76 963

inspect EUROPE

VOLUME 6
SEPTEMBER 2024
1

www.WileyIndustryNews.com

FOCUS TOPICS

- Vision Trade Fair
- Artificial Intelligence

COVER STORY

How to Make EV Batteries Roadworthy with 3D Sensors

WILEY

Partner of VISION AUTOMATICA Control emva VDMA spectronet

FUJIFILM
Value from Innovation

WHEN IT COMES TO QUALITY, IT'S BEST THINGS AREN'T DONE BY HALVES.

Our high-performance optics are the result of precision lens manufacturing with outstanding coatings, developed using an advanced arrangement of optical elements and robust mechanical design. For uncompromising quality in all areas of application.

More details at www.fujifilm.com.
Fujinon. To see more is to know more.

FUJINON

See You at Vision

The fall trade fair season has begun. The highlight of this tarde fair season from my point of view – and you will probably agree – is Vision in Stuttgart, which is now taking place again after last year's regular break. It starts on Tuesday, October 8. At this point, a small advertising block on our own behalf: If you want to drink the best coffee at the trade fair, you are welcome to stop by the inspect stand respectively the stand of Wiley-Verlag. You will find us in Hall 10, Stand A02, right at the entrance. We look forward to seeing you.

– End of advertising block –

With over 450 exhibitors – around 20 percent more than in 2022 – the trade fair is looking forward to full halls with many innovations and special features. If you want to know more details, read the exciting interview I conducted with Exhibition Manager Florian Niethammer. In addition to the content, I think it perfectly reflects the mood of Vision: professionally organized, but bursting with lightness and good vibes. You can find the interview on page 10 in this issue.

In addition to the cover story, which is worth reading as always, I also recommend the section focusing on artificial intelligence, which starts on page 16. Among other things, it deals with an application in which indexable inserts are handled and inspected with AI support. Because the variety of products is so high and the weekly quantity is in the millions, rule-based image processing was not an option. In short, it is an example of a machine vision application that could not have been fully automated without AI.

Also worth a look are the articles on the track inspection of the Japanese Shinkansen transport network, see page 19, as well as the article from page 20 onwards, which describes the potential applications of machine vision and AI in electromobility.

I hope you enjoy reading this issue. See you in Stuttgart.

Best regards,

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

Contents

12

Cover Story:
Safety First: How to Make EV Batteries Roadworthy with 3D Sensors
Visual Inspection of Weld Seams of EV Batterie
Nina Claaßen

10

„No other trade fair demonstrates so comprehensively what is possible with camera-based solutions“
Interview with Florian Niethammer, Head of Trade Fairs and Events at Messe StuttgartProducts and Processes

Topics

Märkte & Management

Cover Story

Focus Topic

ARTIFICIAL INTELLIGENCE

Vision

Automation

Control

Image: Sick

Joining forces for process automation: Dr. Mats Gökstorp, Chairman of the Executive Board at SICK AG (left), and Peter Selders, CEO of the Endress+Hauser Group.

Sick and Endress+Hauser enter into strategic partnership

Sick and Endress+Hauser have signed a contract for a strategic partnership in process automation. The strategic collaboration includes founding a joint venture that will strengthen and expand the process-related solutions for decarbonization, and the transfer of Sales and Service for process automation from Sick to Endress+Hauser. Provided it is approved by the antitrust authorities as planned, the joint venture will commence operations at the turn of the year 2024/2025. **www.sick.de**

Image: Fraunhofer IPA

Fraunhofer IPA founds Robotics Institute Germany

The Fraunhofer Institute for Manufacturing Engineering and Automation IPA is a co-founder of the Robotics Institute Germany (RIG). The RIG aims to bring together Germany's top research into AI-based robotics. In the future, the RIG is to become the central contact point for AI-based robotics in Germany. 21 renowned robotics locations in Germany will jointly build the institute. These include eight universities, the Fraunhofer IPA, the two Fraunhofer Institutes IOSB and IML, as well as non-university research institutions and associations. There are currently 19 associated partners.

The aim is for the RIG to use robotics to build on innovations in the chemistry, pharmaceuticals and automotive industries that have established Germany as an industrial nation in the past and secured prosperity and growth for decades. The starting conditions are good: experts from Germany are among the international leaders in AI-based robotics and have made significant contributions to the global robotics landscape. Now it is time to pool these valuable resources, strengthen them strategically and develop them into a locational advantage for the German economy. **www.ipa.fraunhofer.de**

Image: Senswork

Senswork opens new building in Asia

The company opens a new service location in Singapore. With the branch, Senswork is responding to the growing international demand in Asia. The location enables the company to offer its Asian customers an efficient service.

„The decision to open a branch in Singapore was a logical step given the increasing demand and existing installations in Asia," explains Roman Rieger, Managing Director and co-founder of senswork. „We want to ensure that we can offer our customers the best possible service locally." **www.senswork.com**

Image: Anke Grytzka-Weinhld/Wiley

SPS with about 1,200 exhibitors in 2024

"We love SPS" is written on the statement shirt worn by Gunnar Mey, Vice President Business Development at Mesago, at the SPS pre-press conference. SPS Smart Production Solutions is also still a firm favorite among companies, "even if some medium-sized companies are taking a break as exhibitors, as the economic crisis has now also reached the automation industry," says Steffen Winkler, CSO of the Automation business unit at Bosch Rexroth and member of the SPS exhibitor advisory board.

Organizer Mesago is expecting around 1,200 exhibitors this year, 720 (60 percent) of them from Germany, 44 fewer than last year. By contrast, participation from abroad has risen by two percent to 480 exhibitors – with China, Italy, the USA, Taiwan and Austria leading the way. Another reason for the absence of some exhibitors is the Electronica electronics trade fair taking place at the same time in Munich. From next year, however, this overlap will no longer exist, as SPS will return to its original date at the end of November. **www.mesago.com**

AMS Osram Completes Sale to Focuslight Technologies

AMS Osram has successfully completed the sale of assets in the Passive Optical Components sector to Focuslight Technologies.The sale price amounts to approximately 45 million euros in cash. Aldo Kamper, CEO of AMS Osram, expressed his satisfaction: "The sale of passive optical components to Focuslight Technologies went according to plan. Exiting this non-core business area is a crucial step in our strategic efficiency program 'Re-establish the Base.'"

The program, introduced on July 27, 2023, aims to focus on the profitable core business and promote sustainable growth. Savings of 75 million euros are expected by the end of 2024, with ongoing cost reductions of 150 million euros by the end of 2025. The sold assets include buildings and facilities in Singapore and Switzerland, as well as research facilities and intellectual property. The sale was announced on May 7, 2024, and has now been completed.

www.ams-osram.com

Edmund Optics focuses on sustainability

Edmund Optics has officially launched its website on the topic. The new website is intended to take all interested parties on the company's journey to becoming a fully sustainable company and provide a platform on which sustainability initiatives, future plans and progress are presented.

Edmund Optics wants to create the greatest possible transparency and share its projects and development steps – with the goal of becoming a sustainable company. The new website offers visitors exciting insights into the company's path towards sustainability, which is based on the three pillars of corporate governance (economic sustainability), workforce (social sustainability) and environmental sustainability. **www.edmundoptics.com**

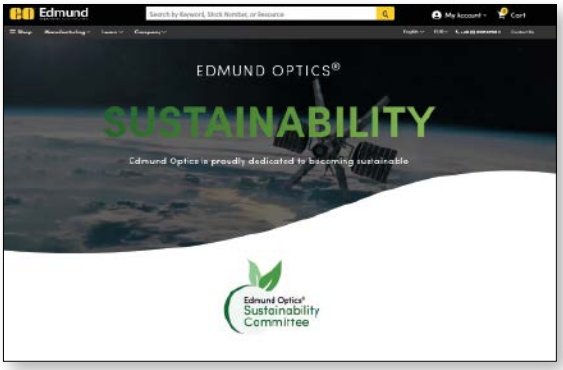


Image: Edmund Optics

Onsemi acquires SWIR Vision Systems

Onsemi has completed the acquisition of SWIR Vision Systems. It's a provider of shortwave infrared (SWIR) colloidal quantum dot (CQD) technology – a technology that extends the detectable spectrum of light to see through objects and capture images that were previously not possible. Integrating this patented technology into Onsemi's industry-leading CMOS sensors will expand the company's intelligent sensor product portfolio and pave the way for further growth in key markets such as industrial, automotive and defense.

The team will continue to be based in North Carolina. The acquisition is not expected to have a significant impact on Onsemi's short- to medium-term financial outlook. **www.onsemi.com**


Image: Neura Robotics

Neura Robotics joins Nvidia Humanoid Robot Developer Program

By combining the Nvidia Isaac robotics development platform with the Neuraverse platform, Neura Robotics aims to accelerate robot development. By accessing Nvidia's technology portfolio, Neura Robotics will leverage its expertise in cobot development to optimize cognitive and humanoid robots using the Nvidia Isaac platform. In particular, Isaac Lab and Isaac Sim will be used to significantly accelerate robot training through a variety of simulated scenarios.

Neura Robotics' product portfolio includes cobots for industrial applications (Lara series), the first cognitive cobot (Maira), mobile robots and manipulators (MAV) and the humanoid robot 4NE-1. This provides robotics developers with a diverse portfolio based on a single AI-integrated platform connected via Neuraverse and benefiting from the capabilities of the Nvidia Isaac platform. **www.neura-robotics.com**


Image: EMVA

The new EMVA Board of Directors elected on June 13th. From left to right Dr. Ronald Mueller; EMVA Treasurer Arndt Bake; Dr. Marco Diani; EMVA President Dr. Chris Yates; Maurice van der Aa; Benjamin Cocquelin; Petra Thanner; Dr. Dirk Berndt; EMVA Vice President Dr. Kai-Udo Modrich.

EMVA: General Assembly Elects New Board of Directors

Dr. Chris Yates continues another term as EMVA President, Dr. Kai-Udo Modrich becomes Vice President, Arndt Bake remains EMVA Treasurer

The General Assembly of the European Machine Vision Association (EMVA), which took place prior to the 22th EMVA Business Conference, has elected the new EMVA Board of Directors consisting of nine members. During the constituent meeting the new elected Board of Directors voted for Dr. Chris Yates as EMVA President. Dr. Kai-Udo Modrich will serve his first term as Vice President and Arndt Bake will again be EMVA Treasurer.

The 23nd EMVA Business Conference takes place from May 22th – 24th, 2025 in Rome/Italy. **www.emva.org**

Smart Vision Lights CEO Dave Spaulding to retire

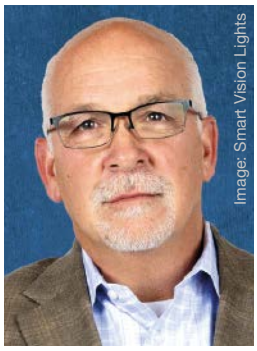


Image: Smart Vision Lights

Dave Spaulding, CEO of SVL

The President and CEO of Smart Vision Lights, Dave Spaulding, will retire at the end of 2024. Steve VanderZwaag, currently Vice President of Engineering, will replace him.

Under the twelve-year leadership of Dave Spaulding, Smart Vision Lights expanded into new markets and launched many new products. During this time, the lighting manufacturer's market share and sales increased significantly while fostering a culture of innovation and customer focus. Steve VanderZwaag joined Smart Vision Lights in 2020, initially leading the development and launch of the new electronic assembly department. VanderZwaag was promoted to Vice President of Engineering in 2023 and has more than 25 years of experience in various business areas, including key engineering and quality leadership positions. **www.smartvisionlights.com**


Image: PNO

Loyst is the IO-Link Community's second IO-Link test laboratory in Asia. Presentation of the official document to the two specialists from China is shown here (from left to right: Franz-Otto Witte, Li Bo, Frank Moritz, Wang Jun and Klaus-Peter Willems).

Second IO-Link test lab in China

China-based Nanjing Loyst Industrial Networks is officially recognized as a new IO-Link test laboratory. "We're pleased to have increased the number of IO-Link test labs around the world to four thanks to Loyst," commented Frank Moritz, Member of the Board of Directors of Profibus & Profinet International (PI). Loyst is one of the most active members of IO-Link China and the second test laboratory outside of Germany.

IO-Link competence centers and test labs not only assist in spreading IO-Link technology, but also ensure the high quality of IO-Link devices. While competence centers advise users, manufacturers and potential new members on organizational and technological issues, the test labs conduct conformity tests on IO-Link devices and IO-Link masters. Loyst is now authorized to conduct IO-Link tests independently and enable manufacturer declarations based on the test reports. **www.profibus.com**

Manufacturer in Taiwan uses MVTec software illegally

MVTec believes it has been harmed in a case of infringement of its intellectual property. The starting point for this is the opening of criminal proceedings by the public prosecutor's office in Taiwan against the company Largan, listed on the Taiwanese stock exchange under number 3008, and its employees. Largan is one of the world's largest suppliers of camera lenses for smartphones.

In order to clarify the matter, MVTec is working closely with the authorities in Taiwan to find a solution that is fair for all parties. So far, Largan has refused to reach such a fair and amicable agreement.

www.mvtec.com

Image: Basler

BU: Dr. Michael Suppa (Roboception) and Hardy Mehl (Basler) are looking forward to further cooperation.

Basler participates in Roboception

Basler AG has acquired 25.1 percent of the shares in Roboception GmbH as part of a strategic investment and capital increase. With innovative hardware and software products, Roboception is a pioneer in the field of intelligent 3D sensor technology and thus provides key elements for flexible automation solutions.

The two companies have had a sales cooperation since 2021 and have worked intensively together in the development of 3D image processing solutions that enable robotic systems to reliably capture and analyze their environment. **www.baslerweb.com**

Image: Zeiss, Arrtec 3D

Zeiss Software and Artec 3D become partners

Together, the two companies provide 3D scanner users with a range of new measuring instruments. A combined inspection solution will enable engineers to tackle more complex challenges in industrial, automotive, aerospace and many other areas. Combining Zeiss software with Artec Studio software will enable users to resolve deviations faster, automate processes, increase productivity and implement new standards in inspection.

Initially, the partnership will focus on Zeiss Inspect Optical 3D and Zeiss Reverse Engineering. This software is designed to quickly go from scan to CAD and ensure that products meet the respective standards. It is now available directly from Artec 3D and can be customized with Zeiss' Airfoil and Tool Correction apps. **www.zeiss.com**

Image: Hexagon

Digital twin helps German community achieve climate goals

Hofbieber is working with Hexagon to develop a municipal digital twin that will accompany and monitor the municipality's progress towards climate neutrality by 2030. In addition to achieving its climate goals, Hofbieber is also aiming for other effects through modern environmental and city management, which is made possible by the digital twin's modeling, such as higher property values, lower insurance premiums, stronger economic development and growth in tourism. By monitoring $C0_2$ emissions using the digital twin, Hofbieber can monitor its progress and compare it with other communities. The digital twin can also be programmed to simulate flood risks, heat islands, urban air currents, traffic and much more in the future. **www.hexagon.com**

„No other trade fair demonstrates so comprehensively what is possible with camera-based solutions“

Interview with Florian Niethammer, Head of Trade Fairs and Events at Messe Stuttgart

In the run-up to Vision in Stuttgart, Exhibition Director Florian Niethammer reveals details of the current number of exhibitors, this year's special features and also provides a forecast for the development of the leading international trade fair for industrial machine vision.

inspect: What do you look forward to most when you think about the vision?
Florian Niethammer: First and foremost, there is clearly the anticipation of welcoming the Vision community, many friends, old and new faces here with us in Stuttgart. I am particularly pleased to see that Vision is developing positively in the direction of the figures we saw before Covid.

inspect: What are the main tasks you need to tackle now so that everything is ready for October 8-10?

Vision covers the entire field of industrial machine vision. In addition, there are two lecture forums – one with an industry focus and one with a research focus – as well as a further supporting program.

Niethammer: The final spurt phase of preparation is a very special time for us: we do everything we can to make the trade fair appearance as uncomplicated as possible for our exhibiting companies, which means preparing them in advance in the best possible way, supporting them with questions and topics and thus ensuring that everything runs smoothly during the trade fair. This phase is also about making everything that was planned on paper a reality in the exhibition halls. This also includes the program accompanying Vision, with the two lecture forums – the Industrial Vision Days and Scientific Vision Days, the presentation of the Vision Award, our Guided Tours and our traditional Exhibitor Get-Together. And last but not least, the aim is to attract many new users of machine vision technology to the upcoming Vision.

inspect: In your opinion, what is the main reason for visitors to travel to Vision in Stuttgart?
Niethammer: Vision, the world's leading trade fair for machine vision, brings the technology of the future to life. Visitors to Vision will discover the innovations, trends and new products in machine vision and learn all about the technologies of tomorrow such as embedded vision, 3D, hyperspectral imaging, AI and deep learning. In addition to key players in the industry from all over the

world, there will be numerous innovative start-ups to discover as part of our Start-Up World. The world's largest lecture forum for machine vision technology, the Industrial Vision Days, will be expanded this year with the Scientific Vision Days. This will focus specifically on research topics. In addition, we will be offering guided tours of Vision specifically for potential new users from the electronics and semiconductor, food and beverage and logistics industries. The aim is to establish contacts with relevant players and solution providers in the industry. In short, I would say that probably nowhere else will you find such a comprehensive overview of what is possible with camera-based solutions.

inspect: How many kilometers will you walk from 8 to 10 October?
Niethammer: Very good question, I've never actually measured that before. But it will certainly reach the famous 10,000 steps per day. But that's also good additional training and suits me, as I'm currently preparing for a marathon. This will take place, how could it be any different, directly on the weekend after the Vision.

inspect: Do you have any current figures on registered exhibitors etc.?
Niethammer: The figures are already incredibly promising: we have already exceeded the 450 company mark and the popularity continues unabated. We are receiving more inquiries every day. Compared to the previous event, we will grow by more than 20 percent in terms of exhibiting companies (editor's note: Vision had 378 exhibitors in 2022). Despite consolidation and M&A activities, we can see that the market for image processing and machine vision is a very attractive field for many new companies. For example, we count a 25 percent share of new companies exhibiting at Vision for the first time. The international relevance of Vision can be seen from the following figures: Exhibiting companies travel to Stuttgart from 36 countries and, even more impressively, more than two thirds of all exhibitors come from abroad – more than ever before in the history of the trade fair.

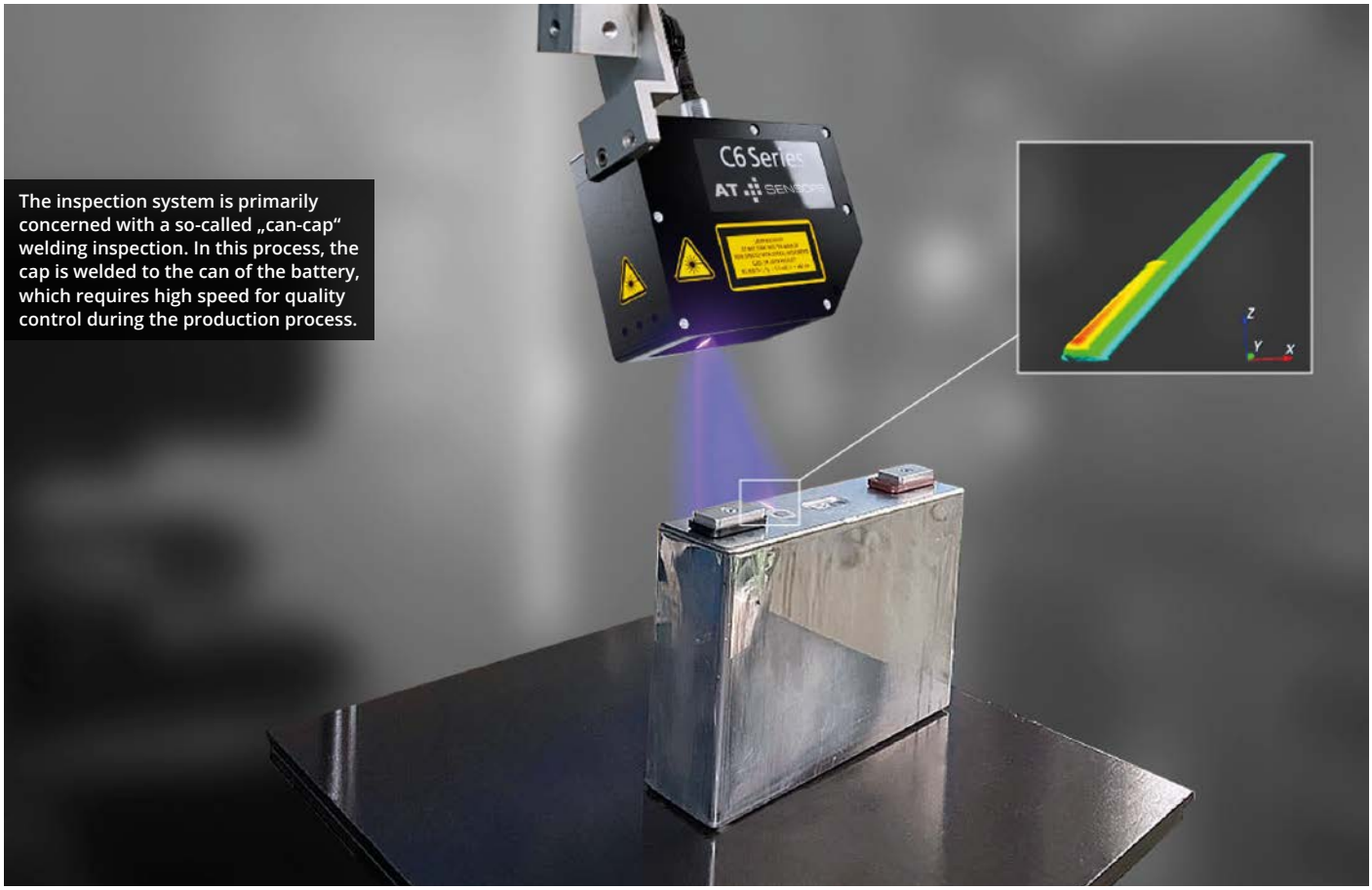
This year, Vision, the world's leading trade fair for industrial machine vision, will take place from October 8 to 10.

inspect: Vision 2022 attracted 6,500 visitors, compared to around 5,400 the year before - both figures are well below the 11,000 trade visitors who came in 2018, i.e. before the pandemic. Do you think the figures will stabilize at this level or do you expect further growth to reach the old level?
Niethammer: The development in exhibitor numbers and the recent positive trend in visitor numbers are, in my view, an indicator that we are also moving in the right direction again in terms of visitor numbers and that we are heading in the direction we came from. Machine vision technology has by no means arrived in all industries and applications where it will provide enormous benefits in the future and the potential is great. After two Vision trade fairs at extraordinary annual intervals, Vision 2024 is now once again the first edition with a lead time of two years. This will also have an effect on the interest and demand of potential visitors, who will once again have the opportunity to experience the latest products and trends live and on site in October after a two-year break. ■

AUTHOR
David Löh
Editor-in-Chief of inspect

CONTACS
Landesmesse Stuttgart GmbH,
Stuttgart, Germany
Tel: +49711 185602541
Email: florian.niethammer@
messe-stuttgart.de
www.vision-messe.de

all images: Messe Stuttgart



The inspection system is primarily concerned with a so-called „can-cap" welding inspection. In this process, the cap is welded to the can of the battery, which requires high speed for quality control during the production process.

Safety First: How to Make EV Batteries Roadworthy with 3D Sensors

Visual Inspection of Weld Seams of EV Batteries

Electric vehicle (EV) batteries are crucial for powering electric motors, making their quality inspection vital to avoid safety risks like malfunctions and short circuits. A new solution for welding inspection of EV batteries has been developed, focusing on precise and reliable inspection of weld seams. This ensures the structural integrity, safety, and reliability of the batteries, which are essential for their performance and longevity.

Malfunctions, short circuits, chemical leaks: these are all serious safety risks that need to be avoided when it comes to electric vehicle batteries, or EV batteries for short. EV batteries are batteries that have been specially developed for storing energy in electric vehicles (EVs). These batteries are at the heart of electric vehicles, as they store the electrical energy needed to power the electric motor. This makes it all the more important to check the quality of these batteries, as these inspections not only minimize safety risks, but also increase the longevity and efficiency of the products.

This is exactly where the northern German technology company AT – Automation Technology comes into play, which has been developing and producing high-quality 3D components for more than 25 years and belongs to the global players in innovative 3D sensor technology. Together with its sales partner Fainstec, AT has come up with an application solution for the integrator Global Engineering Solutions (GES) in Korea, which involves the welding inspection of EV batteries. GES, which specializes in manufacturing systems for the quality control of electronic and energy components, came into contact with Fainstec as part of a search for a suitable 3D sensor for this very welding inspection. Their requirement: the integration of a product with which the weld seams of EV batteries can not only be scanned and inspected reliably, but above all precisely.

The Welding Inspection Application for EV Batteries

The GES inspection system is primarily concerned with a so-called „can-cap" welding inspection. In this process, the cap is welded to the can of the battery, which not only requires a great deal of precision, but also a high speed for quality control during the production process. The sensor required should be able to detect the smallest defects of just 0.4 mm in size in the weld seam at a speed of 100 mm/s and at the same time take into account convex and concave areas, punched holes and the shape of the weld seam.

„The challenge was not only to provide a fast sensor, but also one that could react flexibly to different requirements such as shape and curvature and deliver reliable scanning results. Thanks to our many years of experience in the machine vision industry and the advantages of our C6 CS series, which impresses in particular with its excellent combination of precision and speed, we were able to offer GES an optimal solution," says Dr. Athinodoros Klipfel, Head of Sales at AT.

The Korean integrator GES therefore uses two AT sensors of type C6-1280CS35-7 GigE (405 nm, class 3R) for can-cap welding inspection. These offer a high resolution in X (5 µm) and Z (0.2 µm) as well as a profiling speed of up to 140 kHz. Furthermore, the C6 1280 sensors with a laser line width of 19 µm ensure precise and fast data acquisition as well as easy integration into any system thanks to its standard GenICam interface.

The Reason for the Welding Inspection of EV Batteries

Welds play a crucial role in the production of these vehicle batteries in many ways, as they contribute significantly to the structural integrity, safety and reliability of the battery packs. The battery cells in an EV battery pack must be firmly and securely connected to each other to withstand vibrations, shocks and other mechanical stresses that occur during vehicle use. Welded seams therefore ensure that the cells are securely fastened in the housing and prevent them from coming loose or shifting. They also protect the battery from external influences such as moisture, dust and other contaminants, so that no corrosion or short circuits occur. Another aspect is the electrical connection of the individual cells in the EV batteries. The weld seams must also be robust and reliable at this point in order to ensure a stable power supply and prevent overheating or electrical failures. And finally, the consistency of the weld seams is of course also crucial in the mass production of EV batteries. Automated welding processes that are precisely monitored and tested help to minimize production errors and ensure the safety of the batteries.

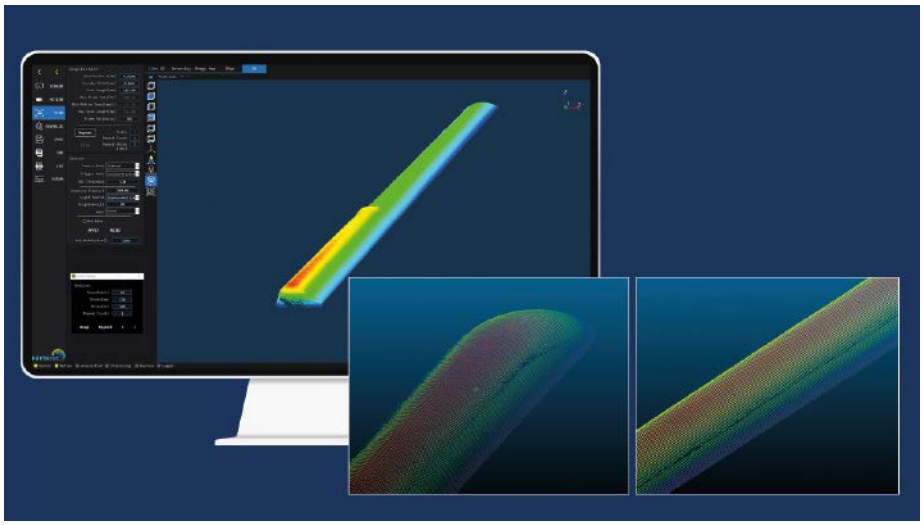
„We have been working with AT since 2017 and are particularly familiar with the quality of their 3D sensors and their good feel for our customers' requirements. The C6 compact sensors used at GES fulfill exactly the requirements that the customer placed on the sensor for their inspection system thanks to their high resolution and profile speed. We were able to score points directly with GES so that they didn't need much time to make their decision," reports Jason Chung, Marketing Assistant at Fainstec.

Application with a Future

Welding Inspection with the AT sensors is now a common procedure that GES successfully uses with numerous end customers who test EV batteries. Thanks to this application, both the product quality of the batteries and operational safety have been significantly improved in various production lines. This application is successfully used in Korea and shows how crucial advanced sensor technology is for the future of e-mobility. ■

AUTHOR
Nina Claaßen
Head of Marketing at Automation Technology

The Korean integrator GES therefore uses two AT sensors of type C6-1280CS35-7 GigE (405 nm, class 3R) for can-cap welding inspection. These offer a high resolution in X (5 µm) and Z (0.2 µm) as well as a profiling speed of up to 140 kHz.



The 3D scan of the weld seam of a prismatic battery recorded with the Fainstec "Clip Studio" visualization software

The C6 1280 sensors with a laser line thickness of 19 µm ensure precise and fast data acquisition as well as easy integration into any system thanks to its standard GenICam interface.

“Without 3D visual inspection, high-power batteries would not be possible to produce”

Interview with Dr. Athinodoros Klipfel, Head of Sales at Automation Technology

Automation Technology, a manufacturer of 3D and infrared components, is to offer not only high-precision but also extremely fast 3D sensor technology in the field of battery inspection. We spoke to Head of Sales Dr. Athinodoros Klipfel about how AT has still managed to maintain its monopoly position in this sector and why there would be no electric cars without 3D sensor technology.

inspect: What are common features that are inspected using (3D) machine vision in battery production today?

Dr. Athinodoros Klipfel: The battery production process involves several critical steps where 3D machine vision plays a key role in ensuring product quality and reliability:

1. Cell Production: During cell production, one of the most important inspection points is the electrode foil. Here, 3D machine vision systems measure the thickness of the foil and detect burrs on the foil edge after the slitting process. Ensuring precise foil dimensions and defect-free edges is crucial for consistent battery performance.

2. Cell Finishing and Quality Control: Once the cells are produced, they undergo thorough quality checks. For cylindrical cells, surface inspection detects imperfections, while prismatic cells require isolating coating inspection. For pouch cells, 3D inspection ensures that surface integrity is maintained, preventing issues that could lead to swelling, leakage, or electrical failure.

3. Welding Inspection: High-precision weld quality inspection is critical, especially for busbars and tab connections, where defects can lead to electrical resistance issues.

4. Module Assembly: As multiple cells are grouped into modules, 3D vision systems verify that cells are correctly positioned and aligned before final pack integration.

Let me give you three specific examples of recent projects in this space where our 3D sensors have been a core part of the solution:

One of our integrators and long term solution partners was challenged with a project to develop surface inspection of cylindrical battery cells for EVs. Other customers of ours developed inspection systems checking the welding on prismatic batteries cover (cap-can application), while others dealt with the inspection of isolating coating.

inspect: How did AT got involved its 3D sensor technology in this very special industry?

Klipfel: Our 3D sensors are famous in the industry for their high profile speed, high resolution and their advanced laser triangulation functionality. AT got involved in this very special industry as battery manufacturers sought high-performance 3D inspection solutions for their production. System integrators and OEMs developing inspection systems had the need to use AT sensors in order to fulfill the requirements of those applications.

inspect: Why should customers choose AT instead of products from the competition?

Klipfel: The 3D sensors of AT feature an unprecedented combination of high profile speed and high resolution enabling the development of fast and precise inspection systems. Thanks to their modularity they can be adapted and optimized to perfectly meet the requirements of any application. System integrators and OEMs can be benefited from the use of AT sensors by maximizing the performance of their inspection systems and by shortening their time to market.

inspect: How did you manage it to develop a 3D sensor which generates high density scans?

Klipfel: We have developed our own laser triangulation imager with 3K resolution and on-sensor processing, which allows capturing 3D profile data at a galactic speed of up to 140 kHz. The technology is called Widely Advanced Rapid Profiling (WARP) and it is unique in its kind. WARP enables the generation of high density 3D scans for use in a broad range of inspection applications.

inspect: What role does 3D visual inspection play in battery production?
Klipfel: Without 3D visual inspection, high-power batteries as we know them today would not be possible to produce. Without 3D inspection, manufacturers run the risk that critical defects, such as misaligned components, poor weld quality, coating irregularities, or microscopic burrs on electrode edges, go undetected, leading to reduced performance, safety hazards like short circuits, and ultimately, costly recalls or even catastrophic battery failures in the field.

inspect: And vice versa: What role does electromobility currently play as an application for AT sensors?
Klipfel: Electromobility currently plays a major role for the AT sensors, as most 3D inspection applications require high speed laser profilers generating high density 3D scans. AT is the only brand in the market offering 3D sensors that fulfill those requirements.

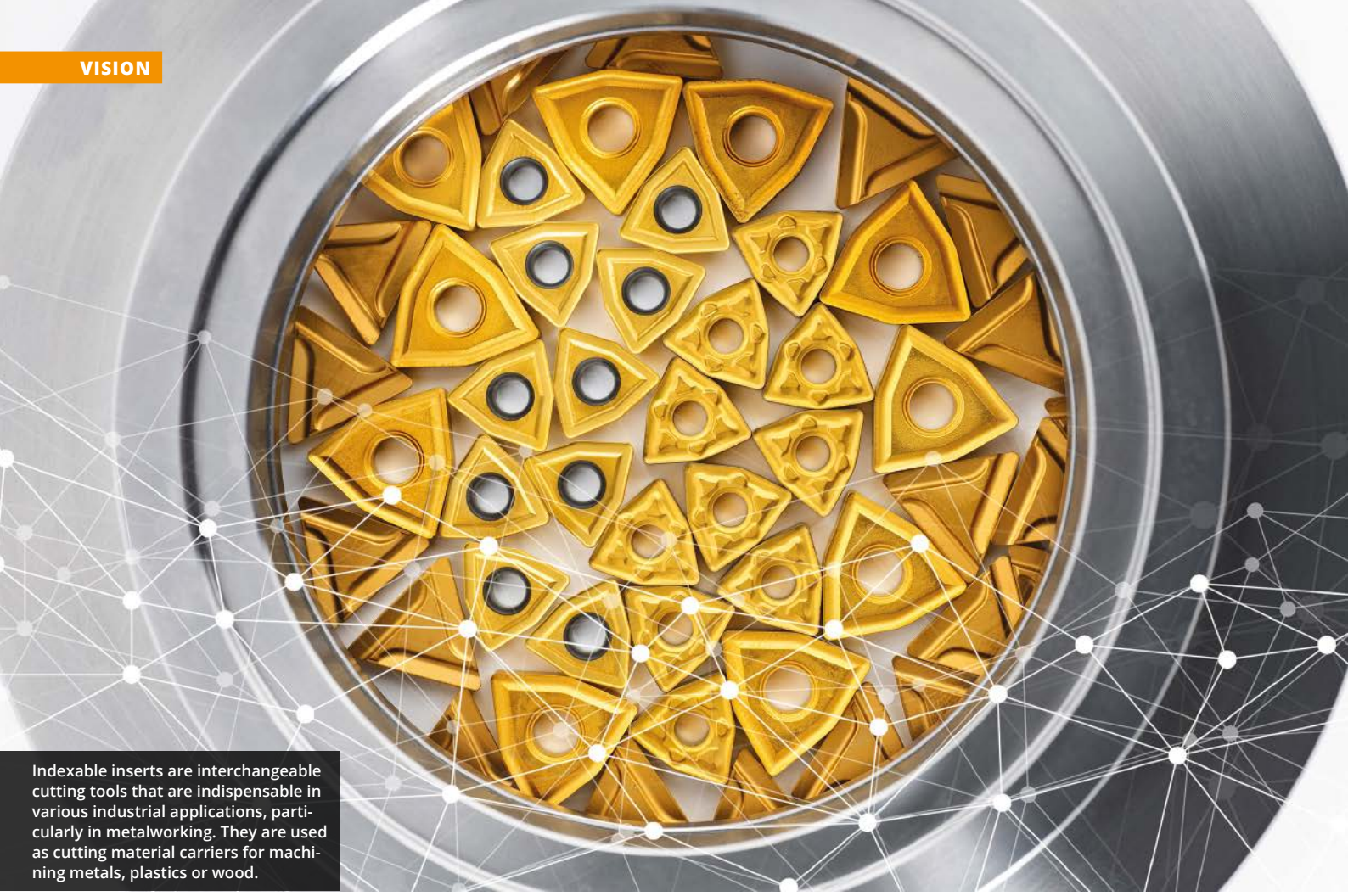
inspect: In Europe at least, the recent sharp rise in growth rates for e-car sales has not been maintained. How do you think the market for 3D machine vision will develop with regard to electric car parts inspection?
Klipfel: While the growth rate for electric vehicle (EV) sales in Europe has recently leveled off, the long-term trend remains clear: the global transition from internal combustion engine (ICE) vehicles to EVs is inevitable. This shift will continue to drive the need for high-precision inspection technologies, including 3D machine vision.

Beyond batteries, many other critical electric car parts also rely on advanced inspection systems. For example, connectors, wiring harnesses, and electronic control units (ECUs) need detailed inspection, often with 2D, thermal, or hyperspectral vision. Structural components like aluminum housings for electric motors and inverters also require dimensional and surface checks to ensure proper fit and performance. The demand for 3D inspection is particularly strong in areas like battery production and assembly, but comprehensive quality control across all these parts is essential to ensure reliable and safe EVs.

Even though the growth rate has slowed in the short term, we expect continued investment in EV production technologies as the automotive industry pushes toward electrification. This shift involves not just expanding production capacity, but also upgrading existing manufacturing lines and introducing new designs. As battery technology evolves – moving towards solid-state batteries, for instance – the complexity and precision required in manufacturing will only increase, driving sustained demand for advanced inspection solutions. ■

CONTACTS
AT – Automation Technology GmbH,
Bad Oldesloe, Germany
Tel: +49 4531 880110
Email: info@at-sensors.com
www.at-sensors.com

all images: Automation Technology



Indexable inserts are interchangeable cutting tools that are indispensable in various industrial applications, particularly in metalworking. They are used as cutting material carriers for machining metals, plastics or wood.

Trained Quickly, Inspected Swiftly

Handling and Defect Inspection of Indexable Inserts

Xactools uses AI to improve the inspection of indexable inserts. Their automated system for a Scandinavian manufacturer ensures zero-defect production, handling and inspecting 2,800 different products or 1.2 million inserts weekly with over 99 percent accuracy.

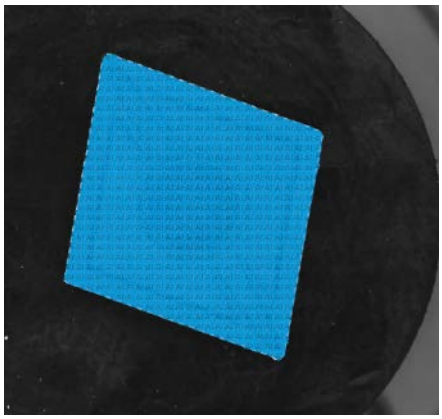
Indexable inserts are interchangeable cutting tools that are indispensable in various industrial applications, especially in metalworking. They are used as cutting material carriers for machining metals, plastics or wood. Their manufacture requires high-precision production processes to ensure an exact geometry and perfect surface finish. Even minimal deviations affect not only the service life but also the performance of the cutting insert. The smallest defects that are invisible to the human eye can cause immense damage, for example when milling or cutting high-quality components – including consequential costs. Careful quality control is essential to ensure that only flawless indexable inserts leave the production process and meet the high requirements in terms of durability and reliability. A flagship project by automation and measurement technology specialist Xactools from Germany demonstrates how artificial intelligence can help visual inspection make quantum leaps. The German medium-sized company has developed a fully automated handling and inspection system for a global manufacturer of indexable inserts based in Scandinavia, in which the Denknet solution for AI-based image evaluation plays a decisive role and sets new standards in terms of performance, zero-defect production and speed.

Inspecting 1.2 Million Parts Per Week

Around 1.2 million indexable inserts leave the Scandinavian company's production halls every week, which have to guarantee the highest possible process reliability and maximum productivity in the metalworking, automotive and aerospace industries, for example. They are manufactured using the sintering process, in which powdered metals, hard metals and other materials are pressed into the desired shape and then sintered, i.e. bonded together under heat and pressure. The strong and robust structure created in this way makes it possible to combine materials with different properties in order to achieve the desired cutting and wear resistance properties. After the sintering process, the edges of the indexable inserts are rounded and ground, and their surfaces are blasted, ground and coated.

The Robotvision system from the Swabian engineers is used directly after the second manufacturing step, the sintering process. „The earlier defects are detected in the process, the better and cheaper it is to rectify them," says Marvin Krebs, Director Technical Sales at Xactools, explaining the system's position. A total of eight high-resolution industrial cameras and two spider robots are used to handle and inspect the indexable inserts for defects, which keep an eye on and load three rotary table nests and finally one pin pallet each. Denknet's AI forms

The AI recognizes the contour of the indexable inserts and also differentiates between OK and NOK for new parts.



Contour detection from below after picking up from the crucible and before placing on the first round table nest

Detection of the component center from below for position correction before placement on the pin pallet

the heart of the complex image processing system between cameras, robots and a multi-GPU computing rack.

Automate Handling and Defect Inspection for 2,800 Products

As versatile as the areas of application of the small tool parts are, so varied are their properties and geometries. This manufacturer alone has around 2,800 products in its portfolio, which can be divided into almost one hundred geometry families. The aim was to automate handling and defect inspection for all of these. „The first challenge results from the numerous color variations within the powder per pressing process," explains Marvin Krebs. „If certain parameters such as time, pressure or positioning vary, this leads to color or gloss level deviations or to a different distribution of speckles on the surface, but this is not a defect." The AI-based image evaluation software used had to be trained to correctly recognize the numerous possible color deviations of the surfaces and rate them as „OK". On the other hand, the smallest irregularities such as cracks, scratches, inclusions or other anomalies must be recognized as such and classified as „NOK". The inspection of metal surfaces is considered one of the highest skills of surface inspection, as their texture can be matt, shiny or even reflective. „The AI had to be extremely trained to variations and lighting conditions for this application," emphasizes Krebs.

But in addition to the visual appearance, it is also about the insert geometry. Categories such as triangle, rectangle, rhombus or square can be found in countless variations due to the smallest deviations and are therefore divided into manageable subcategories, so-called geometry families. Xactools made the pre-selection for the training of the meshes; almost one hundred geometry families were defined and then taught in by the manufacturer itself. What sounds like a laborious undertaking was done surprisingly quickly. „No more than 20 to 30 images were needed to teach each geometry family," recalls Krebs. The Denknet palletizing AI used for this purpose uses the Denknet segmentation and classification network. The customer himself trained the customized image analysis solution with the Denk Vision AI Hub. The AI was integrated into the production line in just a few months and achieved almost perfectly reliable results for the metal components to be tested right from the start. „Indexable inserts identified as defective are sorted out and grouped according to the size and position of the defect. The AI image analysis detects more than 99 percent of production errors," adds Daniel Routschka, Sales Manager Artificial Intelligence at IDS Imaging Development Systems.

But How Exactly does the System Work?

A total of eight cameras with resolutions between 5 and 30 megapixels provide live images of the indexable inserts, which are positioned by magnetic or interchangeable grippers. For example, a camera records the individual indexable inserts from below and from above in order to check them for surface defects. Two other cameras check their cutting edge. A lighting screen measuring 1 x 1 meter provides extremely high illumination at the palletizing stations. „The system detects defects in the thousandth of a millimeter range," emphasizes Marvin Krebs.

This ensures that no damage is caused to the high-end surfaces to be processed later. This is because „uneven and faulty milling processes can potentially impair profitability and competitiveness", as the manufacturer also knows.

To prevent this from happening during the production process and to exercise the greatest possible caution, the system also records images of the contour and position of the panels after inspecting the surfaces and edges.

It can see exactly where and in which rotational position the indexable insert is positioned so that the magnetic gripper can finally place it on pin pallets. To ensure this, the gripper, to which the indexable insert is attached, moves over a camera that detects the exact position of the hole from below. At the same time, the contour of the insert and the outer edge of the gripper are detected in order to correct the position of the indexable insert and hit the pin if necessary. In addition, each individual pin position is detected in order to recognize bent and broken pins so that they are not palletized in the first place.

„The system has been running for six months and the self-learning, global AI now recognizes parts that it has never seen before. After just three to four months, new versions of indexable inserts no longer had to be trained for inspection. The underlying geometry is no longer relevant for the AI; it knows the contour and can also differentiate between OK and NOK for new parts," explains Krebs.

AI Image Analysis with 99 Percent Picking Efficiency

For Marvin Krebs, the added value of the Denknet system compared to conventional image processing is obvious: „Without AI, the creation of part families and defect detection would be completely unthinkable. With rule-based image processing, the robot would also recognize parts within the standard range as NOK and sort them out." In addition, thanks to the Vision AI Hub, no hard coding is necessary, and the flexibility of the networks was another selection criterion for the software. „We were able to easily embed the palletizing AI and several object classes for defects into our own Xactools image processing software via an API," says Krebs.

However, the performance of the solution is high. The entire inspection process takes place in a cycle time of four seconds, with almost 100 percent picking efficiency. The image analysis of live images from eight cameras via a DLL (Dynamic Link Library) requires enormous computing power.

„We work with Denknet for a good reason. The performance is not comparable with that of other providers, it is truly excellent," emphasizes Krebs. „Using artificial intelligence in the most diverse variants on this scale has never been done before." Further variations are currently being tested, for example to further simplify hole detection.

Summary

The extremely varied surfaces and geometries as well as intolerances in the thousandths of a millimeter range make the visual inspection of indexable inserts a supreme discipline that can be transferred to many other demanding applications. The self-explanatory training environment Denknet serves as a simple and at the same time high-performance tool, because it can be operated without programming knowledge and enables the automated training of AI with just a few clicks. A wide range of Vision AI technologies are available for this purpose. "This solution can be customized to any use case and there are no limits – no matter how many 'classes', which camera technology, how large or small the images or even how mixed the data sets are in terms of resolution and type, for example," adds Daniel Routschka, Sales Manager Artificial Intelligence from IDS.

„Over 95 percent of our measuring and testing systems have at least one AI object class integrated. The potential areas of application are getting bigger and bigger for us, the market is growing," confirms Krebs.

AUTHOR
Silke von Gemmingen
Corporate Communications Manager at IDS

CONTACTS
IDS Imaging Development Systems GmbH, Obersulm, Germany
Tel: +49 7134 96196-0
www.ids-imaging.com

all images: Xactools

Track Inspection with AI for Japanese Bullet Train Operator JR Kyushu

AI box processes camera images at high speeds to inspect tracks more efficiently

JR Kyushu Railway Company (JR Kyushu), a Japanese bullet train operator, is using the a System-on-Module (SOM) to automate track inspection. This AI-based solution replaces traditional methods of inspecting miles of track on foot, creating significant efficiencies by improving the inspection speed, cost and accuracy to meet Japan's stringent railway safety requirements.

Image: AMD

At the heart of the track inspection solution is a vision computing box attached to a cart that inspects tracks at speeds of 12 mph. The box features a high-speed camera that uses the FPGA-based Kria K26 SOM for AI-enhanced pre-and-post data and image processing.

JR Kyushu bullet trains operate across an enormous territory of more than 1,455 miles of railroad tracks, with trains traveling at speeds of up to 161 mph. Safety is the company's number-one priority, requiring diligent track inspections carried out at specified intervals. To increase the efficiency and accuracy of assessments, JR Kyushu chose an AMD-powered solution from Tokyo Artisan Intelligence (TAI), which uses high-speed image processing and AI capabilities to detect and inspect loose bolts and other track issues. "With the new solution from TAI and AMD, we were able to improve the efficiency of conventional track inspection, and we anticipate further improvements in inspection efficiency through future functional enhancements," said Kazuhiro Sakaguchi, deputy manager in the Engineering Division, Shinkansen Department at JR Kyushu.

AI makes inspection more efficient and cost effective

At the heart of the track inspection solution is a vision computing box attached to a cart that inspects tracks at speeds of 12 mph. The box features a high-speed camera that uses the FPGA-based Kria K26 SOM for AI-enhanced pre-and-post data and image processing. The Kria K26 SOM is a compact, all-in-one embedded platform that integrates a custom-built AMD Zynq UltraScale+ MPSoC with DDR memory, nonvolatile storage devices, a security module, and an aluminum thermal heat spreader.

"The most important benefit of AI in this case was reduction of cost," said Hiroki Nakahara, co-founder and CEO of TAI. "Replacing the conventional method of inspecting tracks on foot with carts has led to a dramatic improvement in operational efficiency."

The programmability, durability, and embedded intelligence of the AMD Kria SOM-powered solution also make it adaptable to the unique and changing conditions, geographies, and needs of JR Kyushu's territory and ridership. Since railways are installed in a natural environment, the ability to update the Kria SOM to suit the daily changing natural conditions is critical and helps future-proof investments.

Chetan Khona, senior director of Industrial, Vision, Healthcare and Sciences Markets at AMD, says: "JR Kyushu is a perfect example of how the programmability of Kria SOMs, combined with edge AI computing, can automate processes and enhance operational efficiency across a variety of applications, from machine vision to industrial robotics and AI/ML computing." ■

CONTACTS
AMD, Santa Clara, California, USA
www.amd.com

Optimizing quality inspection increases the life of the battery and the ability of the battery to hold a charge for longer periods of time.

Image: Phonlamai Photo/Shutterstock

Machine vision and AI continue to drive battery production for electric vehicles

Quality Assurance Improves Products and Processes

Electric vehicles (EVs) stand out as key players in the transition towards a sustainable future. Machine vision inspection and artificial intelligence (AI) are game changers for the industry – for example in the inspection of battery packs.

Globally, 10 percent of passenger vehicles sold in 2022 were all-electric, according to analysis conducted by the World Resources Institute using data from the International Energy Agency – this is 10 times more than just five years prior. Factors such as the cost of EVs, their range on a single charge, and the amount of time it takes to recharge the battery all play into the growth trajectory. Experts predict that when it becomes cheaper to buy, own, and operate an EV than a traditional gas-powered vehicle, the technology will reach a tipping point and the growth trajectory will rapidly curve upward.

Trends in Electric Vehicles and Lithium-Ion Batteries

As the demand for EVs continues to grow, it's imperative to delve into the heart of these vehicles – the battery pack. The most widely used type of battery for EVs today are lithium-ion battery (LIB) packs due to their high energy density and voltage, stability, low weight, and long-life cycle. Many LIBs use cylindrical cells because they are mature and less expensive to manufacture. Since 2008, there has been an 89 percent drop in the average cost of an EV LIB pack, from 1,355 USD/kilowatt-hour (kWh) to 153 USD/kWh in 2022, and this is expected to decrease even further to 100 USD/kWh by 2026.

Cylindrical cells were one of the first types of mass-produced lithium battery types, and are made up of sheets of anodes, separators, and cathodes that are sandwiched and rolled up. These cells are well-suited for automated manufacturing, and the shape allows the cell to tolerate a higher level of internal pressure without deformation.

These cells are then encased in a clam-shell-type plastic enclosure to make up a module. Multiple modules then make up the battery pack that powers an EV. Hundreds to thousands of battery cells are needed for each vehicle and the battery pack is a key determinant of the weight and expense of the final vehicle.

LIB Manufacturing and Inspection

Alan Eddy is the Chief Technology Officer at Tensor ID, a systems integrator that works with the industry's largest lithium-ion battery manufacturers and leading EV companies. He explains, "When inspecting batteries that power electric vehicles, the inspection system must address multiple challenges, including a thorough inspection of each battery cell for issues like rust or dents. When one cell is damaged, it diminishes the life of the whole battery pack."

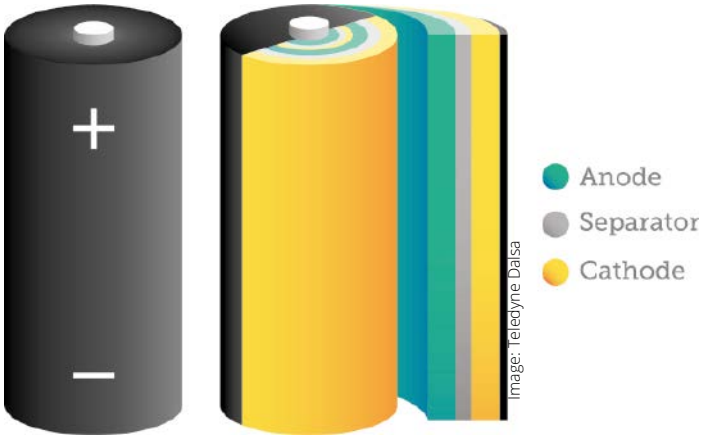


Image: Teledyne Dalsa

Inside a cylindrical Lithium-ion battery

Image: Tensor ID

AI improves inspection performance and is used to identify rust. Tensor ID uses four high-resolution cameras from Teledyne Dalsa to inspect the battery module.

The manufacturing process for LIBs involves intricate steps, from sourcing raw materials to assembling cells and packaging the final battery packs. Detailed quality inspection during this process is crucial to ensuring battery efficiency and safety. It also presents significant challenges due to the variability in production and the potential impact of defects on performance and safety. Identifying internal defects, especially microscopic ones, is a daunting task. This is where machine vision and AI enter the scene.

Machine vision inspection systems can analyze intricate details with unmatched accuracy, speed, and efficiency, resulting in EV battery packs that perform at the highest possible level. Optimizing quality inspection increases the life of the battery and the ability of the battery to hold a charge for longer periods of time.

Tensor ID creates machine vision systems for the inspection of EV battery cells and modules at any stage of inspection, including manufacturing and assembly. Their vision inspection system uses four Teledyne Dalsa Genie Nano area scan cameras to inspect each battery cell at the individual level, and as they're completely assembled just before they put the clamshell casing over it. The battery manufacturers are concerned about issues such as reading the barcode, identifying rust and dents, and determining polarity. When it comes to the inspection of rust, an AI-based software platform is used to classify the images. "AI has been a real game changer when it comes to the inspection of batteries. Rust is particularly difficult to identify accurately due to the shiny, reflective surface of the battery cells," says Eddy. Tensor ID's system trains the AI model with Teledyne Dalsa's Astrocyte AI training tool to recognize the difference between rust and other anomalies, such as a fingerprint or speck of dust. The system can then identify and remove any battery cells with rust on them, as this erosion of materials damages the battery's effectiveness.

Beyond inspection, AI is also poised to play a significant role in optimizing battery performance. AI-driven algorithms can analyze vast amounts of data to fine-tune battery management systems (BMS), improving efficiency and extending the lifespan of batteries. Smart charging, guided by AI, is another area where technology is expected to have a substantial impact for consumers, making the charging process more intelligent and convenient for EV drivers.

Future Trends in Batteries and EVs

As technology continues to advance, the future of electric vehicle batteries looks promising. Some key trends to watch include the development of solid-state batteries, which offer improved energy density and safety. Next-generation materials are also being explored to enhance the performance and sustainability of batteries. The current average range of an EV is approx. 350 kilometers, but cobalt-free batteries could have a range of up to 800 kilometers on a single charge and new solid-state batteries are being tested that could charge in just seven minutes.

Beyond technological advancements, the industry is also focusing on sustainable practices in battery manufacturing. This includes exploring innovative recycling methods to minimize environmental impact and embracing a circular economy approach, where materials from old batteries are repurposed for new ones.

Replacing internal combustion engines with electric engines or hybrid engines can reduce pollution all over the world. To succeed with a transition to EVs, manufacturers know they must focus on ensuring the highest quality LIBs, since they are one of the most important and the most expensive components of electric vehicles.

In the dynamic landscape of electric vehicle battery manufacturing, machine vision inspection emerges as a transformative force. By combining the precision of AI with the demands of quality control, machine vision ensures that battery packs are not just powerhouses but reliable, safe, and efficient ones. The integration of AI, the development of cutting-edge battery technologies, and a commitment to sustainability promise to reshape the EV industry, making it not only a cleaner choice for transportation but also a smarter and more reliable one. ■

AUTHOR
Matthias Moser
Business Development Leader
at Teledyne Dalsa

CONTACTS
Teledyne Dalsa, Krailing, Germany
Tel: +49 89 89545730
Email: sales.europe@teledynedalsa.com
www.teledynedalsa.com

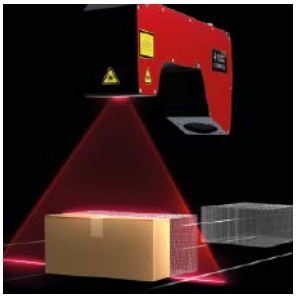


Bild: Automation Technology

3D sensors with high performance

Automation Technology is expanding its ECS series with the new 3D sensor ECS 4090, which was specially developed for applications in the food and logistics industry as well as for robot vision. The ECS 4090 has a significantly larger field of view of either 284, 575 or 1,020 mm, which makes it suitable for a wide range of applications.

Furthermore, the ECS 4090 offers twice the pixel resolution compared to the previous 2040 model, which enables greater precision while maintaining the same accuracy. And with its class 2M laser (660 nm), the ECS 4090 can be used and operated without any problems and without any special laser protection measures.

By supporting standard interfaces such as GenICam and GigE Vision, the ECS 4090 can be seamlessly integrated into existing systems. **www.at-sensors.com**

Bild: Autovimation

Mount Cameras well Protected

Autovimation will present at Vision products for the installation and protection of cameras and IBV technology in industrial applications. Two developments of established camera protection housings will celebrate their premiere there: The Lizard, based on the Salamander series, offers a tube that can be dismantled without tools for easy access to the lens settings. The Quick-Lock/Heat-Guide camera attachment ensures good heat dissipation and allows the lens to be moved directly behind the viewing window. The new Sparrow from the Colibri housing family is cost-effective. It offers a flat lid and a housing extension and also makes it easier to reach the lens. The manufacturer is adding variants and accessories such as a pneumatic protective flap for a clear view in dirty environments to its new Elefant housing series, which is suitable for camera cross-sections up to 100 x 100 mm. As an air-conditioned variant of this series, the Turtle with Peltier element is now also available in a long version with an internal length of 250 mm. In addition, Elefant protective housings are now available with built-in water cooling. **www.autovimation.com**

Bild: SVS-Vistek

Camera Family Expanded to Include 25GigE Models

SVS-Vistek has integrated the 25 GigE interface into various industrial cameras of the FXO family, covering resolutions from 1.8 to 24.6 MP. Sony Pregius sensors of the 3rd and 4th generation enable the capture of high- quality images. By using SFP28 connections, cable lengths of up to 10 km and data transfer rates of up to 3,125 MB/s can be achieved, which, depending on the resolution of the camera model used, enables up to 671 images/s. The FXO models with 25 GigE feature a milled housing with dimensions of 50 x 50 x 100 mm. They also have an operating temperature range of up to 60 °C. One of the special features of the FXO cameras with 25GigE interface is the integrated strobe controller. This allows lighting to be controlled via four high-power outputs with up to 3 amps without the use of conventional lighting controls. **www.svs-vistek.com**

Bild: DK Fixiersysteme

Assembly Systems for Machine Vision

A new modular joint kit from the Moduline series from DK Fixiersysteme offers mounts for quick and precise alignment of cameras, lights and sensors as well as their permanent, fixed installation. The special feature: The five components offer many options for adapting the size and complexity of the process-specific camera mounts. From simple camera mounts with just one joint for well under 100 Euros to multi-joint systems for several separately alignable cameras on a common base, many things are conceivable. The Moduline program was developed together with machine vision integrators in order to achieve the optimal cost-benefit effect for customer projects through requirement-based scalability. **www.dk-fixiersysteme.de**

Bild: MVTec

Applications of Machine Vision Software

At the Vision trade fair, MVTec will present a preview version of Hdevelop Evo for the first time, a further development of the completely revised integrated development environment Hdevelop. The company also wants to show the new versions of the software products Halcon and Merlic, which will be released in the autumn. Deep learning is expected to play a major role in this.

In addition to presenting the latest technologies, the focus is on the added value of MVTec products for customers. At the stand, visitors will learn how they can integrate MVTec's software into different production environments, thereby responding flexibly to the requirements of their production and thus putting together the right machine vision application. **www.mvtec.com**

Bild: Rauscher

SWIR Lighting Range Expanded

Rauscher offers numerous LED-based SWIR illuminations from the German manufacturer MBJ with wavelengths between 1,050 and 1,650 nm. These products from the Power+ series are available in different designs and sizes as narrow or wide bar and ring illuminations. Due to their optimized thermal management with an additional heat sink and the LED technology used, these illuminations are characterized by low heat generation.

MBJ's SWIR lights have an integrated standard-s controller designed for an operating voltage of 24 V. This means that the lights can be operated in four modes (continuous light, dimmed, triggered and in flash mode with double brightness) via plug & play. Optional accessories such as diffusers allow adjustments to individual requirements if necessary. **www.rauscher.de**

Bild: Baumer

Multicode Reader Series for Industry

Baumer is expanding its Smart Vision portfolio with a powerful code and text reader. According to the manufacturer, the compact IDC230 is characterized by the same ease of handling and commissioning for which the recently introduced IDC200 multi-code reader is already known.

A particular advantage, in addition to the easy installation of the handy device, is the time-saving commissioning via web interface. The auto-setup enables several different codes to be read with just one click. The space-saving housing, suitable accessories, Ethernet and USB-C interfaces and the available Profinet, Ethernet/IP and DIOs protocols ensure easy integration of the device. Thanks to the freely configurable data telegram, the devices of the IDC family (IDC230, IDC200) can be easily integrated into existing systems and adapted to individual data formats .

www.baumer.com

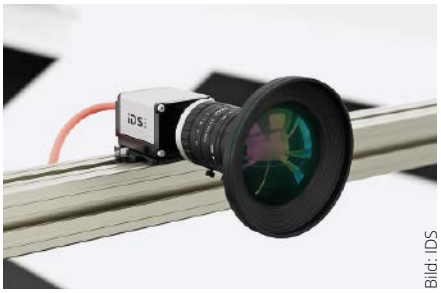


Bild: IDS

3D Camera with a Large Field of View

3D information is particularly relevant for applications in robotics. With Ensenso B, IDS will soon be launching an ultra-compact 3D camera that can work at close range and with a large field of view. The stereo vision camera, which measures 120 x 56 x 104 mm, delivers 3D information from a distance of just 20 centimeters. It will be used in one of the numerous demo systems at Vision. And that's not all: IDS will be presenting the first completely self-developed time-of-flight 3D camera as a prototype.

In addition, IDS is presenting further developments for image processing with artificial intelligence. This includes the all-in-one ecosystem IDS NXT, which was recently expanded with the camera model IDS NXT malibu. The edge device combines on-camera AI, streaming in 4K and video compression.

www.ids-imaging.de

Bild: Balluff

Industrial Cameras in the Short-wave Infrared Range

Balluff is expanding its BVS CA industrial camera product family to include new models with SWIR sensors. This means that short-wave infrared technology (SWIR) for using the short-wave infrared range is now available in the GigE and USB3 camera series. Balluff's industrial cameras with SWIR sensors are used primarily in the semiconductor, packaging and food industries. Since silicon appears transparent in SWIR light, the new camera models are used in wafer inspection, for example. In addition, agricultural products, transparent plastics in waste sorting and fill levels in opaque plastic containers can be checked.

Compatibility with GigE Vision, USB3 Vision and GenICam ensures that the new SWIR models can be easily integrated into existing systems. From the integration to the handling of the cameras, nothing has changed compared to previous models.

www.balluff.de

Bild: Lucid

Family Expanded with a Dual Extended Head Camera

Lucid has introduced a new dual extended head camera that expands the company's modular Phoenix camera family. The dual extended head camera seamlessly transmits synchronized images from its dual 5.0 MP sensors and is suitable for applications that require a wider field of view (FoV). Equipped with two Sony IMX264 global shutter image sensors, each with a resolution of 2,448 x 2,048 pixels, this camera is designed to provide an extended field of view for stereo vision systems, autonomous mobile robots (AMR), unmanned aerial vehicles (UAV), and intelligent transportation systems (ITS). Its lightweight and compact 28 x 28 mm design allows it to be integrated into a variety of space-constrained setups.

www.thinklucid.com

Johanna Unrath founded Jumavis in 2022 after Polytec's decision to divest its machine vision business.

"We Demonstrated Competence in All Areas of Optical Quality Control Right from the Start"

Interview with Johanna Unrath, managing director of Jumavis

In 2022, Johanna Unrath founded Jumavis GmbH, taking over Polytec's machine vision business. The company quickly gained trust from customers and suppliers, demonstrating competence in optical quality control. Unrath discusses the company's growth, the unique name, and their comprehensive portfolio of machine vision components. She emphasizes the importance of sustainable partnerships and the current trends in industrial automation and optical quality control.

inspect: In 2022, the newly founded company Jumavis, with you at the helm, took over Polytec's machine vision business. How did this come about?
Johanna Unrath: After more than 20 years, Polytec ended the distribution of machine vision components with the aim of further strengthening and expanding the core business of its own products in the area of complex optical measurement technology. My idea to continue the business received a positive response from Polytec, so I founded Jumavis GmbH on March 1, 2022. As a sales engineer, I helped shaping machine vision at Polytec for over 16 years. So I personally knew all facets of the business and the long-standing customers and suppliers.

inspect: How has business been since then?
Unrath: In the first year of our existence, many customers placed their trust in us. Our partners and suppliers, with whom I had worked together during my time at Polytec, also remained loyal to us. This enabled us to demonstrate competence in all areas of optical quality control right from the start.

The aim of the first short financial year was to maintain long-standing customer and supplier relationships through the best possible quality of support, which we successfully achieved and we were able to achieve a positive result. We are continuously expanding the business by acquiring new customers – including international ones – and additional suppliers to meaningfully supplement the product portfolio.

inspect: How did you come up with the name Jumavis?
Unrath: The goal was to find a company name that was unique and that didn't exist before. Jumavis is an acronym and consists of: Johanna-Unrath-Machine-Vision. We were able to protect the name for ourselves.

inspect: What portfolio do you offer?
Unrath: Jumavis is a distributor and specialist for machine vision components from numerous well-known manufacturers. The spectrum includes LED and fiber optic lighting (also custom-made), machine vision lasers, matrix or line scan cameras, high-speed cameras, microscope systems, lenses, filters, protective housings, software, 3D sensors, vision sensors, framegrabbers, industrial PCs, cables, tripods, etc.

We know the different markets, the strengths and weaknesses of various components and how they interact in the application. We value manufacturer-neutral and targeted advice. In feasibility studies, Jumavis puts the components together and delivers the best possible solution package for the customer. If integration is desired, we can recommend a suitable integration partner from our network and accompany the project until its successful completion.

inspect: How many employees does Jumavis have?
Unrath: We have grown continuously and the Jumavis team includes highly qualified employees with experience in machine vision and international business. We currently have 11 employees.

A trade fair demo with the 3d sensor LMI Gocator 3210 on the arm of a collaborative robot from Universal Robots

inspect: What are you focusing on in the further development of the company?

Unrath: We would like to support our customers – regardless of whether they are large or small – in their projects in the long term, from the analysis of the task to the planning and selection of the diverse components using our know-how.

In the same way, we maintain partnerships with our suppliers that have existed for years/decades (still through Polytec). Every step we take should be sustainable. We attach great importance to this.

inspect: In your opinion, what are the current biggest trends in machine vision?

Unrath: Industrial production is changing rapidly. Due to expanded technical possibilities, a shortage of skilled workers and competitive pressure, automation is often the only way to continue to be successful on the market.

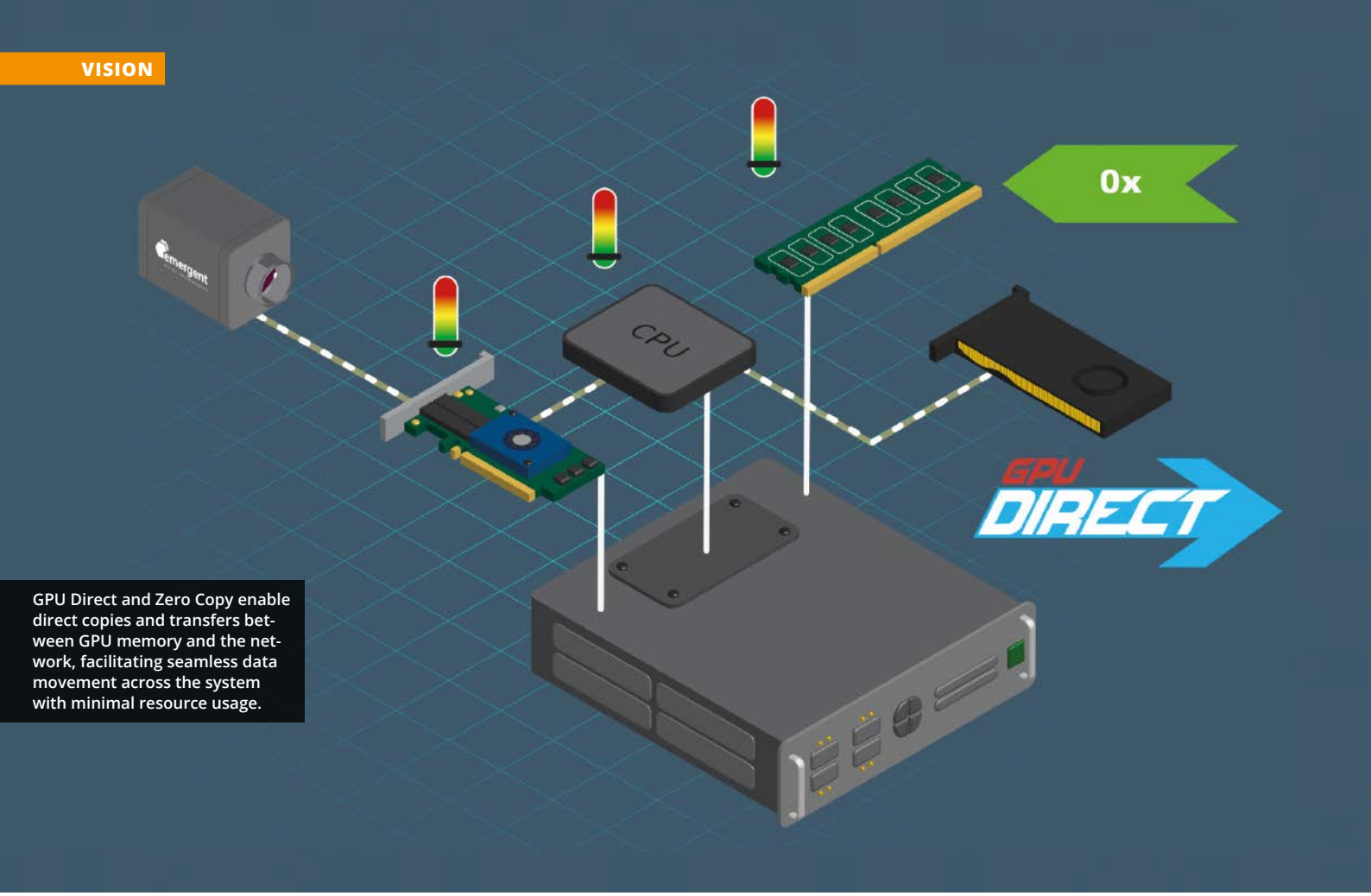
The efficient use of optical quality control systems becomes an important competitive advantage. Faster, more accurate, more efficient and ideally directly networked with the control of the production system. This is what the infrastructure of optical quality control systems of the future will look like. In order to integrate such systems when planning new production facilities, it makes sense to involve specialists as early as possible.

The developed solution can then be implemented i.e. in the digital twin of a production plant. Where possible, we use innovative approaches such as artificial intelligence (AI) and machine learning to further increase the performance of optical quality control. ■

AUTHOR
David Löh
Editor-in-chief of inspect

CONTACTS
Jumavis GmbH, Waldbronn
Tel: +49 7243 20677 0
Email: info@jumavis.de
www.jumavis.de

All images: Jumavis



GPU Direct and Zero Copy enable direct copies and transfers between GPU memory and the network, facilitating seamless data movement across the system with minimal resource usage.

Harnessing the Potential of Vision Technologies

Scalable and Flexible Image Processing Solutions

In the rapidly evolving landscape of digital imaging and machine vision, the need for high-speed, scalable, and flexible processing solutions has never been more critical. A producer of high-speed GigE Vision cameras combines software and camera technologies shows, how they can be used in a wide range of applications to bring the greatest benefit to the user.

Ecapture Pro is a user-friendly software designed to seamlessly integrate Emergent's cameras, supporting speeds of 5, 10, 25, and 100 GigE. It's an tool for large-scale recording systems involving multiple servers, switches, and storage solutions. The software's intuitive UI and drag-and-drop design simplify complex system management, making it accessible for users to harness the full potential of their imaging systems.

Processing Flexibility is Key

Flexproc is a transformative technology that enables user-defined processing across any node in the system. Whether it's on CPUs in the servers, GPUs, or even in the cloud, Flexproc offers processing flexibility. Users can create custom processing plug-ins, leveraging CPU, GPU, and FPGA resources, all managed within Ecapture Pro's UI. This capability enables developing and deploying sophisticated image processing tasks, from simple filters to complex AI and machine learning algorithms.

The HE-25000-SBL from Emergent's Eros series. It is available with 1, 2.5 or 5 GigE and is equipped with the Sony Pregius S IMX540 sensor.

The versatility of Flexproc and Flextrans technologies makes them useful for a broad spectrum of markets. Whether it's AI, machine learning, entertainment, sports, or any field requiring high-performance image processing.

Data Movement within an Imaging System

Flextrans elevates the concept of data movement within an imaging system. It allows for seamless transfers of image data and results between any nodes — be it between GPUs in a single server, across servers, or even to and from the cloud. With support for Zero-Copy and GPU Direct methods, Flextrans ensures the highest performance and lowest latency possible. This technology is a game-changer for applications requiring real-time or low-latency content, eliminating the constraints of slow pre-processed content.

Direct Copies and Transfers Between GPU Memory and the Network

GPU Direct and Zero Copy enable direct copies and transfers between GPU memory and the network, facilitating seamless data movement across the system with minimal resource usage. This efficiency translates into significant cost savings and reduced latency, ensuring that applications can operate at their peak without compromise.

From AI to Entertainment

The versatility of Flexproc and Flextrans technologies makes them useful for a broad spectrum of markets. Whether it's AI, machine learning, entertainment, sports, or any field requiring high-performance image processing. They enable real-time processing and analysis, breaking the barriers of traditional pre-processed content and opening up new possibilities for application development.

Use Cases

Consider the impact of these technologies in sports broadcasting, where real-time 3D graphical representations of sporting events can be generated and streamed to viewers worldwide. Or in the entertainment industry, where high-speed cameras combined with Flexproc and Flextrans can create immersive virtual reality experiences. The potential applications range from AI-controlled inspection systems in manufacturing to enabling advanced research in scientific fields. ■

all images: Emergent

CONTACTS
Emergent Vision Technologies,
Port Coquitlam, Canada
Tel: +1 866 780 60 82
Email: sales@emergentvisiontec.com
www.emergentvisiontec.com

"We See the Embedded Vision Industry as a Key Industry for Growth and Innovation"

Interview with Sam Seidman-Eisler, Sales Engineer at Ximea

In the interview with inspect, Sam Seidman-Eisler discusses Ximea's xiX platform, highlighting its unique features and applications. He talks about the platform's modular design and its impact on various industries, and gives insights on the future of embedded vision technology.

inspect: What role does embedded vision play for Ximea?
Sam Seidman-Eisler: We see the embedded vision industry as a key industry for growth and innovation. For embedded vision applications, we have developed our unique line of PCI express cameras. This is quite different from a typical USB or GigE camera in the sense that they are connected directly to the motherboard of the computing platform and deliver data directly to RAM.

Our embedded vision cameras play a key role for OEM customers who are designing their system from the ground up and are able to tap directly into the computing platform. In addition to OEM customers, researchers and single camera users who are looking to achieve the highest performance out of their cameras can greatly benefit from the bandwidth capabilities of our embedded vision PCIe cameras. Finally, to me the most exciting role of embedded vision is to integrate multiple cameras into a vision system.

inspect: With xiX, Ximea has its own platform for embedded vision in its portfolio. What are its key features?
Sam: Most cameras are limited by the bandwidth of the connection, and not the data throughput limit of the sensor itself. With the bandwidth capabilities of PCI express, this is not the case, and we are able to offer unparalleled sensor performance. In addition to large data transfer speed, we bring the computing platform outside of the camera, allowing for some of the most compact sensor modules on the market.

Very importantly, our design is modular, allowing the use of multi-camera switches to seamlessly connect up to 12 cameras to one PCIe port on a host computer.

With a wide range of resolution, sensor size, and framerate options available, we have camera models for even the most demanding applications!

inspect: How does the xiX platform differ from competing products?
Sam: Compared to other cameras on the market, our xiX cameras are faster, smaller, lighter, and come standard with an excellent API and support package. But it is the PCI express interface that really separates the xiX platform from other similar cameras. The PCIe interface allows us to maximize the performance of any given sensor.

If you find your image solution underperforming, our embedded xiX cameras may be the solution.

inspect: Is there an application focus for embedded systems from Ximea? Which one?
Sam: There are several applications where embedded systems can really enhance the solution. Any system where multiple cameras are needed is the perfect opportunity to utilize our embedded vision platform. This includes 3D and 4D volume capture, motion capture, performance capture, photogrammetry, and many more.

Additionally, applications such as robotics and automation which require a compact, low latency, high resolution, and fast frame transfer rate camera are ideal for the xiX embedded system.

One final application to mention is instrumentation, or the application where you are building a device. With the release of our new Nvidia Jetson carrier board, you can easily connect up to three cameras to a Jetson module, making a compact multi-camera solution easier than ever to create!

inspect: What new features and/or products will there be in the xiX series?
Sam: The latest and greatest from our XIX series included the Nvidia Jetson carrier board, and our uniquely compact detachable sensor head cameras.

With the sensor head detached, the controlling electronics heat up while the sensor itself stays cool, enhancing the sensors noise performance.

The detachable sensor head models allow the sensor head to disconnect from the controlling electronics, allowing the sensor head to fit into tight spaces. Additionally, with the sensor head detached, the controlling electronics heat up while the sensor itself stays cool, enhancing the sensor noise performance.

With the release of faster and higher resolution sensors, such as new models from GPixel and Sony, the bandwidth requirements are only going up. Thanks to the PCI express interface being completely backward compatible and the increasing bandwidth of the latest PCI generations, our xiX series is able to keep up with increased sensor performances with ease, without making our current models obsolete!

inspect: Where do you see biggest growth potential for embedded vision?

Sam: I see the biggest growth in the performance capture market. We recently exhibited at the Game Developers Conference where our hardware was embraced by the gaming/simulation industry. With the increased popularity of augmented reality and virtual reality, the need for realistic virtual worlds is paramount. This is the perfect application for our embedded vision cameras to deliver high quality, high speed data to machine learning and AI applications to create ultra-realistic virtual worlds.

inspect: How do you think the machine vision industry will develop in the USA this year and next? And why?

Sam: I am incredibly optimistic about the future of the machine vision industry. It seems that every trade show we go to we see more and more exhibitors and attendees, with the breadth of applications being seemingly limitless.

As computing power increases, and AI/machine learning gets better, the power of machine vision is increasing dramatically. I see this leading to an increased demand in data output from machine vision camera manufacturers. We are positioned well with our xiX cameras to meet this demand.

It is awesome to see all the unique and innovative applications in which our cameras are used, and I am very excited to see where our future customers will take our cameras. Most of the applications I cannot even dream of in this moment, but I know the opportunities are out there for our cameras to enhance the machine vision world. ■

CONTACT
Ximea GmbH
Münster, Germany
Tel: +49 251 202 4080
Email: sales@ximea.com
www.ximea.com

all Images: Ximea

Sensor for Multi- and hyperspectral imaging from space

Monitoring of Food Systems, Agriculture, Biodiversity, and Mining

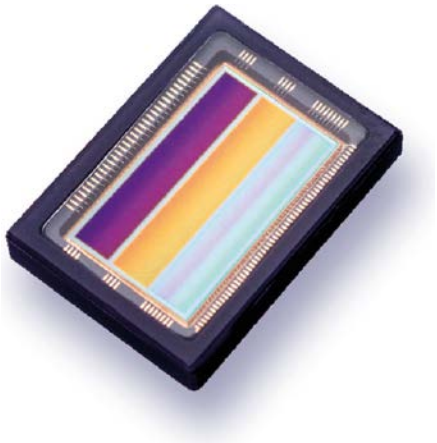
Imec's new multi- and hyperspectral imaging sensors for space applications

A new hyperspectral sensor addresses space applications. It is suited to meet stringent signal-to-noise ratio (SNR) requirements for earth observation from small satellites. Moreover, the optimized process technology ensures a very low sensor-to-sensor variability making these sensors ideal for satellite constellations.

The use of spectral imaging from space is experiencing rapid growth, with many companies building constellations of small satellites to, for example, screen for plant diseases, monitor coastal areas or calculate biomass indices for forest management. Such satellites rely heavily on advanced sensors to gather accurate and detailed data. A critical requirement for these sensors is a broad spectral range and high sensitivity. A wider spectral range allows for the detection of a variety of features, while good light sensitivity ensures that even faint signals can be accurately captured.

2,048 pixels at 340 fps

To realize the new sensor, Imec monolithically integrated specialized thin-film spectral filters on a CMV2000 sensor (AMS) with a track record in space applications. The resulting sensor provides an across-flight resolution of 2,048 px with a 2/3 inch optical format and operates at frame rates up to 340 fps in full resolution. Multiple regions of interest (ROI) can be defined on the sensor, providing the flexibility to serve different types of missions: the sensor can be operated at full spectral resolution or specific bands can be selected, reducing data load while increasing frame rate and SNR.



The sensor provides an across-flight resolution of 2,048 px with a 2/3 inch optical format and operates at frame rates up to 340 fps in full resolution.

With 96 bands, the sensor's spectral range covers 450 to 900 nanometers, equidistantly divided into accurately positioned spectral bands, with a more uniform filter transmission efficiency throughout the complete spectral range compared to the first generation. Achieving 10 digital TDI (time-delayed-integration) stages per band, the sensor doubles the TDI capability of the detector compared to the previous generation, consequently offering maximum SNR across its entire wavelength range and allowing for more accurate detection of features, important for environmental monitoring from space. Moreover, Imec has optimized the fabrication process, resulting in low sensor to sensor variability, ensuring accurate analysis and reduced processing time.

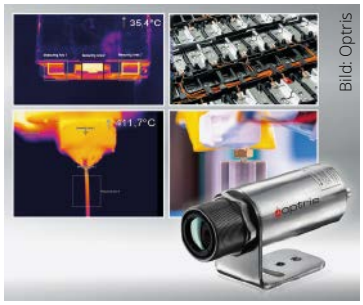
Resistant to Shocks, Vibrations, and Temperature Fluctuations

By integrating thin-film filters monolithically onto the AMS sensor, Imec has created a robust and stable configuration. Unlike alternative setups that place separate optical elements between the lens and sensor, the integrated design enables an exceptional filter to detector alignment and is resistant to shocks, vibrations, and temperature fluctuations – a significant advantage for the harsh conditions of space.

The sensor is available off-the-shelf for individual purchase units, providing low-barrier access to advanced technology and enabling businesses to start with a single unit for evaluation or to enter into supply agreements for larger quantities. ■

CONTACTS
Imec, Leuven, Belgium
Tel: +32 16 28 12 11
www.imechyperspectral.com

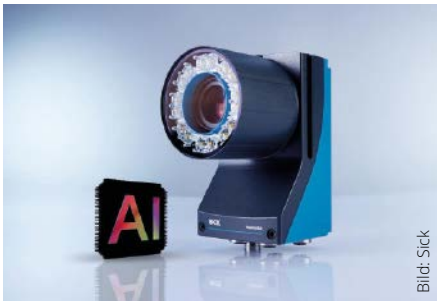
all images: Imec



VGA Infrared Camera for Condition Monitoring

Optris is introducing a new member of its Compact Line with the infrared camera Xi 640. The compact VGA infrared camera offers non-contact condition monitoring in industry. With a high optical resolution of 640 x 480 pixels and a refresh rate of 32 Hz in the spectral range of 8 – 14 µm, the VGA infrared camera can be used to monitor fast thermal processes at temperatures between -20 °C and 900 °C. Optris has equipped the Xi 640 with an "Auto spot finder " function, which can also measure the temperature of objects in motion without having to readjust the camera.

Image processing is carried out using the included, free PIX Connect software with line scan function. Important parameters are configured via a USB 2.0 interface; a USB-to- GigE converter is optional. The Xi 640 is supplied with a process interface cable and a USB cable. **www.optris.de**



2D Vision Sensor with AI

Sick has introduced the Inspector83x 2D vision sensor. The sensor is ready for immediate use and, thanks to artificial intelligence (AI), is particularly suitable for typical inline inspection tasks in demanding high-speed production.

The Inspector83x comes pre-installed with Nova software, which makes the device ready for immediate use. Users access the user interface using a standard PC connected to the camera via USB-C or the network port. Samples are presented to the camera under production conditions. Training and execution of the inspection then take place. Just five samples are sufficient. By combining the AI function with conventional rule-based tools, such as adding a simple measurement value, inspections can be configured quickly and in a practical way. **www.sick.de**

Lens Series for APS-C Format Sensors

Sill Optics is expanding its lens series for large APS-C sensor formats with three color-corrected, telecentric lenses. For the maximum sensor diagonal of 32.6 mm, the lenses enable a full resolution of up to 2.74 µm with monochrome cameras. For a sensor diagonal of up to 28.9 mm, a pixel size of 2.5 µm is even fully resolvable. The new lenses in the series with magnification factors between 0.2 and 0.45 can be used for line scan cameras and area sensors. Thanks to their color-corrected design, they are used not only in the monochrome range (R, G, B), but also in combination with color cameras. The full resolution of 2.74 µm or 2.5 µm can also be used with sensors with Bayer pattern filters. Another feature is the high transmission in the near infrared range (850-950nm), so that high-resolution NIR images are possible with a small adjustment of the working distance. **www.silloptics.com**

Macro Lens in New Edition

With the Navitar Zoom 7000-2, Jumavis partner Navitar is introducing a macro lens. It is a revised version of the Navitar Zoom 7000 lens introduced in 2008. The Navitar Zoom 7000-2, the next generation of macro lenses, has been newly developed, refined and optimized for demanding applications in industrial image processing, life sciences and research based on optimized and more precise manufacturing options. The focal length range has also been expanded to 18–111.

With its performance, the close-focus lens delivers good image quality across different magnification ranges. Its robust construction ensures reliability even in demanding environments and is designed to offer high flexibility. **www.jumavis.de**

Bild: Teledyne

Compact 8k Line Scan Camera

Teledyne Dalsa is now producing the Linea Lite 8k Super Resolution camera. This compact and cost-effective GigE line scan camera delivers images with 8k resolution, a performance that normally requires cameras twice the size.

Teledyne 's proprietary multiline CMOS image sensor design. This new 8k Super Resolution monochrome camera uses two 4k/7 µm pixel rows with a half pixel offset. The data from two 4k/7 µm images is captured simultaneously and then reconstructed to obtain a high resolution 8k/3.5 µm image in real time, significantly improving the signal-to-noise ratio and the detectability of subpixel defects. Teledyne 's patented technology Dalsa also allows the use of 4k/7µm lenses and lighting without sacrificing sensitivity and MTF (due to the smaller pixel size). The camera is compatible with standard M-42 lenses. **www.teledynedalsa.com**

Bild: IPF

Camera Auxiliary Lights and Flash Controllers

With a diameter of 16 mm, the ES16 series LED spotlights from IPF have enough space even in very tight installation situations. The light from the spotlights can be focused using the lens and blurred if necessary to achieve greater light dispersion. Thanks to the flash controller integrated in the cable, the lights can also be used in continuous, switching and flash mode as usual.

The LED spotlights are offered with two focal lengths: ES160100 with 16mm optics (application range from 10-500mm), ES160101 with 6mm optics (application range from 1-200mm). Also new at IPF is the AO000655 flash controller for the DIN rail, with which up to four LED channels can be controlled separately or coupled.

www.ipf-electronic.de

Bild: Wenglor

Spot Lighting with Lockable Zoom Lens

The new spot lights from Wenglor with a lockable zoom lens for a variable beam angle in the range of 4 to 26 degrees with consistent homogeneity enable a precise lighting situation. The powerful flash mode Overdrive with an illuminance of up to 360,000 lux, the robust housing and flexible mounting options make the spot lighting the ideal choice for application lighting in industrial image processing.

Available in white light, red light and infrared light, the spot lighting with exact position repeatability ensures precise alignment of the field of view. This results in optimal lighting with high intensity. The robust aluminum housing with IP67 protection protects against environmental influences and the M30 thread enables quick and easy installation. To keep the construction effort to a minimum, camera mounts provide flexible mounting options. The M30 proximity sensor mounts enable space-saving integration, which can also be used with swivel mounts. **www.wenglor.com**

Bild: Theia

Intelligent Lens System

Theia Technologies announces its new IQ Lens system, which includes a motorized lens, motor control board, average calibration data, and graphical user interface (GUI) software.

Designed for integration into vision systems for automation, robotics and intelligent transportation systems, Theia's motorized lenses and motor control board use stepper motors to operate the lens' zoom, focus, iris and filter. Until recently, using them together required the user to develop software to translate the desired engineering parameters into motor steps and the motor steps into lens commands. With Theia's new IQ Lens System, improvements to both enable quick and easy integration into the vision system.

www.theiatech.com

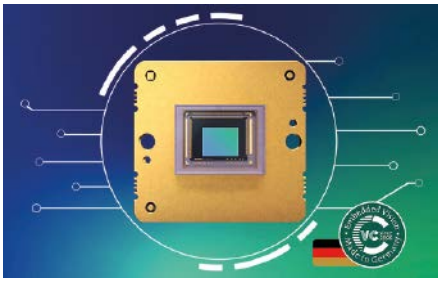


Bild: Vision Components

Mipi Camera Module

Vision Components has introduced the MIPI IMX900, an industrial camera module that integrates the new IMX900 image sensor from Sony. The global shutter camera offers 3.2 megapixel resolution and high light sensitivity up to the infrared range. With a sensor diagonal of just 5.8 mm, the ultra-compact module can be integrated easily and flexibly. On request, VC also supplies a GMSL version of the VC MIPI IMX900 camera module for connection with coaxial cables up to 10 meters long. This option is now available for all VC MIPI cameras.

Also new is the website for the VC MIPI Ecosystem. It is now the first point of contact for embedded vision systems based on the MIPI CSI-2 interface. In addition to the largest portfolio of cameras and image sensors, customers can find all connection options and accessories, information on compatible processor platforms, customization options for individual projects and insights into production. **www.vision-components.com**

Bild: Zebra

Stationary Industrial Scanners for AI Applications

Zebra has introduced the FS42 stationary industrial scanner and the 3S series 3D sensors. The FS42 is equipped with a neural processing unit (NPU). This enables better performance when running AI-based deep learning tools. It is also equipped with Zebra Aurora Focus for quick setup and commissioning.

The 3S Series high-resolution, high-speed 3D sensors are plug-and-play and feature a Power over Ethernet (PoE) connection. They are enhanced with Zebra's Aurora Design Assistant or Aurora Vision Studio to accelerate development and bring 3D vision applications online faster. Kits with Zebra's 4Sight Series EV7 vision controller are also available for multi-camera machine vision and deep learning applications on the factory floor. **www.zebra.com**

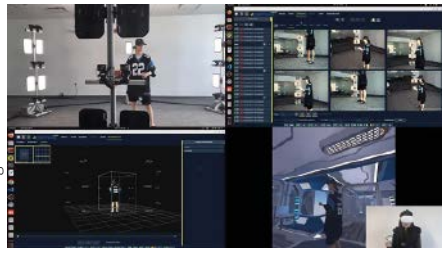


Bild: Emergent

Software Features for Real-time 3D/4D Reconstruction

Emergent Vision Technologies has added real-time 3D/4D reconstruction capabilities to its Ecapture Pro software. It provides a drag-and-drop interface to set up, configure and run multiple volumetric cameras, servers, storage, GPUs and other system components without requiring extensive machine vision knowledge. Previously, Emergent's software had to first record volumetric camera data into memory before it could perform post-processing 3D reconstruction of the video. Now, proprietary algorithms allow eCapture Pro software to generate volumetric video in real-time on a single server, enabling more immediate engagement and immersion in captured events as they happen.

www.emergentvisiontec.com

Bild: ActiveSilicon

Frame Grabber with CoaXPress

Active Silicon has introduced the Firebird Dual CXP-12 frame grabber, the latest in its high performance frame grabber series. The new frame grabber is designed for performance and versatility. It supports CoaXPress cameras with 2 CXP connections or two cameras simultaneously with one connection each. With speeds up to CXP-12 per connection and PoCXP (Power over CoaXPress), it enables streaming with efficiency. Its small, low-profile form factor makes the Dual CXP-12 frame grabber suitable for a wide range of setups, including small embedded PC chassis, 2U rackmount servers, and standard PCs, providing flexibility without compromising performance.

The heart of the FireBird CoaXPress Frame grabber is the proprietary DMA engine technology "ActiveDMA ". RISC-based processor technologies ensure High-speed image data transfers in real time directly to system memory without CPU intervention.

www.activesilicon.com

Bild: Excelitas

High-speed Camera with Streaming

Excelitas Technologies presents the new high-speed camera Pco.dimax 3.6 ST for industrial and scientific applications. The monochrome camera with 3.6 MP resolution and frame rates over 2000 fps streams images via an 8x10Gb fiber optic connection. This enables unlimited recording times. Images are also available in real time in full resolution for viewing and further processing. The user-friendly system with intuitive PCO software meets the highest demands on high-speed image processing in research, quality control, troubleshooting, material and product development and welding processes. The exposure can be set in the range of 10 µs to 10 ms. A large global shutter sensor with 1984 x 1808 pixels, high saturation capacity (60,000 e-), low read noise (<65 e-) and high quantum efficiency (68% at 620 nm) is used. It is sensitive to a wide spectrum from the visible range to near infrared (340 nm ... 1100 nm). The camera is available with C or F mount and optionally with EF mount.

www.excelitas.com

Bild: Flir

Camera Series with IP67 Protection Class

Teledyne Flir has introduced the Forge 1GigE IP67, the latest model in its industrial camera series, designed for use in harsh industrial environments while ensuring highly efficient production capabilities. The Forge 1GigE IP67 camera series features a cylindrical IP67 housing for optimal and easy system integration, simplified post-operation cleaning and the prevention of dirt accumulation. A wide range of IP67-certified components are available from partners such as Smart Vision Lights® and Components Express, LLC. (CEI) to create a complete IP67 vision ecosystem for our customers.

With advanced camera features such as automatic brightness functions (AGC and Auto- Exposure), the new cameras adapt dynamically to variable and external lighting conditions.

www.teledyneflir.com

Spraying coolants and lubricants obscure conventional machine windows and prevent a clear view of the processes inside the machine (upper picture). To remedy this Rotoclear has developed a special camera system that withstands the harsh conditions inside CNC machines while delivering sharp images up to 4K resolution.

Camera System Provides Optical Information from Inside the Machine

Monitoring and Optimization of CNC Manufacturing

Swirling chips and coolant often turn the interior of machining machines and other equipment into a black box. A German company, however, has developed a robust camera system that can provide these essential optical process insights. To withstand the harsh conditions inside the machine, it features a rotating viewing window that keeps the camera lens free from contamination.

Machine downtimes due to crashes between the tool, workpiece, and other machine components can quickly cost several thousand euros," says Rotoclear Managing Director Florian Friedrich. „However, such crashes do not always cause immediate damage: so-called soft collisions lead to long-term inaccuracies in machining, thus reducing the quality of finished workpieces." Additionally, tool wear increases, resulting in more frequent maintenance intervals and higher maintenance costs. Many companies specialize in reducing these error sources and optimizing the processes within CNC machines by equipping the machine with complex sensors and protecting the spindle with special systems.

„These approaches are, however, elaborate, expensive, and ignore a bigger problem," Friedrich explains. „The interior of many machine tools, like machining centers, is a kind of black box." Flying metal chips not only obstruct the view of the tool and workpiece, but also become dangerous projectiles that can cause significant damage inside the machine. Spraying coolants and lubricants obscure conventional machine windows and prevent a clear view of the processes inside the machine. Many businesses equip the cabins of their CNC machines with special rotating windows. Originally from maritime applications, this principle allows an external view of the internal processes. The quality of optical error analysis, however, significantly depends on the operator's competence and experience and can only be conducted in real-time.

Spindle-mounted Camera System

To remedy this and generate new potential for process optimization, Rotoclear has

Company in Detail

Rotoclear

In 2019, Rotoclear was spun off from Autz + Herrmann, which invented the world's first rotating viewing window for machine tools in 1983. The company specializes in the optical monitoring of processes in machining equipment. Rotoclear products provide clear insights where users would otherwise be hindered by liquids or particles. The newly acquired optical information forms the basis for valuable insights to make processes safer, more reliable, and more efficient.

Flying metal chips not only obstruct the view of the tool and workpiece but also become dangerous projectiles that can cause significant damage inside the machine.

The principle of the rotating viewing window, originally from the maritime industry, allows an outside view of the processes inside the machine. The Rotoclean C2 lens uses the same principle: It has a fast-rotating viewing window made of shatterproof glass.

developed a special camera system that withstands the harsh conditions inside CNC machines while delivering sharp images up to 4K resolution. „The biggest challenge is the constant spraying of coolant and oil, which destroys conventional recording devices and even supposedly robust action cameras within a few days to hours," Friedrich explains. The real innovation lies not only in the robust construction, which offers little surface area and space for chip nests to form, but especially in the fast-rotating viewing window made of shatterproof glass in front of the lens. This utilizes a well-established concept: the centrifugal force generated by the rotation flings droplets and solid particles outward, keeping the window clear and clean.

With up to two camera heads per control unit, multiple angles can be captured simultaneously in picture-in-picture mode: from the ceiling (Top View), from the wall (Side View), and even from the tool's perspective (Tool View). The Rotoclear C2 camera head is the first of its kind that can be mounted directly on the spindle head near the tool. Its design has been specially adapted to the accelerations occurring there, which, in combination with the rotating window, generate gyroscopic forces. Additionally, it features an integrated position sensor that compensates for movements at the tool head. „This allows machine operators – and anyone else interested – the ability to observe machining processes in large cabins or deep cavities in the workpiece up close," says Friedrich.

High-Resolution Image Data Enables Detailed Error Analysis

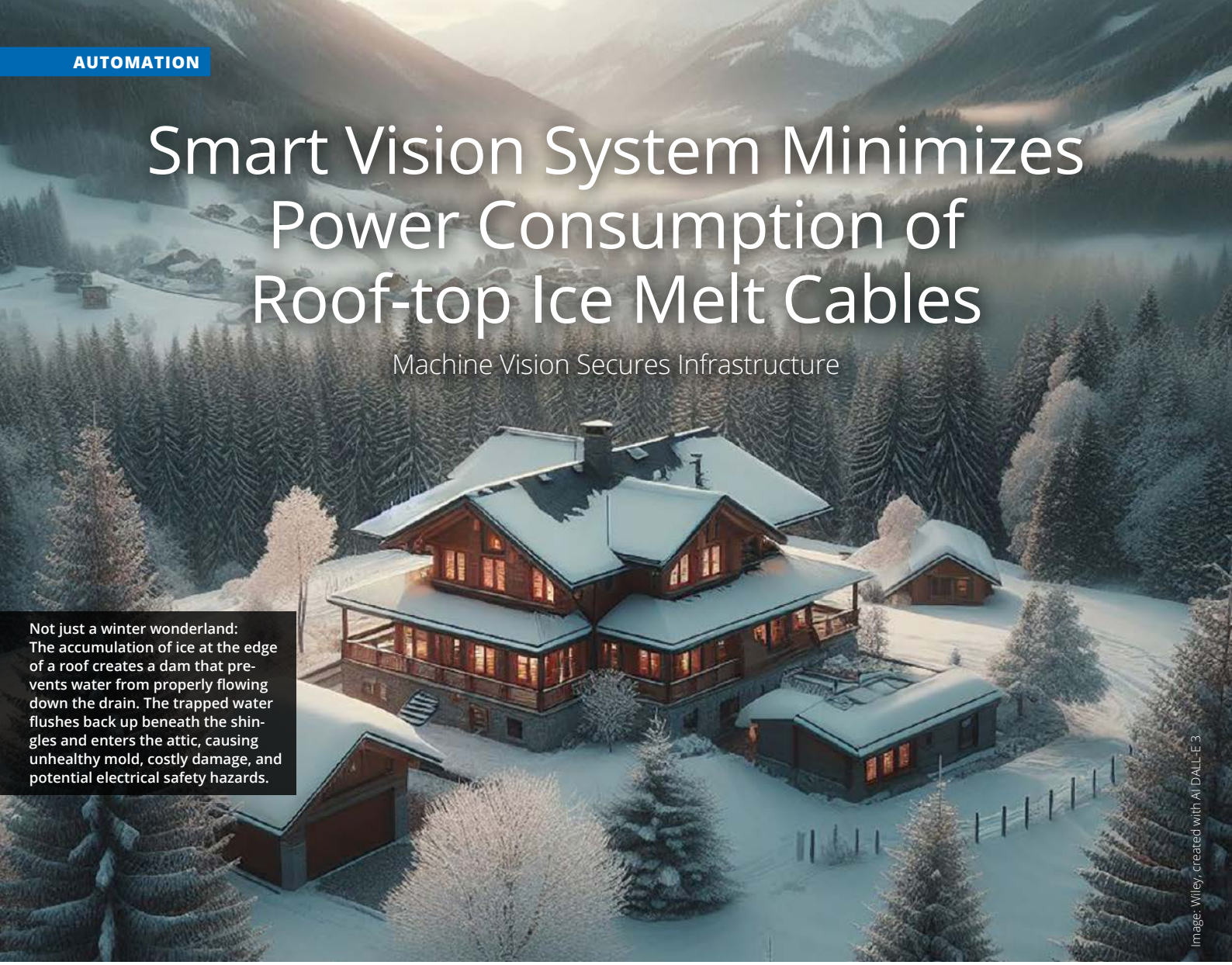
The digital image data from the machine cabin is transmitted to the control unit with a resolution of up to 4K at 30 fps. From there, it can be streamed live via HDMI, TCP/IP, or RSTP and stored in the media gallery. Access is possible remotely via internet protocol, allowing employees to critically inspect the machine interior from the home office and directly contribute to optimizing machining processes if necessary. „Anyone looking to improve processes within their own CNC systems should first ensure they have the necessary optical information as a basis for error analysis," concludes Friedrich. „The Rotoclear C2 reliably delivers this valuable data in high resolution and, thanks to its mounting on the tool spindle, even from entirely new perspectives." ■

CONTACTS
Rotoclear GmbH,
Heidelberg, Germany
Tel: +49 6221 506-200
Email: info@rotoclear.com
https://rotoclear.com

all images: Rotoclear

Smart Vision System Minimizes Power Consumption of Roof-top Ice Melt Cables

Machine Vision Secures Infrastructure



Not just a winter wonderland: The accumulation of ice at the edge of a roof creates a dam that prevents water from properly flowing down the drain. The trapped water flushes back up beneath the shingles and enters the attic, causing unhealthy mold, costly damage, and potential electrical safety hazards.

Image: Wiley, created with AI DALL-E 3

Ice dams on the roof can cause heavy damage to buildings in snowy regions. Heat cables prevent them, but waste Terawatts of power when used permanently. Now there is an innovative camera module that monitors the snow and ice level on the roof to melt it only when necessary – saving up to 90 percent energy and reducing CO_2 emissions accordingly.

In regions with a rough winter climate, heavy snow, and ice layers accumulated on roofs can cause substantial damage to buildings. The nightmare of many homeowners and facility managers is the so-called ice dam. The accumulation of ice at the edge of a roof not only causes icicles but also creates a dam that prevents water from properly flowing down the drain when the softer snow layers melt. The trapped water flushes back up beneath the shingles and enters the attic, causing unhealthy mold, costly damage, and potential electrical safety hazards.

90 Percent Wasted Energy

To avoid that, North American roofs in snowy regions are often equipped with so-called heat cables. These electric heating cables laid on the edge of the roof melt the snow and ice to prevent the formation of a dam. While this is an efficient solution to protect the property, it is extremely inefficient from an energy consumption perspective, because it blindly operates regardless of the snow and ice level. The heat cables could be switched off 90 percent of the time, but they are not. Building owners waste large amounts of money on their power bills, and the wasted energy is an unnecessary burden on the environment and the climate. Thermometer-based systems attempt to reduce waste but can only make assumptions based on the weather conditions. They don't accurately assess the actual ice formations on the roof.

A US-American company teamed up with Maxlab, a Canada-based computer vision solution provider, to design a solution to that issue using machine vision technology. The system consists of one or several camera modules (depending on the size of the roof) that monitor the level of snow and ice on the edge of the roof and trigger the heat cables only when necessary. The camera uploads the captured image data to the cloud via a smart hub for processing. The software not only recognizes the formation of an ice dam but also compiles the data with weather data to optimize the operation of the heat cables even further. If necessary, the heat cables are switched on but remain switched off most of the time when not needed.

Custom Development for Tough Operating Conditions

"The camera module developed had to fulfill demanding requirements to operate under such tough conditions", explains Constantin Malynin, co-founder of Maxlab. Each module consists of two full-HD cameras to provide a panoramic view of the roof. The image sensors are infrared-sensitive to operate under low-light conditions during long winter nights and when the camera itself is covered with snow thanks to the built-in infrared light.

Like the heat cables, the camera module is permanently installed on the roof. That means that it must withstand both the low temperatures of the winter and the summer

image: Maxlab

The Maxlab system consists of one or several camera modules (depending on the size of the roof) that monitor the level of snow and ice on the edge of the roof and trigger the heat cables only when necessary.

heat. The module is designed to operate in a temperature range from -40 to 80 °C (-40 to 176 °F).

The housing is UV-resistant and IP68 waterproof to withstand weather conditions. It is also designed to withstand the weight of a person mistakenly stepping on it during installation and maintenance.

Another specificity of Maxlab's camera module is its extremely low power consumption. To simplify installation on the roof, the camera is not connected to a power supply. It runs on a battery that works in tandem with a solar panel. Since the whole module will typically be covered with snow for weeks, one battery load ensures the system is self-sufficient for the whole winter. Maxlab not only developed the camera module but also the hub that connects the system to the cloud.

Fast Development with Robust Embedded Vision Technology

The development of the camera module was completed within nine months between the first sketch and the first manufacturing batch. This was made possible by Maxlab's Tokay camera platform. It's a modular embedded vision platform that allows Maxlab's engineers to develop custom solutions from pre-existing building blocks. "This modular platform approach is the key to our ability to deliver reliable solutions such as the rooftop camera within a short time frame", explains Malynin. The system has now been selling in thousands of homes and facilities across the United States.

Maxlab's client estimates that thanks to this solution, heat cables can be safely turned out more than 90 percent of the time, saving 100–400 dollars energy costs per month to the owner depending on the size of the property. The system also provides relief to the power network in times it is needed most. Finally, it saves an estimated 500–1,000 kg CO_2 (1,000–2,000lbs) per month for an average home. ■

AUTHOR
Constantine Malynin
Maxlab

CONTACT
Maxlab,
Edmonton, Canada
Tel: +1 587 557 5865
email: hi@maxlab.io
maxlab.io

A multi-scan tunnel, set up on the basis of the Murrelektronik decentral plug-and-play concept.

Machine Vision with Focus on Efficiency

Decentralized Installation Solutions

Incoming goods, material flow, order picking, storage, shipping – these are processes that have to be coordinated in intralogistics. A suitable machine vision installation concept can help system operators save time and reduce susceptibility to errors. Fitted with decentralized installation technology, highly automated company departments achieve entirely new levels of efficiency, which can also benefit other sectors.

The number of sensors and actuators in cutting-edge logistics centers is constantly on the rise. This in turn requires continuous data exchange between the control system and the machines and systems. With its decentralized installation solutions based on the plug-and-play principle, Murrelektronik has struck a chord with its customers.

Potential of Decentralized Solutions

The advantages are clear – components such as IP67 I/O modules can be fitted directly to the machine or system in the field using pre-assembled plug-in connectors (M8 or M12). In this way, all sensors and actuators can be connected to pluggable I/O modules in protection class IP67 – simply and without any wiring errors. That's plug-and-play.

Compared to point-to-point wiring, this cuts the installation time significantly. Instead of laying lots of individual lines to the control cabinet, two lines are enough for fieldbus or Ethernet systems – one each for power and communication. As a result, there is also no need for construction time in the control cabinet, such as stripping, fitting wire end ferrules, and connecting terminals.

Protection from Production Downtimes

The quick and easy installation frees up valuable capacity and enables an existing system to be retrofitted just as quickly – in line with the Brownfield approach. Even planning an upgrade or expansion – from procurement to commissioning – is extremely time-consuming. A decentralized I/O concept based on standardized modules and plug-in connectors creates a time advantage. What's more, IP67 modules such as a hybrid switch also deliver diagnostic data relating to voltage and current for each port via a web interface. LEDs on the module provide initial optical indications for error diagnosis. The diagnostic data can then be transmitted to higher-level cloud systems in a straightforward, targeted way, meaning service technicians have access to all key information at any time from any place, and can respond rapidly when there is an error. This increases machine availability and shortens costly downtime for maintenance.

Up to four cameras for machine vision can be connected to the hybrid switch and integrated into automation systems.

High Flexibility

Fundamentally, a machine vision system consists of sensors and cameras for lighting and recording the objects and an industrial PC for processing the data. High currents can be achieved using L-coded M12 plug-in connectors (16A). Alongside the Ethernet protocols Profinet, Ethernet/IP, and Ethercat, fieldbus modules such as MVK Pro and Impact67 Pro can be used independently of the fieldbus via OPC UA, MQTT, or JSON Rest API.

Machine vision applications can be adapted quickly to changed conditions with specialist products for the decentralized installation concept. A typical example is a multi-reader scan tunnel, which consists of machine vision sensors that scan and photograph a product from every side, sort it,

Scanning and individual picking almost without a control cabinet. Decentralized installation solutions make this possible.

and forward it to the correct place. The data is processed by an industrial PC and compared with the expected information. Murrelektronik has developed an I/O solution for this application that can be connected to the sensors via plug-and-play. At its core is the Xelity Hybrid Switch, through which up to four cameras can be connected per switch. Two M12 ports supply power to the cameras and enable communication. Even larger applications with high energy needs and multi-camera applications can be implemented with ease.

Control-cabinet-free Future

Logically, the next step would be to set aside the control cabinet entirely and implement the automation functions in the field in line with specific requirements. With Vario-X, Murrelektronik has developed just such a system. It consists of a platform, plus a hardware module, which takes over some of the functions of a control cabinet and brings them directly to the machine. Power supply, control systems, switches, safety technology, and I/O modules are installed in the robust waterproof and dust-proof housing. The sensors and actuator systems in the field become even more flexible as a result.

Ultimately, though, it is not a specific product that is decisive when it comes to creating an efficient installation solution. Instead, it is the fundamental idea on which decentralized automation concepts are built – simplifying, modularizing, transferring to the field, and combining technologies. Furthermore, the IO-Link communication standard ensures transparency for the linking of data – from sensor to cloud. ■

AUTHOR
Simon Knapp
Solution Manager Machine Vision
at Murrelektronik

Louis Stadel
Industry Development Manager
Logistics at Murrelektronik

CONTACT
Murrelektronik GmbH
Oppenweiler, Germany
Tel: +49 7191 470
Email: info@murrelektronik.de
www.murrelektronik.com.

all images: Murrelektronik

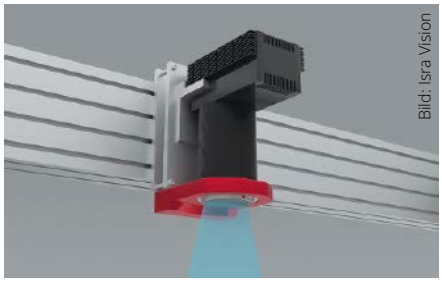


Bild: Isra Vision

Inline Inspection of Polarization Films

Isra Vision offers an advanced automatic optical inspection system with new sensors that enables even better detection of typical defects such as scratches, Harley Bear and perforations. Thanks to a special additional lens, the polarization angle of the camera can be changed automatically. Preconfigured product-specific profiles can be sent to the camera online. Stopping production for adjustment is not necessary. This not only helps to further optimize the inspection performance and thus the quality of the end product, but also saves time and money.

Product-specific settings can be preconfigured as recipes and transmitted online to the camera during operation. Compared to manual adjustment of the polarization angle, automatic adjustment enables greater precision and saves not only time but also costs.

www.isravision.com

Bild: Micro-Epsilon

Laser Sensors Further Developed

Micro-Epsilon has improved the Opto NCDT 1420 series laser sensors. With double the measuring rate , 16-bit digital/analog conversion and IP67 protection, they are now even faster. They are suitable for series applications in automation and mechanical engineering.

They measure on almost all surfaces and work with intelligent exposure control that compensates for light-dark and matt-gloss changes quickly and reliably. Thanks to the small light spot, even the finest details can be captured with high precision. Its robust aluminum housing with IP67 protects the sensor from external influences and ensures vibration resistance. The sensors are also equipped with an integrated controller and drag chain-compatible cables.

The Opto NCDT 1420 laser sensors are used for precise path and distance measurement in measuring ranges from 10 mm to 500 mm. **www.micro-epsilon.com**



Bild: Roboception

New Version of Robotics Software

Roboception has released the version 24.07.0 of Image software, which includes improvements and new features for warehouse automation. Highlights include new measurement and dimensioning features, improvements to the Silhouette Match and CAD Match modules, and support for side views in the BoxPick+Match module. Silhouette Match now offers simplified baseline definition for moving sensors and collision detection. The new measurement features enable depth measurements and dimensioning, useful in various industries such as construction and logistics. Other optimizations include a new sorting strategy, QR code reset , and improvements in CAD Match . These features are designed to help companies increase efficiency and reduce costs.

www.roboception.com


Bild: Verisurf

Software Suite for Process Control

Verisurf has introduced a new software suite that provides a cost-effective solution with comprehensive CAD capabilities, open device compatibility, and a streamlined inspection and reporting process. The Inspection Planner Suite enables users to quickly and easily create and execute inspection plans for various devices such as arms, trackers, scanners, and manual CMMs. It also supports the execution of proven inspection plans on CNC CMMs with 3- and 5-axis touch probes. The workflow includes CAD, model-based definition (MBD)/production information (PMI), plan creation and execution, and GD&T reporting and analysis. The suite offers flexible licensing options, including training and technical support. **www.verisurf.com**


Bild: Scanlab

Smart App for 2D and 3D Scanning Solutions

Scanlab has expanded the range of functions of its calculation app Scancalc. The free app, which was first introduced in 2017, simplifies calculations for users when checking scan parameters for their individual requirements. The app was already able to calculate the focus diameter and display the accuracy of various 2D scan systems at a selected focal length. The new app version has now been expanded to include 3D systems and is available as an iOS and Android version in the usual app stores in German and English. The free app includes the glossary Scanpedia to explain technical terms, as well as a detailed help menu for questions about the calculations. Once the app has been installed, it can be used at any time, without an internet connection. **www.scanlab.com**

Bild: Metrios

Measuring Machine for Heavy Loads

Metrios has introduced the Metrios 332 optical measuring machine . It has an XY measuring range of 300 x 300 mm and a generous part passage of 200 mm. A large measuring range in combination with a large part passage enables the Metrios 332 system to measure a wide variety of components, thus offering flexibility and versatility. The maximum load weight is 20 kg. A wide-field sensor detects the components on the table and measures them at maximum speed. The new Ultra HD sensor can detect even the smallest details in XYZ. There is also a special lighting system: It shields the ambient light and ensures reliable measurement results even on difficult-to-detect surfaces
. **www.metrios.net**

Take spectral analysis to new heights with KnowItAll 2024

Powerful software. Quality data. Results you can rely on.

KnowItAll combines all the tools and spectral databases you need for effective analysis into **a single, easy-to-use interface to make your lab its most efficient**.

Compatible with over 130 instrument formats, it streamlines your entire workflow regardless of how many techniques and instruments you use.

WILEY

sciencesolutions.wiley.com

Measurement technology for high production with high quality

Quality assurance for a sustainable transport sector

With the increasing focus on sustainability and electrification, the importance of batteries continues to grow. A high-precision production process is essential to meet this demand and to keep the quality, performance and cost-effectiveness of batteries at the highest level. State-of-the-art sensor technology is used to optimize the individual production processes and maximize quality.

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 sensors are used by leading battery manufacturers and automotive groups around the world who need high precision and reliability. The manufacturer offers quality and solutions expertise for both series and OEM applications. The sensor signals can be calculated, evaluated or analyzed using turnkey solutions.

More precision in battery production

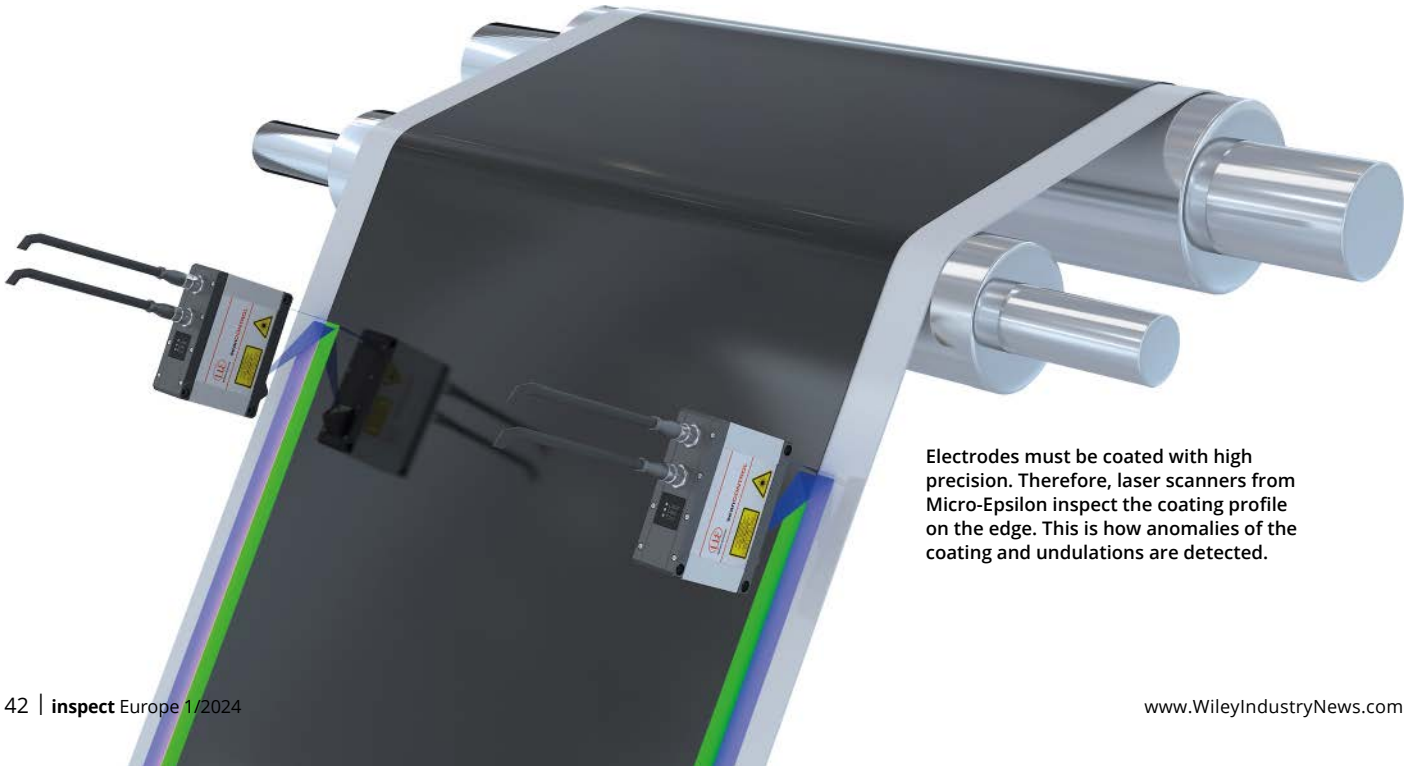
Sensors and systems from Micro-Epsilon are used in highly automated processes in all production steps of anodes and cathodes, separators and active material. They measure with high precision during coating, calendering, assembly and even forming. Micro-Epsilon offers numerous solutions for electrode 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.

Two-sided thickness measurement for electrode coating

With double-sided thickness measurement, two sensors from the Opto NCDT 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 ideally 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 is ideal 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 high accuracy and very compact size, the Opto NCDT 1900 LL is ideal for these measurement tasks. Another advantage is the possibility of solving measurement tasks with laser class 2.

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 can also be used at high process temperatures of up to 200 °C. With 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 now are suitable for distance and thickness measurement tasks across the entire process chain.



Electrodes must be coated with high 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.

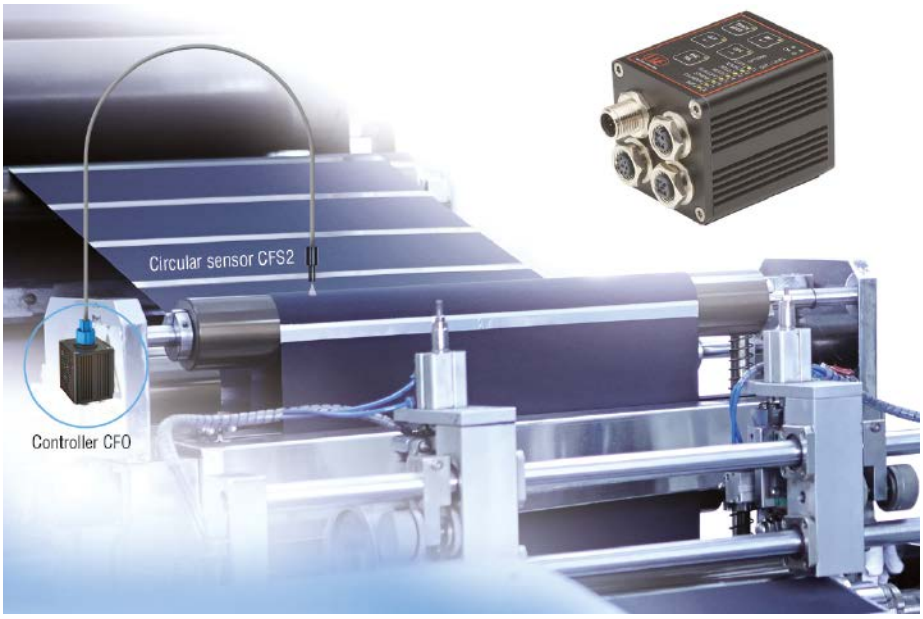
In addition to capacitive sensors, confocal chromatic sensors, white light interferometers and laser sensors are also used. These are typically used to monitor and control wet coating processes, but are also suitable for dry processes.

Process-reliable distinction of black tones in battery production

The production of lithium-ion batteries requires maximum precision. In this ultra-modern manufacturing process, 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 and dimensional measurement technology 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-&-go measurements with extremely high precision. The 3D sensors from Micro-Epsilon enable 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 highest precision in the distinction of black tones is essential. The Colorsensor CFO200 color measuring system in conjunction with the innovative CFS2-M11 circular sensor reliably solves this measurement task and makes it possible to distinguish color nuances.

3D monitoring of the coating application on the belt edges

Electrodes must be coated with very high 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 machine vision environments. The 3D inspect software is available for parameter setting, evaluation and output.

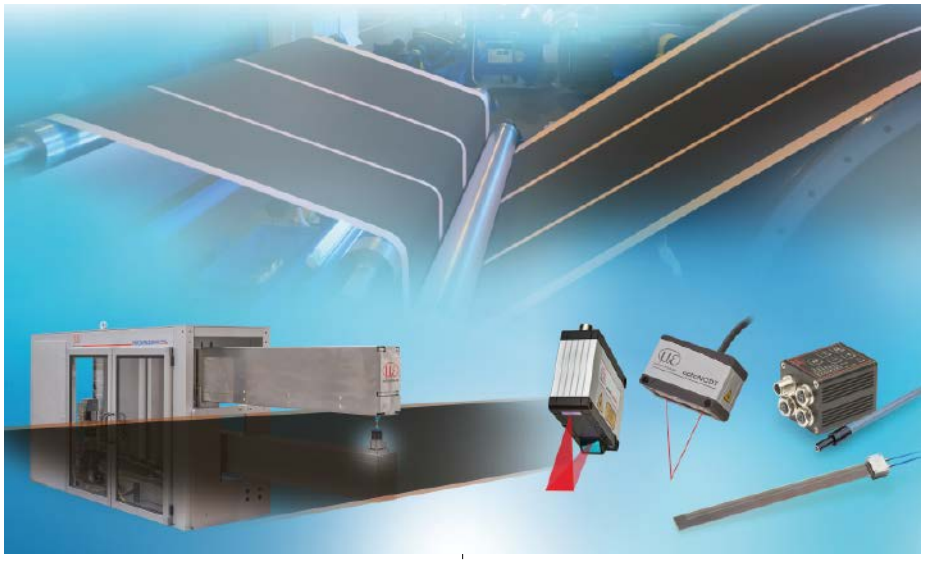
Web edge control of electrode film

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.

Measuring system for high precision inline thickness measurement of battery film

The Thicknesscontrol measuring system is used for high-precision 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 enables 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. ■

Micro-Epsilon develops, produces and distributes a globally unique range of sensors, measuring systems and customer-specific solutions.



AUTHOR
Michael Kuran
Key Account Manager / Group Leader Sales Sensors at Micro-Epsilon

CONTACTS
Micro-Epsilon Messtechnik GmbH & Co. KG, Ortenburg
Tel: +49 8542 168 0
battery@micro-epsilon.com
www.micro-epsilon.com

all images: Micro-Epsilon

The Berlin-based company Gefertec develops and builds machines that use the metal 3D printing process "Wire Arc Additive Manufacturing".

Precise temperatures for 3D printing

Infrared measurement technology for additive manufacturing

Wire Arc Additive Manufacturing (WAAM) is an additive manufacturing process that has become increasingly important in the 3D printing of metals in recent years. High build rates, wire as an inexpensive and easily available starting material and a very controllable process are the main advantages. To optimize 3D printing, Berlin-based 3D printing specialist Gefertec uses infrared measurement technology to record the temperatures in the workpiece.

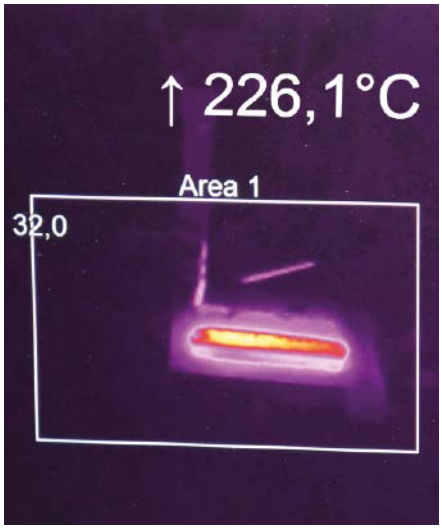
The Berlin-based company Gefertec develops and builds machines that use the wire arc additive manufacturing metal 3D printing process. The arc machines, which are available as 3- and 5-axis variants in several sizes, integrate arc welding technology, CAM software and a machine tool to create a ready-to-use additive manufacturing solution. The currently largest expansion stage with an installation space of 8 m3 can produce components weighing up to 8,000 kg. The associated CAM software uses the CAD data of the workpiece to generate the data that the CNC control uses to precisely position the welding head. The machine then produces the near-net-shape workpiece fully automatically. After the 3D printing process, the surface of the component is completely or partially machined, depending on the requirements of the application.

Essential: The temperature in the process

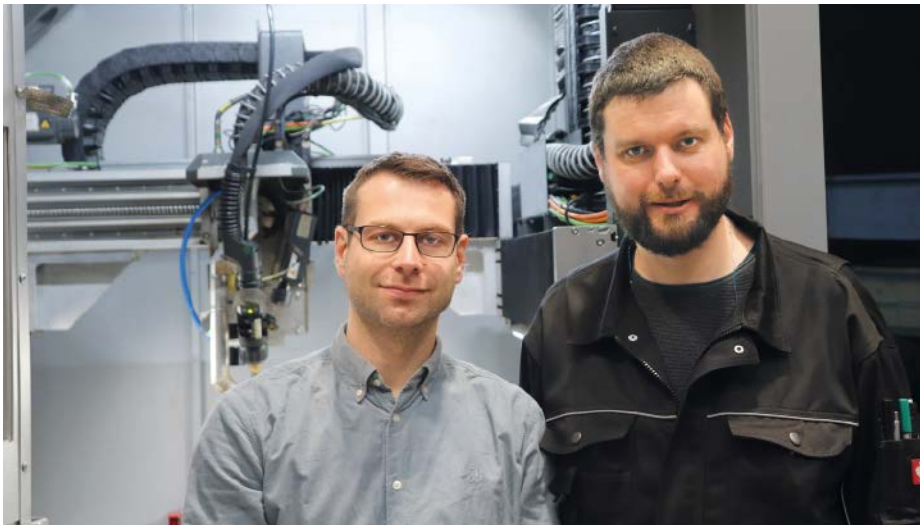
Temperatures play an important role in the WAAM process. This is because the temperature distribution in the workpiece and the cooling behavior are crucial for ensuring the quality of the finished component. "During machine operation, welding is only started when the underlying layer has cooled down to a certain temperature," explains Martin Lange, a product development employee at Gefertec. If the intermediate layer is still too warm, this leads to uneven build-up behavior - the layer thickness would vary too much and the geometry of the component would not be maintained. The corresponding temperature measurement technology is solved in the machine with a pyrometer. After completing a layer, the welding head moves to the starting point of the next layer, where the pyrometer measures the temperature of the component. And only when this has dropped to the preset value the machine continues working. "In most applications, we set a value of 150 to 200 °C for the intermediate layer temperature," says the development engineer: "This is ideal for the reproducibility of the weld seam height."

Pyrometers from the CT series from Optris will be used in the arc machines that Gefertec will deliver in the future. These have a very small measuring head that can be easily integrated into the machine. The separate electronics box, which is located in the control cabinet, has several outputs via which the value is transferred to the machine's control system. In this way, the interlayer temperature is set precisely to the right value during operation.

In order to determine the temperature accurately with a pyrometer, the emissivity must be known exactly. Falsification of the measurement can also occur if the view of



The infrared camera measures the temperatures and their distribution over the entire component, while the software displays the maximum temperature.



Martin Lange (left) is a product development engineer at Gefertec. Martin Wolter is a welding engineer responsible for the process.

the measuring surface is not unobstructed. "With our arc machines, we can also print components made of titanium, although it is impossible to avoid a high level of smoke," says Lange, explaining the problem. In this case, the use of ratio pyrometers, such as those from the CT ratio series from Optris, is recommended. As the ratio of the intensities at two wavelengths is formed here, the measurement remains reliable despite disturbed vision. "This is why we will probably use the pyrometers from the CT ratio series in machines in the future if the user wants to use them to print titanium components," says Lange.

Infrared cameras support development

Infrared cameras are also used in the development of the arc machines and especially in the qualification of the processes. "As part of our investigations, it is advantageous to be able to record an overall image and thus obtain a spatial distribution of the temperatures," explains Martin Wolter, who works as a welding engineer in process development at Gefertec. This makes it possible to examine temperature distributions and cooling processes, which are required for the qualification of the processes. A spotfinder infrared camera such as the Xi 400 from Optris is particularly helpful here. This has an optical resolution of 382 x 288 pixels.

"As the spectral range used in the current infrared camera is not optimal for use on metal surfaces, we only get a qualitative statement and no real temperatures," Wolter emphasizes a small disadvantage of the current infrared camera. In order to determine the actual temperatures in the melt pool and its surroundings, a new infrared camera from Optris, the PI 1ML, which is specially designed for applications with metals, may be used in future. It uses a measuring wavelength in the range of 1 µm; in this spectral range, the emissivity of metals is significantly higher than in the usual spectral range between 8 and 14 µm. This enables more accurate temperature measurements in this application.

The temperature measured with the pyrometer must drop to a preset value before the next layer is welded on. If the temperature were too high, the layer thickness would vary too much and the geometry of the component would not be maintained.

Technology in Detail

Wire Arc Additive Manufacturing (WAAM)

In Wire Arc Additive Manufacturing (WAAM), the material is applied to a base plate as a wire using arc welding, weld bead by weld bead. This has several advantages compared to powder-based processes: wire is significantly cheaper as a starting material and most materials are available in wire form. In addition, the complex powder handling and vacuum technology can be dispensed with. The biggest advantage, however, is the high build-up rate: depending on the material used, this can reach up to 650 cm^3 per hour.

Simple evaluation of the thermographic images

The infrared cameras from Optris can be connected to a PC via a USB interface in order to transfer the recorded images. With the PIX Connect analysis software, which Optris supplies together with the infrared cameras, the thermographic images can be evaluated in real time. The software also makes it easy to archive the images. ■

AUTHORS
Ingo Stahlkopf
Head of Sales, Optris

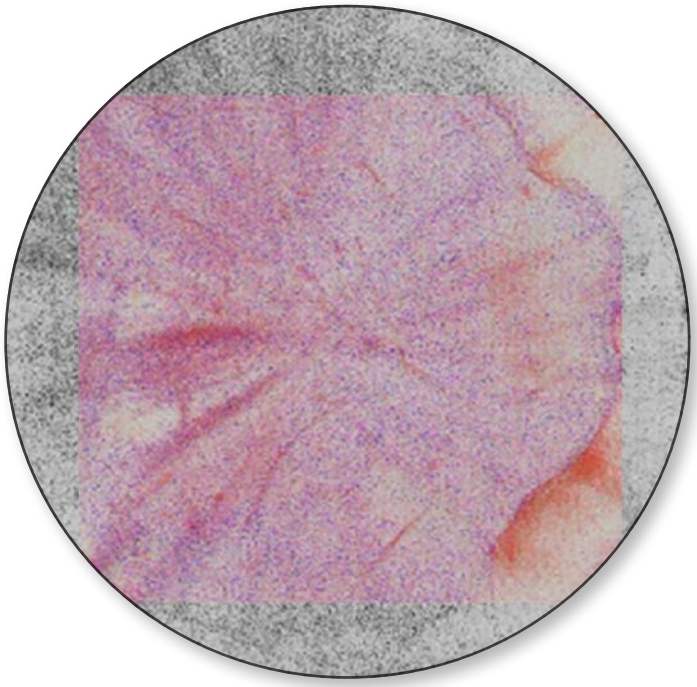
Torsten Czech
Head of Marketing, Optris

CONTACTS
Optris GmbH & Co. KG
Berlin, Germany
Tel: +49 30 5001970
Email: sales@optris.com
www.optris.com

All images: Optris

Machine Learning Helps to Optimize SiC Wafer Defect Detection

Artificial Intelligence in Semiconductor application



Detecting defects on silicon carbide (SiC) wafers is important for semiconductor quality which unique properties are vital for industries like electronics or automotive. A custom solution using machine learning has been developed to improve defect detection, enhancing efficiency and accuracy in wafer inspection.

Detecting defects on etched silicon carbide (SiC) wafers is crucial for ensuring the quality and reliability of semiconductor devices. SiC is highly valued in the semiconductor industry due to its unique technical and physical properties, which contribute to enhanced performance in modern circuits. The adoption of SiC devices is rapidly expanding, particularly in sectors such as electric vehicles, renewable energy systems, and industrial drives, where they offer superior efficiency, power density, and reliability.

In seeking ways optimize its quality assurance process, the SiC material manufacturer Ebner Euroepean Mono Crystal Operation (Eemco) turned to Evident and its Preciv microscope image analysis software for assistance. Evident and Eemco collaborated to develop a custom solution using Preciv software's advanced machine learning algorithms, enhancing the accuracy and efficiency of defect detection and characterization on its large wafers. Their solution has the potential to provide significant benefits across various industries whose manufacturing processes involve SiC wafers.

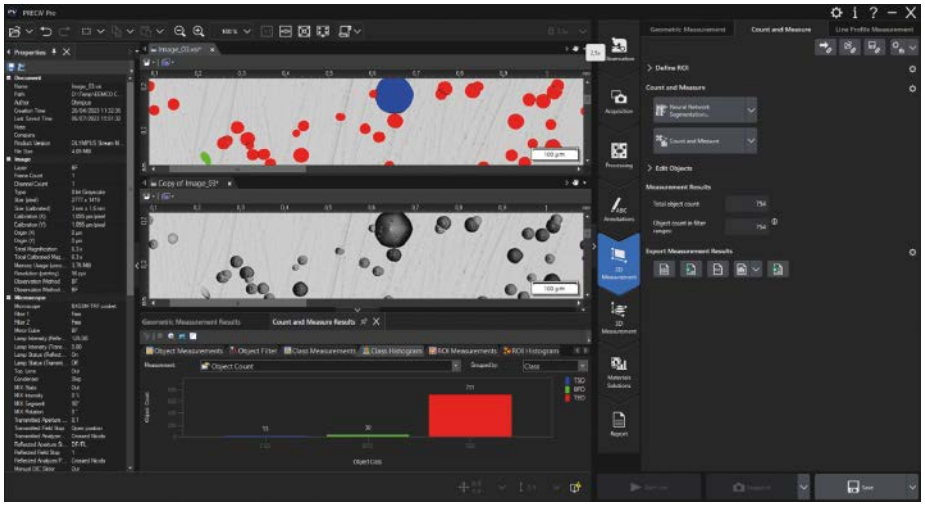
Crafting a Tailored Approach for Optical Examination of Large SiC Wafers

Evident Technology Center Europe (ETCE) solution managers Dr. Norbert Radomski and Dr. Sergej Bock elaborate on the benefits of their tailored wafer inspection solution. "Our expanded portfolio now encompasses the acquisition and analysis of entire etched SiC wafers, ranging from 6 inches to 8 inches," says Dr. Radomski, highlighting the solution's versatility [2, 3]. Dr. Bock adds, "Leveraging machine learning, our solution enhances defect characterization, and concurrent analysis during data acquisition bolsters efficiency."

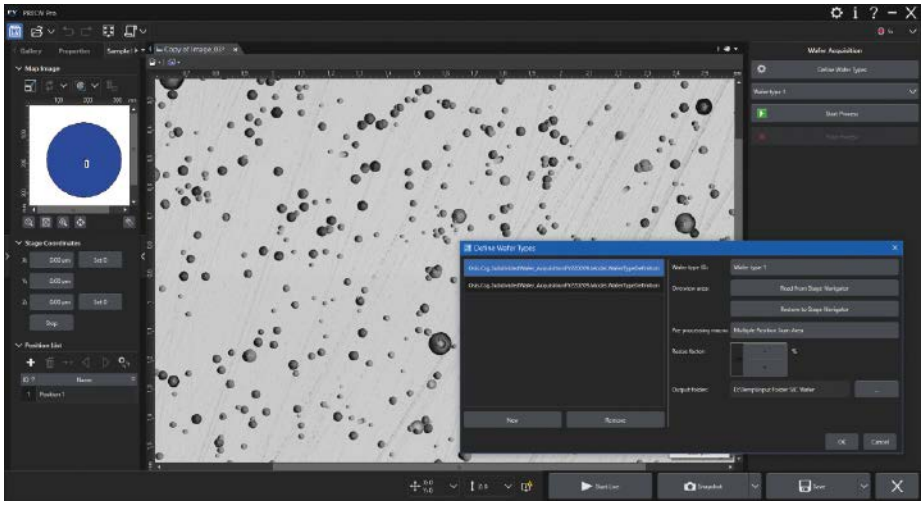
This inspection solution holds significance in detecting and characterizing defects that can arise during the SiC crystal growth process, which uses the physical vapor transport (PVT) method to form a single crystal within a SiC vapor phase. Crucial to this process is managing crystal stress to minimize defect densities, including micropipes (MP), basal plane dislocations (BPD), threading screw dislocations (TSD), and threading edge dislocations (TED) [4]. These defects significantly impact the electrical properties of SiC wafers. The molten potassium hydroxide (KOH) etching method emerges as an effective means to characterize dislocations in SiC [5].

The Problem: Efficient Analysis of Entire Large-Diameter Wafers

To optimize the efficiency of its control and monitor the SiC wafer production process and final product quality, Eemco enlisted the help of Evident's Custom Solutions team. The objective was to develop a solution capable of conducting comprehensive optical analyses of entire wafers measuring 150 mm and 200 mm (6 and 8 in.) in diameter.



Dislocations detected by neural network segmentation (upper part) and a brightfield image of an etched SiC wafer (image resolution: 1.095 µm/pixel). Note that clustered and overlayed dislocations are separated



First step in Preciv software's wafer acquisition workflow, defining the wafer types

"This is a formidable task," remarks Radomski, highlighting the challenges. "Firstly, obtaining high-resolution images (1–2 µm/pixel) of the entire wafer is time-consuming and generates substantial data volume per wafer. Secondly, traditional particle analysis falls short in detecting dislocations accurately due to clustering and overlapping, rendering simple threshold-based segmentation inadequate for meaningful results."

A limitation of thresholding is the inability to discern specific structures in images. Instead, it identifies multiple objects simultaneously without distinguishing between them based on predefined grayscale or RGB intensity values [7]. "In contrast," Bock emphasizes, "machine learning forms rules for object detection based on multiple examples of representatives of objects of interest." Leveraging this automated evaluation via deep artificial neural networks, which autonomously classify image areas irrespective of preset threshold values, helps to streamline image analysis and enhance accuracy.

Evident's Custom Solutions team successfully demonstrated the efficacy of a segmentation approach utilizing a suitably trained neural network. This approach enables the automatic separation of clustered and superimposed dislocations facilitating comprehensive defect density analysis.

It's worth noting that both training and executing a neural network demand substantial computing power, typically furnished by hundreds or even thousands of Compute Unified Device Architecture (CUDA) cores within a Cuda-enabled Nvidia graphics card.

"A single image of a 6-inch wafer (150 mm) captured at a resolution of 1.095 µm/pixel comprises roughly 4,000 individual images and totals about 25 GB in size. Even with cutting-edge graphics cards, performing neural network segmentation on the entire image would require hours," Bock explains.

Doubling Acquisition and Analysis Throughput through A Twofold Approach

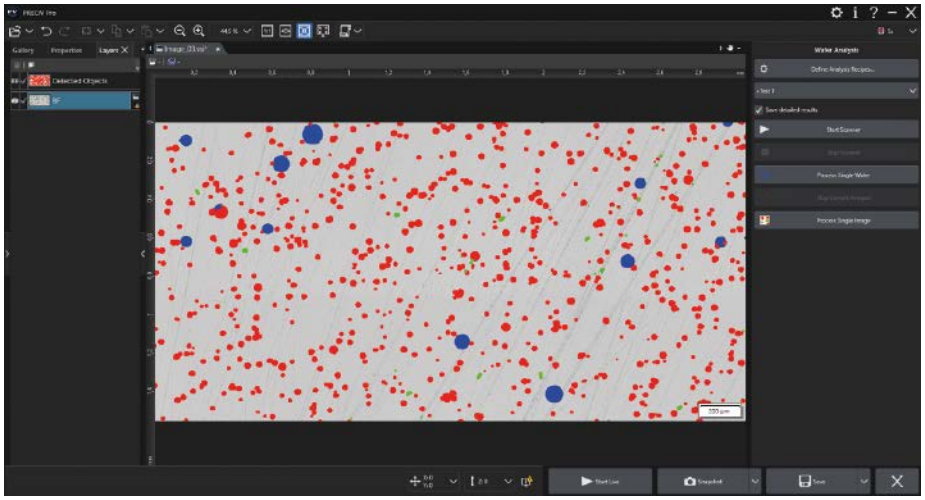
Given that the density of dislocations per unit area serves as a pivotal quality criterion for SiC wafers, the custom solution adopts a 'divide and concur' approach, separating the process into acquisition and analysis stages, each handled by a separate PC. With two instances of Preciv software performing the acquisition and analysis workflows in parallel, this setup effectively doubles throughput, enhancing overall efficiency.

Dr. Radomski breaks down the whole process, "Upon capture, the entire wafer image is stored in a predefined location by the acquisition system. A status file indicates the completeness of the image, signaling readiness for analysis via the neural network-based defect wafer analysis solution. This analysis solution segments the large wafer image into smaller tiles of user-defined dimensions, subjecting each tile to batch analysis employing neural network segmentation. Dividing the computation across smaller tiles markedly improves efficiency. Moreover, the output includes dislocation density data for each individual tile area. Given the known positions of these tiles on the wafer, the output effectively comprises a density map spanning the entire wafer."

The custom solution workflow commences with wafer acquisition, marking the initial stage of this comprehensive process.

Meticulous Records of Each SiC Wafer's Inspection Results

The SiC wafer inspection yields exportable results in CSV or XLSX format, offering



The Define Analysis Recipes dialog box of the wafer analysis solution in Preciv software

detailed data per tile, including specific information on detected defects, or in a summarized table format showcasing defect classes per tile. The primary sheet comprises an image per tile alongside object IDs denoting identified defects, their respective center of mass in the X and Y directions, and various shape descriptors such as sphericity and orientation.

The summary file presents row and column IDs for all subtiles, alongside individual defect counts per class. Each class corresponds to a distinct defect type. Additionally, the software generates a comprehensive overview image of the SiC wafer in TIF format, featuring a detection layer color-coded to indicate defect classes. For documentation purposes, a compressed JPEG image with embedded detection overlays is also available. Together, these meticulously organized images and data facilitate efficient defect analysis across the entire wafer.

Custom Solution Paves the Way for Improved SiC Wafer Quality and Performance

Underscoring their shared dedication to innovation and excellence in SiC manufacturing, the collaboration between Eemco and Evident accomplished its target objective: to optimize the image acquisition and analysis workflows for etched SiC wafers.

Leveraging Preciv software's advanced functionalities and machine learning techniques, Eemco's detection and characterization of SiC wafer defects has undergone remarkable enhancements. The solution not only improves its workflow efficiency but also helps assure improved product quality and reliable performance across various applications. As the demand for SiC-based devices continues its upward trajectory, such collaborative endeavors epitomize the industry's commitment to addressing evolving technological demands and ushering in a new era of sustainable, high-performance electronics.

References

[1] "Eemco Applications." 2021. Eemco.

[2] Bock S. and Radomski N. 2022. "Optimizing Wafer Inspection with Advanced Microscopy and Image Analysis." Electronics Today.

[3] Bock S. 2023 "Optimize Your Wafer Inspection Microscope and Workflow." Evident InSight Blog.

[4] Seldrum T. "Short Overview Etch Pits: High Quality 150 mm SiC Substrates for Power Electronics Application." Power Electronics Europe. Issue 4.

[5] Wang et al. 2021. "Micropipes in SiC Single Crystal Observed by Molten KOH Etching" Materials. 14(19), 5890.

[6] Ou et al. 2023 "Novel Photonic Applications of Silicon Carbide." Materials. 16(3), 1014.

[7] Janovsky A. 2023. "The Potential of AI-Based Image Analysis in Metallography and Materialography." Evident InSight Blog.

AUTHORS

Norbert Radomski
Solution Manager in the Global Customized Solutions Group at Evident in Germany

Sergej Bock
Solution Manager in the Global Customized Solutions Group at Evident in Germany

CONTACTS
Evident Europe GmbH, Hamburg, Germany
www.evidentscientific.com

all images: Evident

Neue Silizium-Photodioden für den nahen Infrarotbereich

Bild: Fraunhofer IPMS

Bildsensoren und Fotodioden sind in vielen Anwendungen gefragt, vor allem im nahen Infrarotbereich. Allerdings bieten siliziumbasierte Photodioden noch keine ausreichende Empfindlichkeit, weshalb teure und umweltschädliche Materialien wie Indiumgalliumarsenid (InGaAs) zum Einsatz kommen. Das Fraunhofer-Institut für Photonische Mikrosysteme IPMS entwickelt nun im Projekt »MesSi« kostengünstige, empfindliche Silizium-Photodioden. Die Bundesregierung fördert das Projekt mit 566.000 Euro. Neue Pyramiden- und Ringstrukturen sowie eine dünne Metallschicht im Schottky-Übergang sollen die Empfindlichkeit erhöhen. Diese Innovationen ermöglichen Anwendungen im nahen Infrarotbereich, etwa in der Sicherheitstechnik, beim autonomen Fahren und in der medizinischen Bildgebung. Silizium-Photodioden bieten ökonomische und ökologische Vorteile und tragen zur Nachhaltigkeit in der Halbleiterindustrie bei.

ipms.fraunhofer.de

Strahlungsresistente Objektive für hochauflösende CMOS-Sensoren

Bild: Resolve Optics

Resolve Optics bietet einen Design- und Fertigungsservice für Hersteller von Nuklearkameras und -sensoren, die strahlungsbeständige Objektive benötigen. Um dieser Nachfrage gerecht zu werden, wurde ein 10-fach strahlungsresistentes Zoomobjektiv entwickelt, das bessere HD-Farbbilder für nukleare Anwendungen liefert. Versionen dieses Objektivs wurden bisher für die CMOS-Sensorformate 1/4 Zoll, 1/3 Zoll und 2/3 Zoll hergestellt. Das HD-Zoomobjektiv verwendet speziell ausgewählte, strahlungsresistente Gläser, die klare, scharfe Bilder ohne den starken Gelbstich erzeugen, der bei herkömmlichen strahlungsbeständigen Objektiven an Farbsensoren ein Problem darstellt. Diese Gläser können Langzeitstrahlung bis zu einer kumulativen Dosis von einhundert Millionen rad und Temperaturen von bis zu 85 °C ohne Transmissionsverlust standhalten. Alle strahlungsbeständigen Objektive von Resolve Optics bieten eine hohe Bildauflösung und minimale geometrische Verzerrung im Bereich von 400 bis 750 nm.

www.resolveoptics.com

Bild: Aerotech

Control Function for AGV Laser Scanner

The demand for laser processes with higher throughput is increasing across all industries, while quality standards are becoming more stringent at the same time. Conventional laser scanning systems are quickly reaching their limits. The motion control experts at Aerotech are therefore now supporting their users with an extended controller function: The "enhanced scanner control" (ESC) can be used without additional setup or programming effort and ensures fewer errors with more throughput.

Aerotech , applications that are already benefiting from the new control functions include deep hole laser drilling, circular contouring, corner contouring and laser cutting.

www.aerotech.com

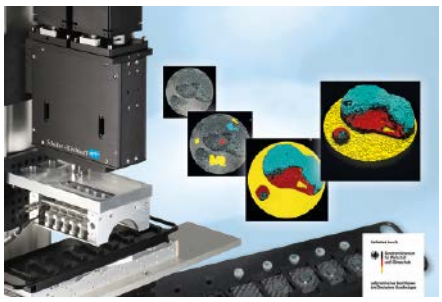


Bild: Schäfter & Kirchhoff

Adhesive Fracture Surface Inspection System

The Adhescan system is now available for sale at Schäfter+Kirchhoff. It is a user-friendly complete system for the quantifiable, reliable and reproducible fracture pattern assessment of common types of adhesive fractures. The system was developed to use expert knowledge objectively and reproducibly. Adhesive professionals benefit from the simple operation and the specially developed image capture in combination with trainable machine learning algorithms.

Adhescan is a further development of a demonstrator that was developed in collaboration with Fraunhofer IFAM (Department of Adhesion and Interface Research & Quality Assurance and Cyber- Physical Systems) as part of a publicly funded project of the Federal Ministry for Economic Affairs and Climate Policy (BMWK) (SAMBA, 20Q1924A).

www.sukhamburg.com

Bild: Flir

Test and Measuring Instrument Series

Extech, distributed by Teledyne Flir, has announced the launch of a new series of measuring instruments aimed at electrical, HVAC and industrial professionals: the EX Series multimeters and clamp meters, the IAQ320 air quality meter and the BR450W borescopes.

The newly introduced EX series devices are equipped with integrated safety features and ensure accurate diagnosis while protecting engineers from potential electrical hazards. Their technology simplifies complex measurements and increases the reliability of all readings, making them indispensable for professionals.

When it comes to endoscope inspections, the BR450W wireless video borescopes offer clarity and flexibility. These devices provide high-resolution images of hard-to-reach places, enabling non-invasive diagnosis that helps avoid costly disassembly and potential damage. Suitable for applications ranging from automotive to aerospace, these borescopes ensure that no defect goes undetected.

www.teledyneflir.com

New Version of Measurement Software

This year, Zeiss is releasing a new version of their software for metrology on the market: Zeiss Calypso 2024 with many new features and improvements for different user groups. The software evaluates the data obtained from tactile and optical measurements from Zeiss coordinate measuring machines and is continuously being further developed by the company. In Calypso 2024, users can create test plans from product and manufacturing information (PMI, Product Manufacturing Information) based on the new form and position library. In the context of quality assurance, this means that, for example, the CAD model of a component is enriched with form and position tolerances. This information serves users as a tool for generating clear, repeatable and comparable measurement results. The combination of PMI and the software's new library therefore enables work to be carried out even faster and more productively.

www.zeiss.com

Bild: Hexagon

Portable 3D Scanners

Hexagons has introduced two new handheld devices. The Atlascan Max and Marvelscan are suitable for measuring parts in a wide range of inspection environments where metrology is not traditionally used: for example, automotive, rail, industrial equipment and general manufacturing, as well as off-manufacturing restoration projects. The devices can also carry out 3D scanning processes in tight spaces, harsh environments or outdoors. Since access to a control PC is not required during measurement, this multi-mode scanning enables the efficient measurement of different feature types and surfaces. For example, users can scan open surfaces in standard mode and then quickly switch to fine mode using the device's controls for higher resolution on complicated features.

www.hexagon.com

Bild: Creaform

Kit for Automated Quality Control

Creaform is launching an automation kit that transforms the portable 3D scanners Handyscan 3D and Metrascan 3D into full-fledged automated quality control (AQC) solutions. Equipped with a collaborative robot (cobot) and all associated equipment, the The actual workstation allows the operator to use the 3D scanners in both portable and automated mode. A safe solution that is easy to install and use.

VXscan-R digital twin environment, making it a user-friendly all-in- one system that can be operated by anyone, including employees who are unfamiliar with or unfamiliar with the technology - according to the manufacturer.

www.creaform3d.com

Index

Imprint

Published by
Wiley-VCH GmbH
Boschstraße 12
69469 Weinheim, Germany
Tel.: +49/6201/606-0

Managing Director
Dr. Guido F. Herrmann

Publishing Director
Steffen Ebert

Product Management
Anke Grytzka-Weinhold
Tel.: +49/6201/606-456
agrytzka@wiley.com

Editor-in-Chief
David Löh
Tel.: +49/6201/606-771
david.loeh@wiley.com

Editorial
Andreas Grösslein
Tel.: +49/6201/606-718
andreas.groesslein@wiley.com

Stephanie Nickl
Tel.: +49/6201 606-030
snickl2@wiley.com

Advisory Board
Roland Beyer, Daimler AG

Prof. Dr. Christoph Heckenkamp, Hochschule Darmstadt

Dipl.-Ing. Gerhard Kleinpeter, BMW Group

Dr. rer. nat. Abdelmalek Nasraoui, Gerhard Schubert GmbH

Dr. Dipl.-Ing. phys. Ralph Neubecker, Hochschule Darmstadt

Commercial Manager
Jörg Wüllner
Tel.: 06201/606-748
jwuellner@wiley.com

Sales Representatives
Martin Fettig
Tel.: +49/721/14508044
m.fettig@das-medienquartier.de

Sylvia Heider
Tel.: +49 (0) 06201 606 589
sheider@wiley.com

Production
Jörg Stenger
Kerstin Kunkel (Sales Administrator)
Andreas Kettenbach (Design)
Ramona Scheirich (Litho)

Wiley GIT Reader Service
65341 Eltville
Tel.: +49/6123/9238-246
Fax: +49/6123/9238-244
WileyGIT@vuservice.de
Our service is available for you from Monday to Friday 8 am – 5 pm CET

Bank Account
J.P. Morgan AG Frankfurt
IBAN: DE55501108006161517443
BIC: CHAS DE FX

Advertising price list from October 2023

Circulation
5,500 copies

Individual Copies
Single copy € 17.00 plus postage.

Pupils and students receive a discount of 50 % at sight of a valid certificate.

Subscription orders can be revoked within 1 week in writing. Dispatch complaints are possible only within four weeks after publishing date. Subscription cancellations are accepted six weeks before end of year.

Print
westermann DRUCK | pva

Printed in Germany
ISSN 2567-7519

WILEY

WILEY

YOU GET WHAT YOU SEE

www.WileyIndustryNews.com

Wiley Industry News

WIN NEWS

MIDOPT®
MIDWEST OPTICAL SYSTEMS, INC.

FILTERS: A NECESSITY,
NOT AN ACCESSORY.

INNOVATIVE FILTER DESIGNS FOR INDUSTRIAL IMAGING

Optical Performance: high transmission and superior out-of-band blocking for maximum contrast

StablEDGE® Technology: superior wavelength control at any angle or lens field of view

Unmatched Durability: durable coatings designed to withstand harsh environments

Exceptional Quality: 100% tested and inspected to ensure surface quality exceeds industry standard

Product Availability: same-day shipping on over 3,000 mounted and unmounted filters

VISIT US AT
VISION

BOOTH #10F52

info@midopt.com • +1-847-359-3550 • MIDOPT.COM