser scanners are characterized by high dynamics, precision and their compact size. With the Scancontrol 3000 and the new Scancontrol 3002 series, Micro-Epsilon offers a comprehensive portfolio with numerous measurement areas. The sensors are based on the latest GigE Vision and GenICam standards and can therefore be integrated in a wide range of image processing environments. The powerful 3DInspect software is available for parameter setting, evaluation and output.

Web Edge Control of Electrode Film

During the production of battery cells, electrode and separator films must be guided reliably. Optical Optocontrol micrometers detect the required edge position for web edge control. Operating several micrometers enables the concurrent detection of the web width. Due to their high measuring rate, Optocontrol micrometers are also suitable for monitoring dynamic production processes.

Inline Systems for Measuring the Strip Thickness

The Thicknessgauge sensor system is used for inline thickness measurement of strip materials. Equipped with a white light interferometer, it detects thin coatings from 10 µm on plastic films with sub-micrometer accuracy. Several models with different sensor types, measuring ranges and measuring widths are available from Micro-Epsilon for precise thickness measurement. Depending on the requirements of the measurement task, these systems use two optical or electromagnetic distance sensors to measure the strip thickness of cell material, films and coatings with micrometer accuracy.



During the production of battery cells, electrode and separator films must be guided reliably. Optical Optocontrol micrometers detect the required edge position for web edge control.

Inline Thickness Measurement of Battery Film

The Thicknesscontrol measuring system is used for inline thickness measurement of coated battery film and impresses with long-term stable measurements. It consists of one or two robust measuring frames, each of which can be equipped with up to four thickness measuring tracks according to customer requirements. This allows up to eight thickness measurement channels in one measuring system. The sensors are based on the confocal chromatic measuring method and are evaluated and synchronized via a multi-channel controller. A patented linearization of the individual measuring tracks achieves measuring accuracies in submicrometers.

Conclusion

The use of sensor systems in battery production increases efficiency and quality and conserves resources. Micro-Epsilon develops, produces and distributes sensors, measuring systems and customer-specific solutions. The wide range of products is based on different measuring principles and is tailored to the high requirements of battery production. It is ideal for monitoring production processes in battery cell manufacturing. Various measuring methods are available for measuring the thickness of the battery film, which are optimized for the respective process steps. ■

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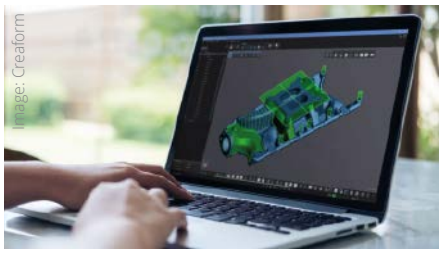
Image: Creaform

Streamlining Reverse Engineering with Advanced 3D Scan Software

Creaform has introduced Scan-to-CAD Pro, an application module within the Creaform Metrology Suite, designed to enhance reverse engineering workflows. The software simplifies the conversion of 3D scan data into detailed CAD models. The module offers advanced algorithms for mesh extraction, flexible alignment, and optimized mesh editing tools, allowing professionals to choose the best fit for their workflow. Scan-to-CAD Pro includes features like 2D sketching and 3D modeling tools, acting as a seamless bridge between 3D scanning and CAD software, such as Solidworks. This accelerates the design process, reducing the need for multiple design iterations, especially in complex geometries.

www.ametek.com


Image: Micro-Epsilon

Efficient 3D Inline Inspection in Battery Production

The Surfacecontrol 3D snapshot sensor from Micro-Epsilon is employed for inline coplanarity inspection of pole terminals, shunts, and bridges. Integrated directly into the production line at the rotary indexing table, this sensor generates a precise 3D point cloud within milliseconds. These data are transmitted via gigabit ethernet to proprietary software for processing and coplanarity calculation. The Surfacecontrol 3500-80, positioned orthogonally to the measurement object, offers high data quality for precise results. Its compact, inline-capable design eliminates the need for an additional controller, saving space and costs. The sensor's field of view of 80 x 50 mm (about 3 x 2 inches) facilitates efficient measurement, ensuring the accuracy required in battery production. **www.micro-epsilon.de**


Image: Zeiss

Solution for Precision and Efficiency in Industrial Inspection

Zeiss introduces O-Inspect duo, a device that combines precise measurement technology with high-resolution microscopic inspection. It targets quality labs and enterprises with high demands for component inspection and measurement, combining efficiency and flexibility. It inspects complex parts, from large workpieces like circuit boards to smaller components, using a high-resolution microscope for non-destructive inspection. The device integrates optical and tactile metrology, featuring contactless sensors for precise results and the Zeiss VAST XXT sensor for tactile 3D measurement. It includes adjustable lighting and a 5-megapixel color camera for optimal inspection, and is compatible with Zeiss software.

www.zeiss.com


Image: Waygate Technologies

Inspection Innovations at Control 2025

Waygate Technologies participated in the Control 2025 trade fair in Stuttgart. The company showcased its range of industrial X-ray, CT, and ultrasound testing technologies, along with various services. Highlights included the Phoenix V|tome|x M Neo, a versatile CT scanner for labs and production, and the Phoenix Nanome|x Neo for material analysis and electronics testing. An exclusive preview of a next-generation CT system, designed for electronics and research, was also provided: The DXR Flex, a flexible digital X-ray detector, aimed to replace traditional films, enhancing efficiency and image quality. Additionally, Waygate presented advanced ultrasound technologies like the portable Krautkrämer USM 100 for quick fault detection, the Krautkrämer Rotoarray Compact for efficient phased-array testing, and the Krautkrämer CL Go+ for corrosion measurement.

www.bakerhughes.com


Image: Mitutoyo

Precision Measurement with Advanced Technology

The FTA-H3000 from Mitutoyo's Formtracer Avant series combines both functions in a single device for accuracy and efficiency. Traditionally, separate devices were needed for roughness and contour analysis, but the FTA-H3000 integrates them, reducing operator error and boosting productivity. This model features an expanded measurement range (Z1 = 16 mm), offering 3.2 times the capacity of its predecessor, allowing for precise measurement of workpieces with significant height variations. The device's precision is underscored by its Z1-axis accuracy of (0.5+0.02H) µm and low noise level, ensuring reliable data in compliance with DIN EN ISO 21920 standards. The device supports easy probe exchange and accommodates various geometries for diverse measurement needs. Existing Avant customers benefit from seamless retrofitting options.

www.mitutoyo.de


Image: Bruker Alicona

Innovations in Optical 3D Measurement Technology

Bruker Alicona showcased its latest advancements in optical 3D measurement technology at the Control trade fair. The company emphasized automation, user-friendliness, and robustness against environmental influences. The Focus X system, featuring a Shopfloor Enclosure, offered protection against dust and liquids, ensuring performance even in harsh conditions. The enclosure included a workspace and efficient thermal management, making it both mobile and user-friendly. The Real 3D Unit X enhanced the Focus X with five-axis capabilities, allowing comprehensive 360° measurements and facilitating complete automation through the Met Max software. Bruker Alicona also introduced Automatic Round Tool Alignment for precise tool measurement and Contour Scanning for faster, intuitive contour measurements.

www.bruker.com

The automated measuring system Smartmeasure-AL enables high productivity through continuous, fully automatic measuring cycles.

No More Input Errors Despite High Efficiency

Automated Precision Measurement System

An advanced automated measurement system seamlessly integrates with measurement equipment. This system enhances industrial measurement processes through precision, reliability, and complete automation.

Smartmeasure-AL addresses labor shortages by offering efficiency, precision, and adaptability across industries.

Smartmeasure-AL ensures high productivity through continuous, fully automatic measuring cycles. The system enables autonomous 24/7 operation, ensuring constant performance without operator influence. This increases efficiency and minimizes downtime, allowing factories to maintain a high level of production even during worker shortages. Measurement results are sent directly to CNC machines, resulting in real-time tool correction and increased operational efficiency. Smartmeasure-AL supports multi-pallet operation, optimizing workflows, increasing workpiece throughput, and improving overall factory productivity.

Unlike conventional measurement setups, where variations can occur due to different operators, Smartmeasure-AL offers consistency. Once the system is configured, repeated measurements can be taken in exactly the same way, reducing errors and ensuring highly reliable measurement results. By eliminating the variability of manual measurements, manufacturers can achieve greater consistency and meet stringent quality standards. The system's intuitive software enables operators to easily re-measure workpieces that have failed the GO/NG assessment without having to repeat entire batches, saving time, minimizing material waste, and improving production efficiency.

Intuitive Software even for beginners

Smartmeasure-AL ensures easy operation and connectivity for industrial applications. The user-friendly Space4Win software and graphical user interface (GUI) enable users to operate the system effortlessly, even without prior knowledge. The integration of RFID technology allows automatic part program selection, reducing set-up times and optimizing workflows. Measurement results can be sent to statistical software or external systems for further analysis, facilitating decision making and improving quality assurance. Smartmeasure-AL's flexible configuration enables adaptation to different manufacturing environments, making it suitable for companies looking to expand automation and increase efficiency.

Smartmeasure-AL addresses labor shortages by offering efficiency, precision, and adaptability across industries. It sets new standards for automated measurement with features such as operator-less operation, reduction of input errors, and simplification of workflows. Smartmeasure-AL integrates seamlessly into existing workflows, providing a cost-effective way to increase accuracy, increase machine uptime, and stay competitive. ■

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All images: Mitutoyo

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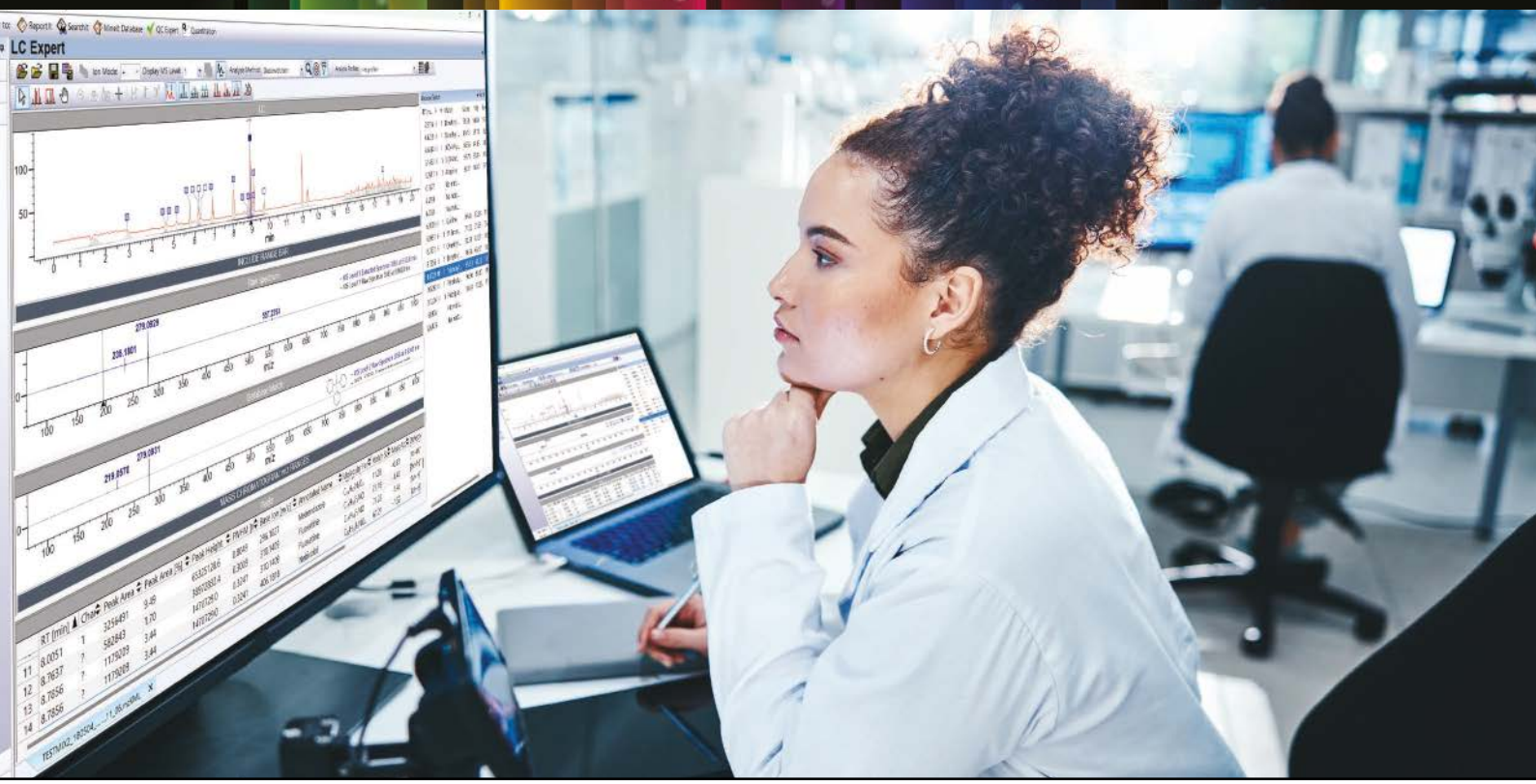

Streamline component identification with the new KnowItAll LC Expert

Eliminate hours of manual LC-MS analysis with **KnowItAll LC Expert**. This powerful tool simplifies analysis by automatically deconvoluting raw LC-MS chromatograms and identifying the components with a single click.

It features both MS/MS and accurate mass search methods to ensure the most complete analysis. Combined with Wiley's comprehensive, trusted data collections, LC Expert takes non-targeted and targeted spectral analysis to the next level.

Learn how to take LC-MS analysis from hours to minutes!

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Specim FX hyperspectral camera in wafer inspection

Image: Dive Imaging Systems

Hyperspectral Imaging for Surface and Layer Analysis

Optical Wafer Inspection

By combining spectral analysis with high-resolution imaging, hyperspectral imaging enables full-surface, 100 percent inspection of wafers. This comprehensive approach detects layer thickness variations, contamination, and defects with exceptional accuracy. Hyperspectral imaging brings advanced, non-invasive inspection capabilities to the semiconductor industry and beyond. Direct inspection of production wafers leads to fewer defects, greater resource efficiency, and significantly faster inspection times.

Dive's Vepioneer Hyperspectral Vision System for non-destructive wafer inspection

Image: Dive Imaging Systems

In semiconductor manufacturing, hyperspectral imaging evaluates the spatial distribution of thin film thickness of oxides, resists, or surface parameters before or after every processing step in lithography or CVD/PVD/ALD processes. Combining detailed spectral data with high-resolution imaging enables a thorough analysis of wafer properties, ensuring quality and consistency.

Dive Imaging Systems is a German-based manufacturer of tools for surface and layer inspection in semiconductor production. It builds Hyperspectral Vision systems – integrating hardware, software, and comprehensive solutions for industrial inspection tasks. With a primary focus on performance surfaces and thin film applications, the company addresses the need for meticulous inspection and quality control in thin-layer application processes.

Any deviation from specifications can lead to malfunctions, making accurate assessment crucial. Dive's technology offers a comprehensive evaluation of surface characteristics, particularly beneficial in semiconductor manufacturing. Beyond semiconductors, Dive's technology caters to a wide range of industries, including electronics production, glass or foil coating for optics, encapsulation, and cleanliness of bonding surfaces.

Dr. Philipp Wollmann, CEO of Dive Imaging Systems, states, "Our goal is to offer a fully integrated hyperspectral imaging solution for industrial inspection, providing comprehensive insights on surface characteristics and layer parameters like thickness, with the aid of artificial intelligence and machine learning."

With Dive's solutions, the success of processing steps in semiconductor manufacturing can be tested directly on production wafers, significantly reducing the need for standard test wafers. Hyperspectral cameras are crucial in this integration.

Improved Quality, and Faster Inspection with Hyperspectral Imaging

Hyperspectral imaging had a profound impact on Dive's system. By integrating Specim's FX10 VNIR and FX17 NIR hyperspectral cameras, Dive has achieved high accuracy and speed in their wafer inspection processes. According to Wollmann, hyperspectral imaging provides several advantages in wafer inspection over traditional imaging methods: "Hyperspectral imaging offers a significant leap forward in wafer inspection by enabling non-invasive, full-area analysis that improves reliability, supports the industry's zero-defect goal, and reduces both costs and waste. Notably, it reveals previously unknown quality-determining parameters and achieves high production efficiency with a scan time of 30 seconds for a 300 mm wafer."

Technology in Detail

Hyperspectral Imaging

Hyperspectral imaging combines spectroscopy, which provides material and topology information, with imaging for shape and structure recognition, yielding a comprehensive data set. For instance, a layer stack data set can reveal layer thickness distribution, layer composition homogeneity, defect presence and classification, pore detection and quantification, quality classification, and downstream production step quality predictions.

Image: Specim

Specim FX10 and FX17 Hyperspectral Cameras

"The integration of hyperspectral cameras has improved our imaging solution for industrial inspection regarding quality and efficiency. Looking ahead, we are excited to leverage this technology further to meet the evolving demands of the semiconductor industry", Wollmann states.

He believes that hyperspectral vision technology will revolutionize machine vision due to its ability to capture unique, detailed data from hundreds of images. This comprehensive data set is suitable for detecting nuances in industrial processes, surpassing the capabilities of traditional methods. Integrating machine learning and AI algorithms with chemical-analytical methods enables unprecedented combinations that offer innovative approaches to assessing product quality. ■

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Edgar Wuchrer next to a welding machine with automated quality control: Up to three integrated camera stations take pictures of the test part, the image processing software Kivision does the evaluation. Thanks to the tightly knit design for inspection process reliability, it ensures that every part is inspected even at high cycle rates.

Who inspects inspection systems?

Automated quality control requires self-monitoring inspection systems

Automated inspection systems ensure that everything runs smoothly without human intervention. But who checks the quality inspection systems? With increasing automation, the machine can and must monitor itself more and more. This requires a sophisticated strategy for inspection process reliability. It ensures that every inspection step runs smoothly, even in very short cycle times and in complex processes.

Just a few years ago, employees were largely responsible for quality control. However, due to fatigue during long and late shifts, differences in the level of experience of individual employees or other circumstances, they often represented a source of error themselves. By integrating in-line inspection systems for 100 percent inspection, manufacturers are now increasingly freeing up employee capacity for more demanding tasks while maintaining product and inspection quality at a consistent level. But who checks whether the machine itself is becoming a source of error?

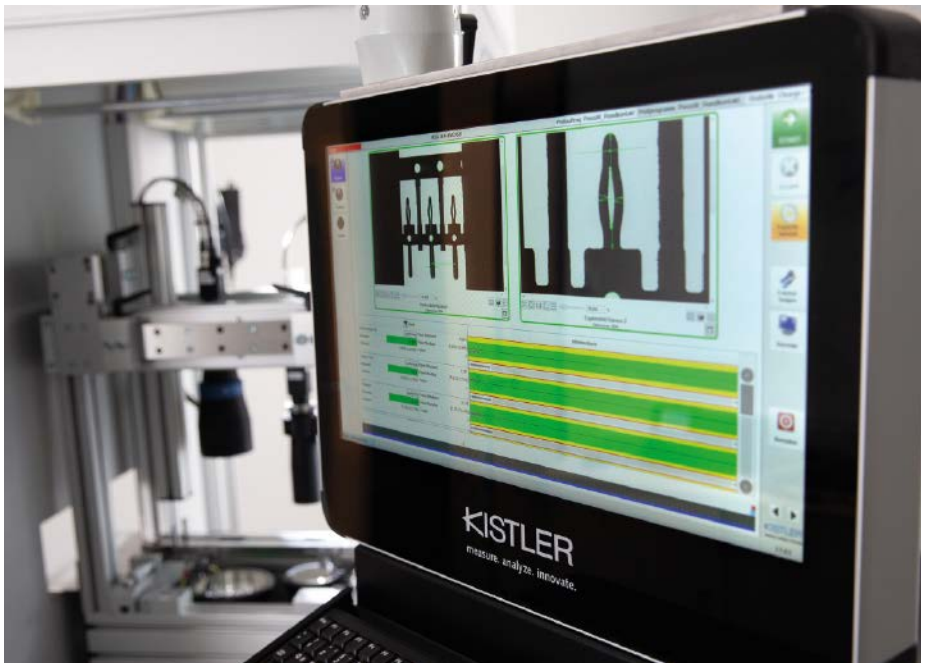
Inspection Process Reliability: the Machine Monitors Itself

To ensure that the individual inspection systems and sensors fulfill their tasks as required and that no produced part leaves the line untested, manufacturing companies need a strategy for both the testing and the safety of the process. To achieve this, the interaction between the individual components and inspection steps must be precisely defined, as well as the consequences if one of the process steps fails.

Use case: Every Process Step is Fully Monitored

An example from the inline inspection of series-produced components using the Kistler KVC 621 SE optical quality inspection system illustrates what such a concept might look like. This compact testing system for punched metal components can perform an optical inspection of up to 4,000 parts per minute to check for dimensional accuracy and surface defects such as scratches or dents. Up to three integrated camera stations take pictures of the test part, the image processing software Kivision does the evaluation. Thanks to the tightly knit design for inspection process reliability, it ensures that every part is inspected even at high cycle rates. The built-in camera stations and the software for image processing are connected by the programmable logic controller (PLC). This initiates

The optical quality inspection machine KVC 621 SE has a concept for inspection process reliability that ensures that every single part is inspected.



All images: Kistler

The Kivision software analyzes the inspection images and detects surface defects as well as deviations in dimensional accuracy.

the individual steps such as the recording of the test piece, the data transfer and the evaluation by the image processing software. It also checks the communication between the individual components. The camera, for example, sends the signal to the PLC when an image has been taken and transmits the image to the software.

At this point, a problem can arise that computer users know only too well: parallel processes slow down data processing. If the camera delivers a new inspection image before the inspection of the last one has been completed, it can put additional strain on the software. In such cases, the PLC detects that the expected feedback is not being provided, stops the system and issues an error message to the operators, including the cause of the error. This ensures that the inspection system checks each part and defines its status as OK or NOK.

Another typical source of error when testing punched parts in endless strips is the removal of NOK parts from the strip using a stamp. Here, it is not sufficient to identify a part as defective if it is not subsequently removed. Therefore, sensors monitor the up and down movement of the stamp to check its end position. An additional laser light barrier is also used to ensure that the NOK part has actually been separated – after all, a stamp stroke does not necessarily mean that a part has been completely separated.

Careful design of the inspection processes avoids stumbling blocks

When designing systems and the associated inspection processes, a wide range of potential sources of error that could affect smooth operation come to light. Individual requirements are almost always hidden in production processes which become increasingly complex with a higher level of automation. To ensure a smooth process, it is therefore important to analyze, implement and secure all crucial process and quality assurance steps accordingly. ■

Company in Detail

Kistler Group

Kistler develops and manufactures dynamic pressure, force, torque and acceleration measurement technology. Sensor technology from this Swiss corporation helps to shape future innovations in automotive development and industrial automation, and also in many emerging sectors, such as electrified drive technology, autonomous driving, emission reduction and Industry 4.0. Kistler employs some 2,000 people at more than 60 facilities across the globe. The company was founded in 1959 and in 2024, it posted sales of 448 Mio. CHF. About 9 percent of this figure is reinvested in research and technology.

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Image: Adcole

“Positioning Adcole Sustainably as First Choice”

Interview with Dirk Broichhausen, Managing Director of Adcole, a manufacturer of precision measuring instruments

Dirk Broichhausen has been managing Adcole’s business of measuring instruments in Recklinghausen, Germany, since September 2024. We spoke to him about goals, resilience, niche markets as an opportunity and the future of optical systems.

inspect: What was your goal and vision when you took over the management of Adcole?
Dirk Broichhausen: My goal was and is to maintain proven strategies and product lines and thus remain a reliable partner for our customers and also to further develop the team and introduce new product solutions. My vision is to sustainably position Adcole as the ‘First Choice’ through a healthy mix of continuity, growth and innovation and to offer our customers an attractive range of systems. Specifically, we now want to introduce optical measuring systems in addition to our tactile measuring systems.

inspect: We are currently going through turbulent economic and political times. What is your strategy for strengthening Adcole’s resilience?
Broichhausen: Every crisis also has its opportunities. And I see our opportunity in asserting ourselves as the measurement standard in our niche markets, both in laboratories and in production. When it comes to precision components and accurate measurements, our systems represent the pinnacle of what is technically feasible today and that will continue to be our aspiration in the future. We have a strong presence in the automotive sector, but are also increasingly active in the niche market of energy supply. A new trend here is motor solutions for generators that secure the power supply for AI data centres. AI is finding its way everywhere today and it needs energy–regardless of the global economic crises. This is where precision measurement technology and our measurement systems for motor construction are in demand.

inspect: What fascinates you about measurement technology?
Broichhausen: It has been part of my professional life for many years. Measurement technology always provides a target/actual comparison: What are the dimensions, what should they be? In other words, it shows where we are and defines where we want to go. For me, the exciting question is always: what economies of scale can I derive from my measurements? For example, the question of how I can utilise materials even better and save costs. That’s what fascinates me about measurement technology.

inspect: How does Adcole position itself in the global market for precision measurement technology and what competitive advantages characterise your company over the competition?
Broichhausen: With our cutting-edge systems, we are now achieving measurement accuracies well below 1 µ. Customers tell us that in cases of doubt, they compare measured values that they have measured with systems from other suppliers in production with the Adcole measuring device in the laboratory to be on the safe side. This means that the high-precision market trusts us and we are very proud of that. Our market is not a mass market where products are available on every corner. Our currency is our precise, cutting-edge technology and the trust that can be placed in our systems.

inspect: What products does the Adcole portfolio include and which industries do you address?
Broichhausen: We have specialised in the high-precision measurement of shafts or, more precisely, round shafts. We focus on camshafts, crankshafts, but also on pump shafts and drive shafts for the drivetrain or powertrain for electromobility. We also offer measurement technology for industrial engine construction. As I have already mentioned, the current trend here is large engine construction for generators for AI data centres. We are talking about huge crankshafts that are over 4.50 metres in size. This is a very attractive niche market for us, which is also very challenging because the demands on measuring accuracy are as high here as perhaps only in engine technology for Formula 1.

inspect: Can you give us a brief insight into your high-precision measurement systems for automotive applications and EV drive systems?

» **The high-precision market trusts us and we are proud of that. Our market is not a mass market where products are available on every corner. Our currency is our precision cutting-edge technology and the trust that can be placed in our systems.**

Broichhausen: Our measuring systems are not specifically designed for one application, but are generalised. This means that the customer can flexibly set any shape of shaft, all possible geometries, roundnesses, diameters, lead angles and other quality parameters. Only the length of the shaft is specified. These general systems are produced by our parent company in the USA. We serve the European market from Recklinghausen, Germany. This is where the customising takes place, i.e. we make the customer-specific adaptations so that every customer can implement their exact measuring programme.

inspect: What trends do you currently see in measurement technology and how are these reflected in your products?
Broichhausen: The demands on accuracy are constantly increasing, whether in lorry engine construction, motorsport or large engine construction. Engine components such as crankshafts are being machined more and more precisely by machine manufacturers. Grinding machines are grinding ever more precisely. This means that the measuring technology must also become increasingly precise. Our tactile systems can already deliver measuring accuracy in the micrometre range for diameters and roundnesses. Our goal is quite clearly to enable our customers to produce more and more precisely and efficiently with us.

inspect: You are very familiar with machine vision thanks to your time at Isra Vision. To what extent does machine vision play a role in Adcole's measuring systems?
Broichhausen: It is clear that we also want to market optical measuring systems in the future. That is our strategy and my image processing expertise will of course also play a role in this. We have a new product series, the Optishaft series. This is a camera-based system that we have developed with our partner company QVI. Camera-based systems were the focus at Isra Vision. Adcole is now also entering this market. However, tactile measurement technology will remain the standard in production. Optical measurement technology is a good addition. When it comes to high throughput with very fast, precise measurements, Optishaft is a good choice. Our customers can combine both worlds and, for example, reference data or files from the optical measurement with the data from the tactile system in the measuring room.

inspect: How will the market for precision measurement technology develop in the future and what role will Adcole play in it?
Broichhausen: We are currently investing heavily in software. This means that in addition to high-precision hardware, we are clearly endeavouring to take software to the next level. We will definitely be introducing the topic of AI. In general, we see AI as an opportunity for us to enable many new applications. And we are convinced that AI will bring great benefits for the customer. ■

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inspect WORLD OF VISION

Digital Events 2025

April 16, 2025:

Metrology & Precision Manufacturing

High quality standards and the optimization of production efficiency are at the heart of modern manufacturing processes. Both are crucial for manufacturers to remain competitive.
This event therefore revolves around measurement technology, production software and machine vision – in short: technologies that help to optimize your production.

June 4, 2025:

Machine Vision, Robotics, and AI combined

Only robots with the ability to see can perform complex tasks such as bin picking or handling unsorted objects on conveyor belts. Cameras provide this sense of sight. In combination with artificial intelligence, the range of applications is immense.

June 25, 2025:

Panel discussion: What were the biggest trends at Automate?

At Automate, the largest automation trade fair in North America, numerous innovative products were once again on display or even presented to the public for the first time. The expert panel discusses the highlights and technology trends that emerged at the trade fair.

September 17, 2025:

Protection & safety in automation with robots In co-op with GIT security?

Safe interaction between humans and robots increasingly requires new technologies and solutions. In addition, the closer man and machine get to each other, the higher the safety requirements. In our webinar, we look at the complete safety function so that safe human-robot collaboration can be guaranteed.

October, 2025:

Embedded Vision: From board-level through smart cameras to intelligent vision systems.

This technology day provides information on the latest technology and industry trends, introduces new products and answers the question of which applications require a customized vision system and when a ready-to-use vision solution is the better choice.

Beginning of December 2025:

Industrial Solutions for the Mobile Automation

Robust solutions are in demand in numerous sectors such as agriculture, marine and the construction industry. We present technologies and solutions that increase efficiency and productivity.

Register now and secure a place:

Do you have expert knowledge that you would like to share?

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Do you have an exciting innovation that you would like to present to your target group?

Then the digital events from inspect and messtec drives Automation are just right for you. They allow you to reach over 200,000 machine vision users and integrators, engineers, automation specialists and machine builders worldwide.

Interested? Then get in touch with us.

In addition to these events, we will also be happy to plan an individual webinar with you at a time that best suits your marketing plan.

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