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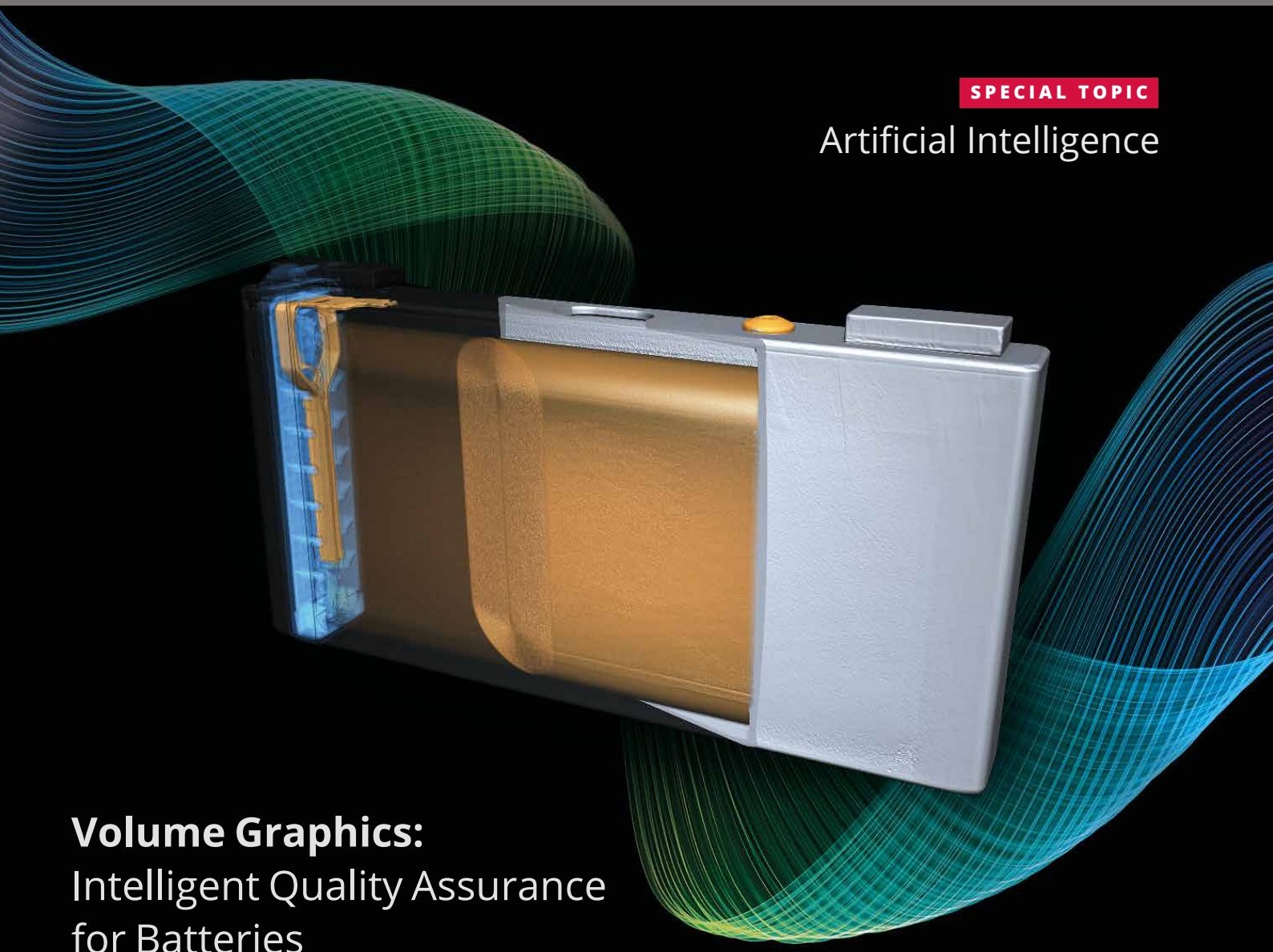
inspect international

WORLD OF VISION

www.WileyIndustryNews.com



SPECIAL TOPIC

Artificial Intelligence

Volume Graphics:
Intelligent Quality Assurance for Batteries

Partner of VISION AUTOMATICA Control emva VDMA ICC spectronet.

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Good products deserve an award – **our inspect award.**

inspect award 2022

Do not think twice, submit now!

Where? inspect-award.de (German) or inspect-award.com (English)

Until when? 14 May 2021

Who? Every company whose product from the Vision, Automation and Control sector convinces with an innovative approach.

www.inspect-award.com

April Showers Bring May Flowers

Spring is in the air, and the industry is confident. According to the market research company Imarc, the global machine vision market reached a value of US$ 10.7 billion in 2020. Looking forward, it is expected to exhibit moderate growth during the forecast period 2021 to 2026. Both engineering and sensorics and measurement technology are also reporting positive economic industry development. In engineering, four out of five companies suffered from a loss of revenue in 2020, but since September 2020 the number of companies that were able to avoid a decline has risen from 13 to 21percent according to VDMA. While sensorics and measurement had a 2 percent decrease in revenue, they are expecting a growth of 9 percent in 2021, reports AMA. Good news looking to the future!

There is also great news at Wiley. We have combined and totally revamped the different websites of our magazine brands inspect, messtec drives Automation and PhotonicsViews. With our new internet presence Wiley Industry News, WIN>NEWS for short, we will provide you with user reports, videos and in-depth whitepapers, news, product information, and multimedia content like podcasts. It brings you the latest from all corners of automation, machine vision, and “light at work”.

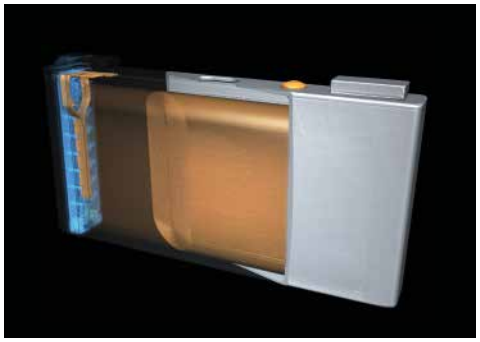
» **Both engineering and sensorics and measurement technology are reporting positive economic industry development.«**

Not only our new portal will provide you with everything that brings you closer to the technology of today and tomorrow. This issue of inspect international also covers many topics of current and future interest. This includes, for example, a series of insights into AI in machine vision, a report about AI-powered camera sensors, and our cover story: An article about preventing defects in modern batteries with the aid of computed tomography.

I am looking forward to a successful and innovative 2021 with you,

Hoping to see you in person again soon,

Yours,
Sonja Schleif



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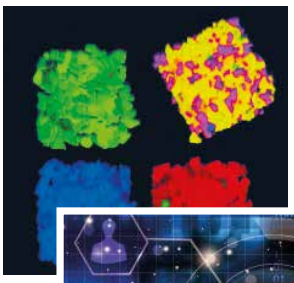
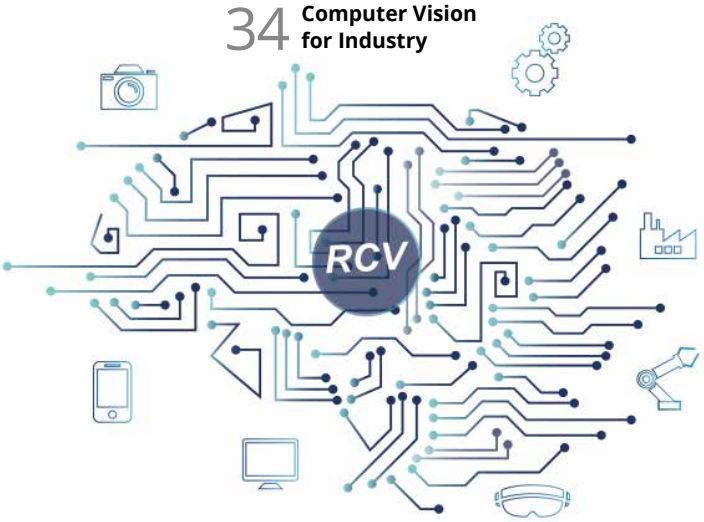




Automation

Control

Partner of: VISION, AUTOMATICA, Control, emva, VDMA, spectronet

EMVA Business Conference 2021 will take place purely virtually

The EMVA is holding the annual Business Conference this year as a purely virtual fair, making it the "Special Edition 2021". Originally it was supposed to take place in Sofia, Bulgaria. The new date is May 12-14, 2022.

After considering the situation in view of the corona pandemic and in consultation with the local conference partners in Sofia, Bulgaria, the board and management of EMVA decided the annual EMVA Business Conference to be postponed to May 12-14, 2022.

This year, instead, the EMVA Business Conference Special Edition 2021 will take place on June 10 and 11, 2021, to which business leaders and technical experts from the machine vision industry and the various user markets from Europe and around the world can register with immediate effect.

emva
european machine vision association

On the afternoon of June 10 and 11, 2021, an attractive and interactive program will be offered in a 4-hour session. In addition to keynotes and specialist lectures, you can look forward to pitch presentations from start-ups, panel discussions and fireside chats. The program is rounded off by individual networking meetings in the virtual room.

www.emva.org

Smart Vision Lights: Paul Powers appointed Vice President Global Sales and Marketing

Smart Vision Lights (SVL), a manufacturer of LED lighting, appoints Paul Powers as vice president, global sales and marketing. Powers joined Smart Vision Lights in June 2017 as business development manager for the eastern U.S., bringing more than

Image: Smart Vision Lights

21 years of experience in engineering manufacturing and sales support. Previously with Sentry Equipment and Erectors (Lynchburg, VA), a packaging equipment manufacturer and systems integrator, Powers has experience in the automotive, packaging and tooling industries. He has designed packaging lines for Fortune 500 companies and is well-versed in the various challenges of designing automated systems for industrial inspection.

Powers holds a bachelor's degree in business administration from Ferris State University (Big Rapids, MI) and a Business Solutions Professional certificate from Michigan State University.

www.smartvisionlights.com

Senswork opens development center for deep learning and AI

Senswork opens the Innovation Lab in Munich, where it is researching solutions for optical inspection using deep learning and AI. The company is currently working on the image analysis of large data sets using neural networks, the creation and evaluation of high-resolution 3D measurement applications and data acquisition outside of the wavelength range that can be perceived by humans.

www.senswork.com

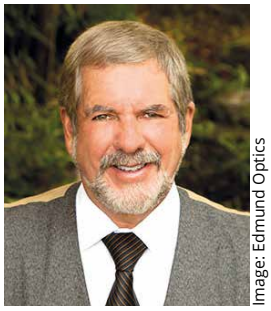


Image: Edmund Optics

Edmund Optics' CEO becomes SPIE Fellow

The International Society for Optics and Photonics (SPIE) has named Robert Edmund, CEO of Edmund Optics, a SPIE Fellow, honoring him for his achievements in the industry.

Robert Edmund is committed to educating the next generation of engineers: in 2011 he dedicated the Edmund Scientific Division to public relations, and now the program teaches optics to thousands of students annually. In addition, Robert has advocated optics for the US Parliament for more than 30 years. He is also deeply committed to the University of Arizona, giving out two special scholarships each year to undergraduate and graduate students pursuing careers in optics.

www.edmundoptics.com

Kim Povlsen named President of Universal Robots

Teradyne appoints Kim Povlsen as the new President of Universal Robots (UR). Povlsen is set to lead the next phase of growth and innovation for Universal Robots.

Kim Povlsen has held various senior business and technology leadership positions at Schneider Electric, a global energy management and automation company. Most recently,

Image: Universal Robots

as Vice President Strategy & Technology, he was responsible for technology strategy and implementation within this multi-billion dollar global organization. Povlsen lives in Aarhus, Denmark and has a Masters degree in Computer Science & Embedded Engineering from the University of Southern Denmark. The university's graduates include many of the innovators and leaders of Odense's prestigious robotics community.

www.universal-robots.com

Active Silicon acquired by Solid State

Solid State bought Active Silicon. The purchase price is £ 6.3 million and will be processed using Solid State's existing cash resources and banking facilities.

Solid State is an electronics company that supplies industrial and military markets with robust and durable components, assemblies and manufactured units for use in harsh environments. The group operates in two main divisions: manufacturing (steatite) and value creation needs (solids demand and pacemaker).

www.activesilicon.com

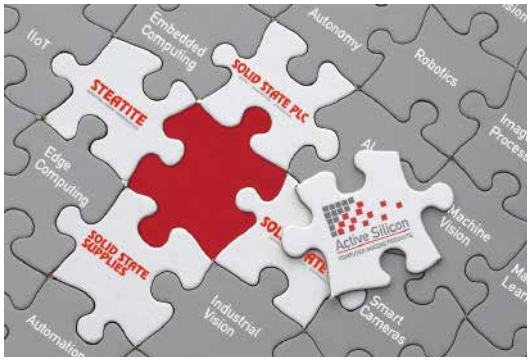


Image: Active Silicon

Image: Physik Instrumente

Physik Instrumente buys producer of granite base plates PGW

Physik Instrumente (PI) acquired all shares in the Japanese company Precision Granite W Co. Ltd. (PGW) acquired. PGW is headquartered in Gifu Prefecture, the center of Japanese aviation technology, and produces granite base plates with high surface precision. These serve, for example, as the basis for machine beds or measurement setups. System integration is also part of the PGW portfolio. Both fit perfectly with PI's corporate strategy, which among other things also includes the establishment of a global network of design centers, explains the Karlsruhe-based company. In the medium term, PI wants to integrate PGW into this network and make it the design center for the Asian region. It is also planned that PGW will create complete system structures for PI in the future.

www.physikinstrumente.de

DIN and DKE cooperate with SABS

DIN and DKE have signed a cooperation agreement (Memorandum of Understanding) with the South African standards organization SABS. The aim is to further deepen the close cooperation in standardization between the three organizations and thus to promote economic exchange.

South Africa is a promising market for German companies and at the same time the gateway to other African markets in the region. Germany, in turn, is one of South Africa's most important bilateral trading partners.

Cooperation in research projects is envisaged, the results of which standardization can pave the way to the market. In addition, the cooperation agreement provides for an even stronger exchange of knowledge and best practice between the organizations involved. This applies, for example, to international standardization projects, but also to questions of training and further education in the field of standardization. In this context, DIN and DKE will also offer training measures as part of development cooperation in order to improve the quality infrastructure in South Africa.

www.din.de

MVTec changes responsibilities in product management

Christoph Wagner is the new product manager for Merlic and remains responsible for embedded vision. He has been Product and Business Development Manager Embedded Vision at MVTec since 2017. Before that, Wagner was technical support manager and product manager for 2D and 3D profile sensors (photoelectric sensors). The mechanical engineering technician and certified business administrator has more than ten years of experience in product management, technical support and research and development in the field of industrial image processing.

Thomas Hopfner takes on the newly created position of Product Manager Licensing and Interfaces at MVTec. In this role, the expert for licensing and hardware interface standards can optimally contribute his experience. In addition, he will be responsible for the support and expansion of the image acquisition partner program in the future.

www.mvtec.com

Image: Omron

Omron cooperates with Onrobot

Omron has signed a new distribution agreement with Onrobot, a Danish manufacturer of gripper tools for collaborative robot applications (cobots). The agreement between the two companies aims to give customers more flexibility in implementing solutions with collaborative robots. These are increasingly viewed as one of the most effective ways to increase the performance of production lines.

The areas of application include, for example, conveyor technology and unloading as well as assembly and machine equipment. The ease of integration of the Onrobot products into the Omron cobot was an important factor in the decision for the new agreement.

www.omron.de

Basler confirms strong annual result and gives positive forecast for 2021

Basler AG has released the audited annual report for fiscal year 2020 today. In a declining market environment characterized by Covid-19 in 2020, the group's sales increased to Euro 170.5 million (previous year: Euro 162.0 million). Incoming orders amounted to Euro 181.6 million, and were significantly higher than the previous year's level of Euro 166.5 million.

The earnings before taxes increased to Euro 20.4 million (previous year: Euro 16.9 million, +21 %). Thus, the pre-tax margin summed up to 12.0 % (previous year: 10.4 %).

The free cash flow amounted to Euro 14.0 million (previous year: Euro -9.7 million). In previous reporting periods, free cash flow was extraordinarily burdened due to earn out payments for past acquisitions.

The financial year 2021 was characterized by uncertainties due to the pandemic. A positive order backlog and a positive trend in the development of incoming orders since the fourth quarter of 2020, however, made the company start the new fiscal year powerfully. The growth signals from the application fields of logistics, semiconductor and electronics as well as the confidence in China make the management optimistic for the new fiscal year. Based on current information, the Basler group plans to achieve sales within a corridor of Euro 190 – 210 million in fiscal year 2021. Depending on sales, this would result in a pre-tax return between 12 % and 14 %. The basis of this assessment is a strong investment cycle in the semiconductor, electronics as well as logistics sector. Furthermore, a vaccine-related improvement of the course of the pandemic is expected for the second half-year. Moreover, it is assumed that no major supply breakdown on the supply market for electronic components will ccur. This forecast is consistent with the medium-term target to achieve sales of Euro 250 million until the end of 2023, at an average EBT margin of 12 %.

Image: Basler

www.baslerweb.com

Datalogic takes over Italian sensor manufacturer

Datalogic buys the Italian sensor manufacturer Micro Detectors for 37 million euros. He and his 200 employees will be part of the subsidiary Datalogic S.r.l. The previous owner was the industrial holding Finmasi Group. With the takeover of M.D. Micro Detectors S.p.A. Datalogic Group is expanding its product portfolio to include inductive and ultrasonic sensors that are used in industrial sectors such as electronics, pharmaceuticals, logistics and automotive.

Based on preliminary figures, Micro Detectors and its subsidiaries are forecasting sales of approx. 25 million euros, an EBITDA of approx. 4 million euros and a positive net financial position (NFP) of 250,000 euros for the fiscal year ended December 31, 2020. The company employs around 200 people.

Image: Datalogic

The Datalogic Group fulfills the financial obligations from the acquisition exclusively with its own funds within existing credit lines. The transaction is currently expected to close on March 1, 2021, subject to the satisfaction of conditions that are in line with market practice for similar transactions.

www.datalogic.com

EMVA and Khronos determine requirements for embedded standard

The European Machine Vision Association (EMVA) and the Khronos Group formed a joint Embedded Camera API Exploratory Group. The aim is to explore the industry's interest in creating open, license-free API standards for controlling embedded cameras and sensors. Participation is open to all interested sensor and camera manufacturers, chip providers and software developers from image processing and sensor technology.

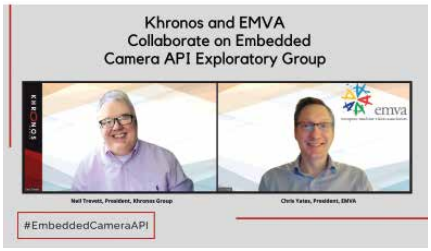


Image: EMVA

The exploratory group, in collaboration with EMVA, will use the Khronos framework for new standards initiatives. All companies, universities, consortia, open source participants and industry experts are welcome and can participate for free after signing a confidentiality agreement. All participants discuss the creation of a specification sheet (Scope of Work - SOW) on an equal footing, which describes an overarching consensus on a standard initiative for the participants and their markets.

www.emva.org

China live events close successfully

Laser World of Photonics China 2021 was successfully held in the Shanghai New International Expo Center. The exhibition attracted a total of 1,094 exhibitors from 18 countries and covered a total exhibition area of 63,500 square meters. With strict guidelines and measures in epidemic prevention and safety control, the three-day exhibition received 79,453 professional visitors, 39 % higher than the previous exhibition.

The Photonics Congress China 2021 was held along with Laser World of Photonics China 2021. It included nine forums and over 100 VIP speeches. The Congress is made up of the 16th International Laser Processing and Systems Conference (LPC 2021), 2021 Chinese Laser Market Summit, 2021 Optical Made in China 2025 Forum (Shanghai) and Workshop on Safety of Industrial Lasers and Systems Use. Conference themes included new research findings and developments in a wide range of areas: laser processing, advanced laser, optical technology, infrared imaging technology, lidar, laser safety, beam analysis, etc. The conferences were fully booked and attracted a total of 4,854 visitors.

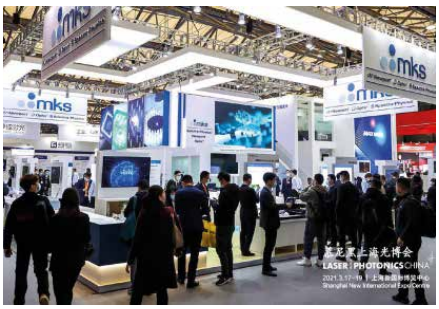


Image: Messe München

The next Laser World of Photonics China will be held in the Shanghai New International Expo Center from March 16–18, 2022.

www.world-of-photonics-china.com

Image: Messe München

Laser World of Photonics is postponed

Due to the existing travel restrictions and the currently unclear Covid-19 situation, Messe München has decided to postpone the Laser World of Photonics by ten months. One of the main reasons for this is the high proportion of international exhibitors and visitors, which is more than half of the total number of participants and has a high proportion of participants from other continents.

While the trade fair has a new date, the scientific congress will take place on the planned date from June 20 to 24, 2021 as an online event. At the virtual World of Photonics Congress there will be five conferences with more than 40 sub-topics. The range of topics ranges from basic research to applied sciences, from laser science, photonics and quantum optics, optical metrology, digital optical technologies and optics in biomedicine to the use of lasers in manufacturing.

www.messe-muenchen.de

Image: Zeiss

Zeiss opens research center in California

The new "Zeiss Innovation Center," as it is officially called, "enables us to work in new ways with our partners in science, industry and the local community," Dr. Christian Müller, Chief Financial Officer, is certain. The focus here is on digital solutions. In addition, this step is part of the Group's strategy to be present in the vicinity of research centers and growth markets. And this certainly includes the region where, in addition to Silicon Valley, San Francisco, Oakland and San Jose are located.

The center is also the U.S. headquarters for the Medical Technology division, whose activities are bundled in the publicly listed Carl Zeiss Meditec AG, in which Zeiss holds a majority stake. Medical Technology develops and markets solutions for ophthalmology and microsurgery worldwide.

The new site will also bring together X-Ray Microscopy and the Microscopy Customer Centre, which is expected to strengthen initiatives focused on growth markets and research and development in materials research, life sciences and industrial applications. A joint Microscopy and Ophthalmology site will also enable collaboration, particularly in the areas of machine vision, machine learning and artificial intelligence, he said. In addition, the Process Control Solutions of the Semiconductor Manufacturing Technology division are also housed in the center.

The building features a solar power system, usage-based lighting and ventilation controls, and a heat recovery system. In addition, lighting and insulation technology help regulate room temperature. Outside, stormwater is collected or retained, and measures are implemented to maintain or enhance wetlands. To reduce traffic congestion and air pollution, the company offers commuters charging stations for e-vehicles and bicycle parking facilities, and supports them in carpooling.

www.zeiss.com

Image: Günter Prätor/Jenoptik

Jenoptik creates financial scope for acquisitions

Jenoptik has placed a promissory note loan in the amount of 400 million euros on the capital market. The additional funds are intended to enable the optics and photonics group to make acquisitions and investments in photonics.

The promissory note loan comprises several tranches with maturities of five, seven and ten years, which were issued in euros but and to a lesser extent in US dollars, and for the most part with an initial value date of September 30, 2021, six months in the future. Fixed and variable interest rate variants were also on offer.

"Following the completion of these capital measures, we will again have a very solid, long-term and broad-based funding base. The increase in debt is within a very reasonable range and our balance sheet remains healthy, as evidenced by the equity ratio of around 50 percent," said Chief Financial Officer (CFO) Hans-Dieter Schumacher, summarizing the new Group financing.

Over 250 institutional investors such as banks and international credit institutions have subscribed to the promissory note loan.

"We are observing that more and more investors want to invest their money sustainably. To this end, we have opened up an attractive opportunity for investors with this promissory bill," says the CFO. Three ESG indicators are therefore built into the promissory note loan, which address the topics of environment, social affairs and corporate governance. Jenoptik has set itself specific, verifiable targets for sustainability in the supply chain, the group-wide proportion of green electricity, and the diversity of its management team. If all three targets are achieved, Jenoptik receives a small interest advantage. Conversely, a malus must be accepted if less than two of the three targets are achieved.

www.jenoptik.de

US associations merge to form Association for Advancing Automation (A3)

The three associations Robotic Industries Association (RIA), the AIA - Advancing Vision + Imaging and the Motion Control & Motor Association (MCMA) unite to form the Association for Advancing Automation (A3), which then has more than 1,100 member companies. These in turn represent millions of employees and billions in sales.

By comparison, the VDMA has a total of around 3,300 member companies. According to the VDMA, the German mechanical engineering industry as a whole generates nearly 230 billion euros in sales (2019) and employs about 1.35 million people.

With this move, the A3 aims to become the "world's leading automation trade association" and "drive the transformation of the global economy." As of April 14, 2021, the website www.automate.org will become the new address of the new association.

www.a3automate.org

Image: Association for Advancing Automation (A3)

Heidelberg Instruments acquires Multiphoton Optics

While Heidelberg Instruments has high expectations for the further development of 3D lithography systems at the MPO site in Würzburg, the strategic merger for Multiphoton Optics primarily means access to sales potential and structures, production capacities and the global service network of the new parent company.

Dr. Benedikt Stender, one of the two managing directors of MPO, will lead the company as sole managing director in the future. Dr. Boris Neubert, who was previously responsible for operations on the MPO management board, is moving to Heidelberg Instruments, where he will be responsible for integrating MPO into the new parent company.

The current specialty of Multiphoton Optics (MPO) is the production of 3D free-form surfaces and structures, with a focus on micro-optics using 3D lithography. In research and development, the current focus is primarily on manufacturing processes using two-photon polymerization (2PP) and application-specific software and hardware modules.

"MPO is a pioneer of two-photon lithography and has developed a high-performance exposure system for 3D printing down to the sub-micrometer range. MPO thus fills a gap between conventional laser lithography, on which our strong core business is based, and the nanostructuring technology (t-SPL) added three years ago in the Heidelberg Instruments Nano division. Together with MPO, we will expand our position in micro-optics and structured surfaces," reports Konrad Roessler, Managing Director of Heidelberg Instruments.

heidelberg-instruments.com

Research project aims to increase the rate of plastic recycling

The BMBF research project "Tasteful" combines tracer-based sorting with object recognition and artificial intelligence (AI). Two companies, two universities and a Fraunhofer Institute are teaming up to make plastics recycling more efficient by distinguishing between types of plastic such as PET according to additional criteria.

Different PET-based packaging fractions that could be distinguished by tracers and thus subsequently sorted

Polysecure, HD Vision Systems, Karlsruhe Institute of Technology (KIT), Pforzheim University and the Fraunhofer Institute for Foundry, Composite and Processing Technology IGCV are involved in the project. The aim of the research project "Tracer Based Sorting - Efficient and Flexible" (Tasteful) is a higher efficiency and practicability of the tracer-based sorting technology (TBS). Sub-goals of the project are the improvement of the excitation technology, the expansion of the tracer and thus the sorting code portfolio as well as the expansion of the sorting technology with object recognition systems.

www.hdvisionsystems.com

EMVA offers position as Business Development Manager

The European Machine Vision Association currently represents members from 26 nations and promotes the wider adoption, standardization, and use of vision technology. To support the achievement of EMVA's ambitious growth targets the association is looking for a Business Development Manager (m/f) with the enthusiasm to drive projects to successful outcomes by working closely with the General Manager and Board of Directors to shape the future of this leading international industry association.

https://www.emva.org/wp-content/uploads/EMVA-BDM-AD_2021.pdf

Image: SVS-Vistek

SVS-Vistek presents new company building

SVS-Vistek will move into a new, modern company building in Gilching near Munich in summer 2021. In order to adapt the production capacities to the forecast customer requirements in the future and to be able to offer the growing number of employees a modern working environment, the company management decided to move to the conveniently located northern industrial area of Gilching close to the BAB 96 decided in 2021.

The groundbreaking for the two-story building with an area of approx. 5,200 m² has already taken place. An innovative temperature concept based on geothermal energy with concrete core activation and a solar system reflects the ecological orientation of the building. SVS-Vistek will use around 2600 m² in the first step and ensure optimal work processes with the most modern equipment. Among other things, production areas with purified air and overpressure with lock systems are planned, which guarantee dust-protected production of the cameras according to the highest quality requirements.

www.svs-vistek.com

Stemmer Imaging: Corona pushes operating result into the red

Stemmer Imaging clearly felt the effects of the Corona pandemic in fiscal 2020. The second quarter was hit the hardest. Subsequently, the business recovered. In the end, however, a negative operating result and a drop in sales of almost 13 percent remained.

In the 2020 financial year, Stemmer Imaging generated consolidated sales of 105.2 million euros, which is 12.8 percent less than in the previous year. The development of sales in 2020 was significantly influenced by the Corona pandemic, which led to a decline in sales in most of the major markets and industries. The operating result was -1.6 million euros (previous year: 7.5 million euros). After depreciation and amortization (EBITDA), the result was a plus of 7.2 million euros, 33 percent less than in 2019.

Order intake was particularly strong in the fourth quarter of 2020, with growth of 14 % compared to the first half of the year. Due in particular to a weak second quarter, the full-year figure was 113.9 million euros and thus nevertheless significantly below the previous year's figure of 119.4 million euros.

Sales also picked up in the second half of the year: While sales in the first half of the year were 52.3 million euros (previous year: 58.2), revenues in the second half rose to 53 million euros (previous year: 62.3).

Stemmer Imaging's Supervisory Board has reappointed Arne Dehn (51) as CEO for a further five years until the end of 2026, following the expiry of his current mandate at the end of 2021. Dehn was appointed to the Executive Board in January 2019.

www.stemmer-imaging.com

WIN>DAYS – The Virtual Industry Event

Virtual Trade Fair for Automation, Machine Vision & Photonics

After the first successful Wiley Industry Days in fall 2020, the innovative trade fair format will be continued in June 2021: The Wiley publishing house's trade journal group, which includes inspect, messtec drives Automation, PhotonicsViews as well as GIT SICHERHEIT, will again organize the virtual Wiley Industry Days, or WIN>DAYS for short, in 2021 together with renowned companies and institutions. A top-class conference program included.

Exhibitors from the Machine Vision & Photonics, Automation and Safety & Security sectors will be presenting themselves in the halls of the WIN>DAYS exhibition center. In addition, this year the sectors of civil engineering and architecture as well as hygiene and healthcare will be added. Visitors can expect products, solutions and trends. WIN>DAYS will be rounded off by the conference program taking place at the same time in the digital auditoriums.

Participation is free of charge – all that is required is advance registration at www.wileyindustrydays.com.

The Conference Program

The focus of the event is on exhibition and networking – accompanied by a compact conference program. Panel discussions with high-profile guests and selected key note speakers will provide information on the latest developments from industry and research. In addition, exhibitors invite visitors to attend presentations. The digital conference program can be viewed via the auditoriums – interested parties can click directly into the presentations.

On each day, the conference areas will also feature thematic focal points for you to follow. Among them are Hyperspectral Machine Vision, Artificial Intelligence/Deep Learning, Embedded Vision and Augmented Reality. (dl) ■

This Is How the Wiley Industry Days Work

Digital trade fair: The Wiley Industry Days exhibition center is set up like a physical trade fair. The lobby with info points is used for orientation.

Networking and exchange: Visitors can send chat requests to each other throughout the exhibition grounds. Each participant has an overview at all times of who is on the entire site or in the various rooms and at the stands.

At the virtual trade show booth: Visitors see the booth staff and can contact them via the integrated chat function or by email. If required, private rooms are also available for video chats.

Top Products in Machine Vision Wanted!

inspect award 2022

The application phase for the inspect award 2022 has begun. All machine vision and optical metrology companies are invited to submit their products. The deadline is May 14, 2021.

At **www.inspect-award.com**, companies from the machine vision and optical metrology industries can submit their latest products to compete free of charge for the prestigious inspect award 2022. A jury of five experts will select the ten most innovative products in each of the categories "Vision" and "Automation + Control" from all applications. Afterwards, the readers of inspect and all visitors of wileyindustrynews.com are called upon to vote for the winners. The total of six winners in the "Vision" and "Automation + Control" categories will then be honored at the Vision trade fair in Stuttgart at the beginning of October.

The nominated products will be presented to the public in a prominent position in inspect issue 3 (to be published on June 14, 2021). In inspect issue 6, all the winning products will then be honored once again in detail. In addition, all award-winning companies will receive the right to use the coveted inspect Award winner logo free of charge. So it pays to take part. (dl) ■

Application deadline is May 14, 2021

The application phase for the inspect award 2022 runs until May 14, 2021. Apply now at www.inspect-award.com!

Briefly Introduced: The Jury

Anne Wendel
Since 2014, Anne Wendel has been responsible for the Machine Vision department at the VDMA with around 115 member companies from Europe. Her work focuses on statistical analyses, standardization, marketing activities, public relations, and trade fair policy. In the latter function, she is responsible, among other things, for the development of the Vision trade fair, for which the VDMA is the technical and conceptual sponsor.

Thomas Lübkemeier
Since 2013, Thomas Lübkemeier has led the Barcelona-based European Machine Vision Association (EMVA) as General Secretary. He is an engineer in electrical/automation engineering and was, among other things,

stationed abroad for several years for German companies and, after his return to Germany, was responsible as managing director for various foreign subsidiaries.

Prof. Dr.-Ing. Michael Heizmann
Even after his doctorate at the University of Karlsruhe in 2004 on a topic of machine vision for forensic technology, Prof. Dr.-Ing. Michael Heizmann remained faithful to machine vision for many years. Since 2016, he has been Professor of Mechatronic Metrology Systems at the Institute of Industrial Information Technology IIIT at the Karlsruhe Institute of Technology (KIT) and at the same time Institute Director (collegial institute management) of the IIIT. He is an expert in theoretical image and signal processing as well as in surface metrology and inspection.

Paul-Gerald Dittrich
Paul-Gerald Dittrich holds an M. Eng. in electrical engineering/system design. He is a research associate in the field of spectral imaging at the Ilmenau University of Technology in the Faculty of Mechanical Engineering in the depart-

ment of quality assurance and industrial machine vision. He also works at Spectronet as a project manager to improve project-specific collaboration between companies and research institutions that develop or apply machine vision and photonics for quality assurance.

David Löh
After his journalistic beginnings at daily newspapers during and after his studies, David Löh took a liking to the world of trade magazines. He started out at an automation trade magazine, which he left in favor of an exciting assignment at a plastics trade magazine. After another stint in a responsible position, he returned to automation at the end of 2019 to take over as Editor-in-Chief of inspect.

Intelligent Quality Assurance for Batteries

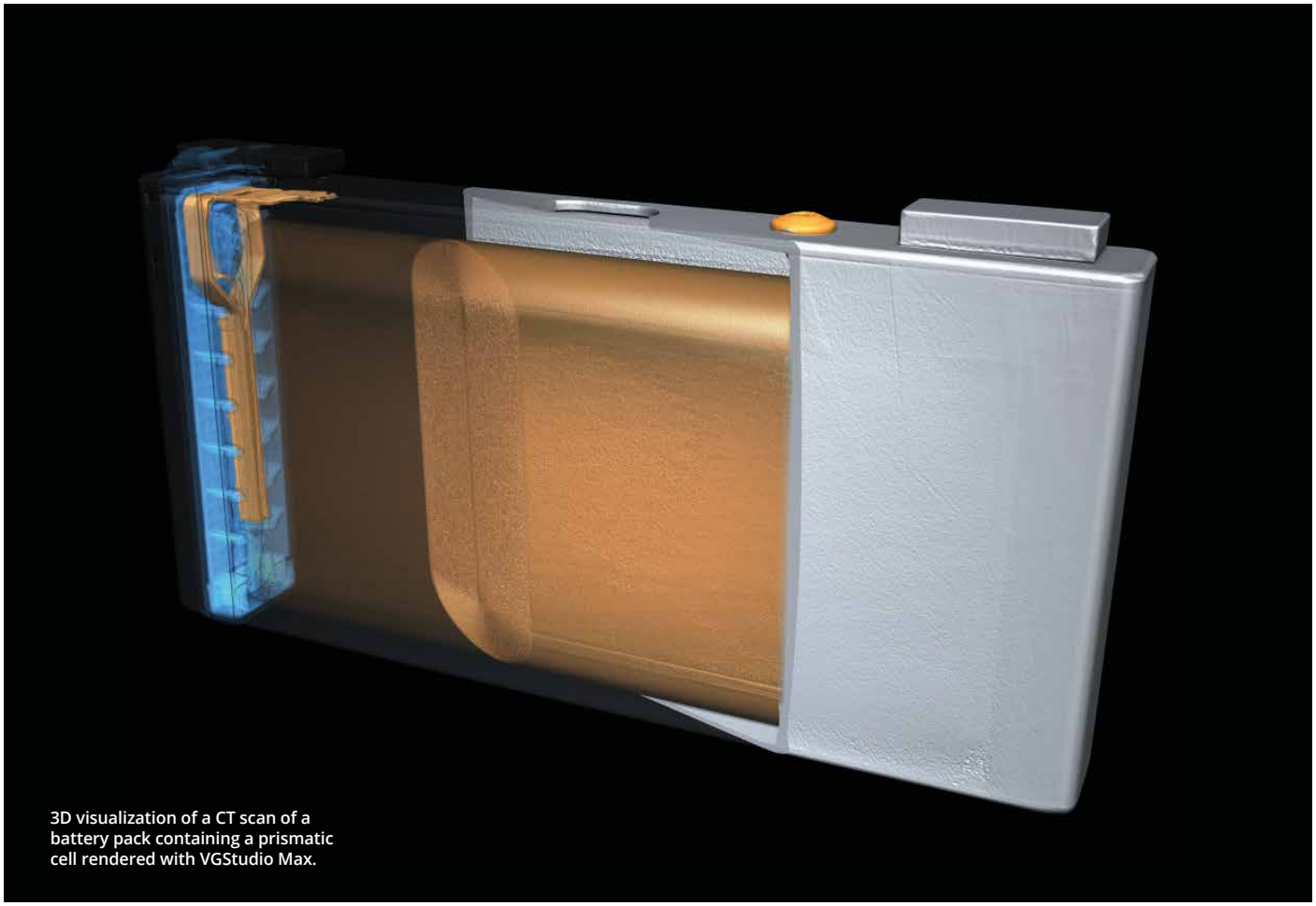
Computed Tomography Detects Defects in Modern Lithium-Ion Batteries

Because of their high-power density, rechargeable lithium-ion batteries are subject to strict quality monitoring. Industrial computed tomography is increasingly being used to detect any defects before delivery or during production.

The CT analysis software from Volume Graphics, Heidelberg, provides functions that allow a deep look into the inner workings of energy storage devices. Methods from the field of artificial intelligence are also becoming increasingly important.

Not only because of the debate on climate change, lithium-ion batteries are attracting increased attention for a number of reasons these days. They are seen as key components for the mobility of the future. Compared with other types of storage, Li-ion batteries have convincing advantages: no memory effect, lower self-discharge, and even more crucial, significantly higher power density. A $LiCoO_2$ cell delivers 3.6 V of voltage – three times that of a metal hydride cell and almost twice that of a lead-acid cell.

But there are two sides to every coin. Wherever lithium or its compounds are involved, safety becomes an i ssue. Lithium is a highly flammable alkali metal. In addition, strong currents sometimes flow in the cells, especially if the charging process is too fast. It is not uncommon for extreme temperature developments to occur with subsequent deformations. In the worst case, there is a



3D visualization of a CT scan of a battery pack containing a prismatic cell rendered with VGStudio Max.

Image: Volume Graphics, Scan: Waygate Technologies (formerly GE Inspection Technologies)

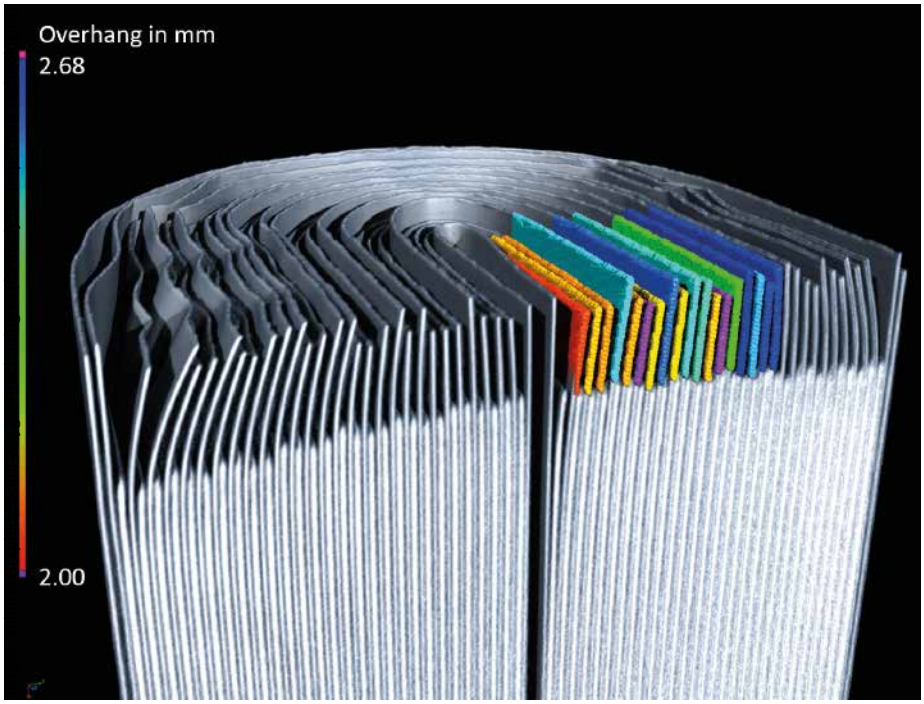


Image: Volume Graphics, Scan: Waygate Technologies (formerly GE Inspection Technologies)

Volume Graphics' software allows the measurement of anode overlap. The amounts of protrusion are shown using a color scale, which in this example ranges from 2 mm (red) to 2.68 mm (blue).

risk of fire or explosion. This is why we read about recalls time and again.

Although computed tomography cannot reveal the electrochemistry within the cell, it can illuminate the "mechanical" inner workings. A thermal runaway can have mechanical causes. Conversely, electrochemical processes can change mechanical conditions. The insights that CT can contribute are increasingly being used by research institutions and battery manufacturers. "The testing of batteries opens up a whole new field of application for CT," explains Pascal Pinter, Product Manager Material Research & Development at Volume Graphics. "With our software, both geometric measurements and material testing are feasible."

Production-Accompanying Application

The experts at Volume Graphics do not just have finished cells in mind. "Due to the very complex process of manufacturing these batteries, CT-based analyses already make sense during production, for example to remove defective components from the process chain at an early stage," continues Pinter. With a high-resolution CT scanner, for example, irregularities in the layers of the electrode packages become visible. Delaminations are a typical phenomenon. You can also localize foreign particles, for example residues resulting from the cutting process. Other contaminants can be welding particles that form when the contacts are attached, or the housing is sealed. The major risk that these types of foreign particles pose is short circuits.

An important internal dimension to be monitored during manufacturing is the so-called anode overlap. The anode is always dimensioned so that it overlaps the cathode. This is to counteract lithium plating and possible damage to the cell. Lithium plating means that pure Li is deposited in the anode. It is then no longer available for the formation of ions. A constant anode protrusion requires high precision in manufacturing. It is defined by the manufacturer and can be checked using the CT analysis software from Heidelberg.

Image: Volume Graphics, Scan: Waygate Technologies (formerly GE Inspection Technologies)

Delaminations, the detachment of the electrode windings or coatings, can be easily visualized with CT.

» With our software, both geometric measurements and material testing are feasible.«

Finally, you can use CT for inspection and forensics in the after-sales phase, for example to determine the cause of a device failure. It can also be used in the context of comprehensive sustainability concepts. Cells that no longer meet the original requirements of e-mobility due to capacity loss may still be usable for stationary applications. A look at the inner workings could therefore help to save valuable resources.

Artificial Intelligence Detects Defects

When examining batteries using CT, quality engineers face a challenge: The interesting structures in the gray-scale images provided by the CT scanner often have very low contrasts. This is due to the low-density differences of some materials. In addition, the films and coatings of the cell packages are very thin and close together. It is sometimes very difficult to determine which irregularities can be interpreted as defects, scattered

radiation, or artifacts. The central question is: which voxel is a defect voxel, which is not (a voxel is the smallest 3D element in the CT model, similar to pixels in 2D images)? Even experienced quality engineers often come to different interpretations. The only thing left for them to do is to adjust or vary the scan parameters of their system accordingly and, if necessary, to pay special attention to certain regions of interest (ROI).

This is the conventional approach – but it has its drawbacks. On the one hand, it depends on the operator and is therefore individual; on the other hand, it requires additional time, which has to be added to the scanning time. Since the sometimes-filigreed structures of the cell interior require high-resolution scanners, and therefore long scanning times, things quickly become tight, especially when accompanying random sample inspections must be carried out within a specified cycle time.

In such cases, the deep learning method proves to be particularly effective. This approach works well, for example, when examining cast-metal workpieces, where similar tasks have to be performed as in the case of battery cells. Deep learning comes from the field of artificial intelligence and is based on artificial neural networks (ANN), which are modeled on the human brain. What neurons or nerve cells are to biology, interconnected mathematical functions that calculate a certain output depending on the input are to the digital world. The application of such a network in CT-based defect detection delivers very accurate results and does so in a very short time. The network needs something like a memory for this, i.e., it has to be "trained" with defect data.

But where does this data come from? There are basically two ways to generate it: Firstly, the simulation of artificial defect data based on the model of real defects. Special software is available for this purpose. The physical effects that occur during scanning can be imitated in this way. The result is an artificial but accurate pool of data. Secondly, the defect data can also be taken from real components. In this case the defects have to be detected manually. This approach requires a larger number of real objects. Which method is most suitable must be decided on a case-by-case basis. "If customers commission us to train an ANN, we will provide them with an algorithm that fits their problem exactly," emphasizes Pascal Pinter. "If necessary, they should provide us with a certain number of battery cells, both intact and containing critical faults."

When the trained ANN is applied, the irregularities in the real scans are compared with the defect data "in memory." The ANN then identifies similarities. It reliably answers the question of what a defect voxel is and what is not. An advantage for series-part inspection: The method is also very accurate at lower resolutions, as they occur in the case of shorter scan times and could also allow inline inspection of battery cells in the long term. ■

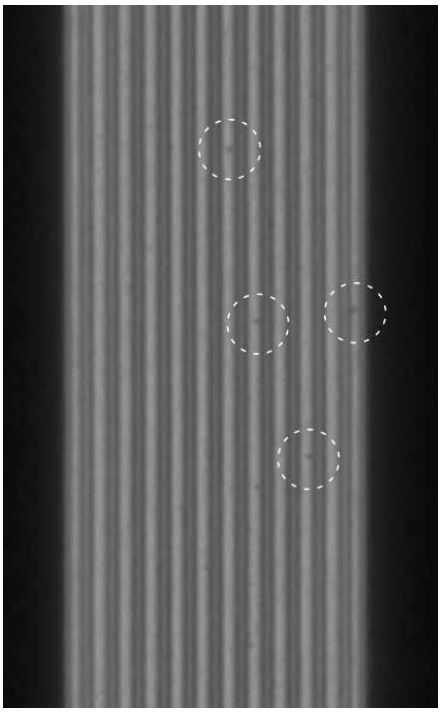


Image: Volume Graphics

The contrasts of CT images of the internals of batteries are very low, making it difficult to interpret any defects. Artificial intelligence methods such as deep learning provide clarity.

Key Technology of the Hour: LI-Ion Batteries

The quality characteristics that play a role in Li-ion batteries only become fully clear when the structure and manufacturing processes are known: First, we have to distinguish between three cell designs: 1. cylindrical cells (e.g. in notebooks, hand tools), 2. prismatic cells (e. g. in vehicles), 3. flat pouch cells (e. g. in smartphones). A cell mainly consists of two electrodes: an anode and a cathode. If you look at the discharge process, the anode is the negative pole, the cathode the positive pole. In addition, there is an ion-permeable separator foil between the two electrodes and an ion-conductive electrolyte. The electrodes, in turn, consist of so-called active materials. Graphite is generally used for the anode, and lithium cobalt dioxide (LiCoO2) for the cathode. Other Li compounds with manganese, nickel, iron, or aluminum oxide are also suitable and may lead to different voltages. Both active materials are deposited as slurry on both sides of a metal carrier foil, also called current collector. Copper is used for the anode and aluminum for the cathode. During charging, Li-ions flow from the cathode to the anode to embed themselves in the graphite layer; during discharging, the flow direction is reversed.

The thicknesses of the current collector foils are 10-25 µm, those of the electrode coatings 200-250 µm. In order to be able to contact the electrodes later, the carrier foils remain uncoated in the edge area. After coating, the films go into the dryer and then into a calendering unit, which compresses and smooths the active coatings under 150-250 bar. A laser or knife then cuts the films into sheets. Sheets are cut out for pouch cells. In the meantime, cleaning takes place; both cut quality and cleanliness are important quality criteria.

Finally, the blanks are wound or stacked together with the separator film to form a jellyroll and pressed. This results in the following structure for the wraps/stacks: anode-separator-cathode-separator-anode-separator-cathode, etc. Connectors are welded to the uncoated Al and Cu foil overhangs, also known as current collectors, by means of laser or ultrasound. Prepared in this way, the packages are usually placed in an aluminum housing, which is welded except for a filling hole for the electrolyte. Once the electrolyte has been introduced, the first charging process, also known as formation, takes place. The final mechanical process is the closing of the housing by a rivet or a weld. A subsequent "aging" period of several weeks serves to verify the function.

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Biomedical Imaging

A Guide to Choosing Machine Vision Camera Specifications and How to Calculate Them

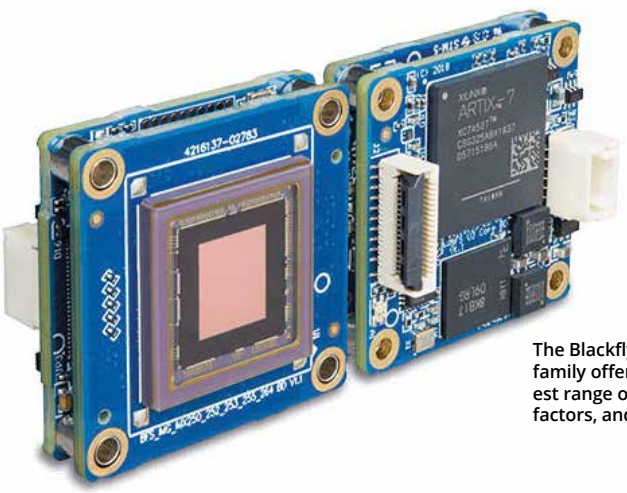
Research and diagnostic biomedical applications typically require imagers with high spatial resolution, accurate color reproduction, greater sensitivity in low light conditions, and in many cases some combination of all three factors to improve reliability of data. Having the appropriate microscopy camera, histology camera, cytology/cytogenetics camera, epifluorescence camera, etc. is critical to providing a proper diagnosis in a clinical application or reliable data for research purposes. So how do you know what machine vision camera is best for your bioscience application? In the following sections, we cover several aspects to consider when choosing a machine vision camera for your biomedical and life science applications.

Application Specific Factors to Consider

Resolution and Color Accuracy

The resolution required is dependent on the magnification of the structure of interest in the sample relative to the size of pixels on the camera, i. e. high resolution in a microscopy application can be achieved by a 2MP camera, a 25MP camera, or anything in between. It depends on the magnification of the structure of interest in the sample by the optics relative to the size of the pixels on the camera. In order to select the best camera options to achieve the desired resolution, first determine the size of the smallest structure in the sample that you wish to resolve. Then, multiply it by the lens magnifications in your optical system. This will provide the size of these structures when projected on the camera sensor.

If the size of the structure is at least 2.33 (Nyquist) times the size of a pixel on the camera sensor, then the camera should be able to resolve that structure. For example, if the size of these projected structures is ~8um, then a camera with 3.45um pixels should be able to resolve those structures. There



The Blackfly S camera family offers the broadest range of sensors, form factors, and interfaces.

are other methods to measure resolution (e.g. line pairs) but this is an easy calculation to find suitable camera options to test.

Imaging applications such as histology, cytology, and cytogenetics work with a broad range of white light (between ~400 nm and 700 nm) or use a selected wavelength within this range (for example, 565 nm). If the specimens in these samples are not alive (or fixed) they can be exposed to bright light levels without the risk of the stain fading or killing the sample. Under these conditions, the main requirement for the camera is high resolution and color reproduction. In other words, low light sensitivity is not an important factor. To find high-resolution models, use our FLIR Machine Vision Camera Selector and filter and sort for megapixels.

Sensitivity, Quantum Efficiency, and Dynamic Range

For imaging applications with live specimens, the challenge is to avoid overexposing the sample to too much light, which will bleach fluorescent molecules or kill the specimen. These applications typically use a technique called epifluorescence. Epifluorescence techniques can be used on both fixed and live specimens. Some specimens are rare or costly to acquire and the process for creating samples can be expensive in materials and labor. Therefore, a system that preserves the quality of the samples can help to reduce the ongoing cost of these imaging applications.

Epifluorescence uses a high energy wavelength that is filtered to excite the sample to emit a low energy wavelength. The low energy wavelength is filtered back to the camera. Under these conditions, the main requirement is sensitivity because this allows the use of less intense, damaging light on the sample. A camera with excellent sensitivity can provide high quality images even when the emission light is low energy.

To find models with excellent sensitivity to perform well under low light conditions, you can focus on three specifications: absolute sensitivity, quantum efficiency, and dynamic range. Absolute sensitivity is the number of photons needed to get a signal equivalent to the noise observed by the sensor, the lower the number the better. Quantum efficiency is the percentage of photons converted to electrons at a particular wavelength – here you want a high number. Dynamic range is the ratio of signal to noise including temporal dark noise (the noise in the sensor when there is no signal), the higher the better. For easy comparison, the Flir model selector to filter and find the highest values is available. Generally, monochrome models have better performance in low light compared to color equivalents. To view the details of a model's imaging performance, the detailed EMVA Imaging Performance document is a great reference.

The Oryx camera family offers high resolution sensors paired with the fast 10GigE interface.

Combination of Factors

For applications that use both white light and epifluorescence, it is best to look for camera models that offer Sony's new conversion gain feature, which provides the ability to optimize the sensor for high sensitivity or high saturation capacity. High conversion gain is ideal for low light environments, as read noise is minimized, yielding a low Absolute Sensitivity threshold perfect for detecting weak signals with short exposures. Low conversion gain is ideal for brightly lit conditions, as saturation capacity is maximized, yielding improved dynamic range. The maximum dynamic range will be limited by the 12-bit ADC.

To find a list of models with conversation gain, please refer to Flir's Machine Vision Sensor Review at their website.

Choosing the Right Cameras

When choosing a camera, selecting a newer CMOS sensor is always a good starting point. Newer sensors typically offer greater performance (and may be lower in price). Also, if the application in question requires the purchase of many cameras over several years (for example, the ongoing manufacture of a diagnostic instrument), then it is critical to select a camera that is not at the end of its lifecycle – otherwise you will have to incur the cost of designing-in a replacement camera prematurely.

Flir manufactures over 200 variants of machine vision cameras that broadly fit into three camera families that use the latest CMOS sensors: Blackfly S, Oryx, and Firefly.

The Blackfly S camera family offers the broadest range of sensors, form factors, and interfaces. With every model offered in both USB3 and GigE variants, these cameras are extremely versatile and easy to incorporate during the design-in phase. Board level Blackfly S versions are miniaturized versions of our full featured cased variety and are particularly suited for space constrained and embedded applications. The wide range of features, great price to performance ratios, and resolutions up to 24MP makes them a preferred choice in biomedical and life science applications.

The Oryx camera family offers high resolution sensors paired with the fast 10GigE interface, enabling the capture of 4K resolution, 12-bit images at over 60FPS. Oryx's 10GBASE-T interface is a proven and widely deployed standard that provides reliable image transfer at cable lengths over 50 m on inexpensive CAT6A, or greater than 30 m on CAT5e.

The Firefly camera family offers a very small case form factor, light weight, low power, and low price. The Firefly DL model also has the capability to run a previously trained neural network that can be used for object detection or classification.

All Flir machine vision color cameras provide the ability to customize color reproduction in the form of different white balancing options and the use of a unique color correction matrix, which is important in biomedical imaging where accuracy of colors can mean different things depending on visual human analysis for diagnosis vs. a machine-readable format for data accuracy. For more information on these features, see Using White Balance with Blackfly S and Spinnaker and Using Color Correction in Blackfly S and Oryx.

Additionally, the Flir machine vision Blackfly S, Oryx, and Firefly camera families can be controlled and programmed using GenICam3 and the Spinnaker SDK which has been designed ground-up with ease of development and deployment in mind, ensuring that the company's products enable faster application development and testing.

To further narrow down the selection of camera models, the Flir website has a machine vision camera selector with multiple filter criteria available at: https://www.flir.ca/browse/industrial/machine-vision-cameras/modelselector/ ■

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All images: Flir Systems

Reduce Textil Waste with Hyperspectral Imaging

An InGaAs-Based Spectral Camera Covers the Different Spectral Signatures of Conventional Fabrics and Increases the Reliability of the Detection

New EU guidelines for the recycling of fabrics and textiles have been in force since 2018. The aim of this very important project for the environment is to reuse all textiles worldwide from 2025. Hyperspectral imaging offers the technical requirements for successfully achieving this ambitious goal.

The textile industry causes a significant part of the pollution from which mankind is increasingly suffering worldwide. The reasons for this are diverse. On the one hand, the production of fabrics and clothing requires a high level of resources, especially, e.g., with cotton an immense water consumption. On the other hand, a large part of used and new textiles - current estimates are around 16 million tons per year – ends up in landfills, although at least a partial reuse of the materials would be possible. In addition, microplastics as the residues from synthetic textile fibers are increasingly reaching soil and water, where they endanger the existence of entire animal species and mankind through the food chains. The trend towards replacing clothing with new ones more and more frequently is partly responsible for this negative development. Companies in the fashion industry are presenting more and more collections each year. Where one new summer and winter collection used to be on the market in the past, up to 25 new launches per year are no longer uncommon.

In order to reduce the serious consequences of these developments for the environment, it is necessary to significantly increase the rate of textile recycling. This cannot be achieved with the current manual methods, since employees cannot sort different substances with the required speed and endurance and, in addition, special knowledge of the different types of textile is re-

Image: Specim/Shutterstock

quired: reliable identification and separation of different types of fibers and substances with blended fabrics based solely on appearance is almost impossible by hand. To make things worse, such workplaces are generally very unsanitary and even potentially dangerous due to possible toxins in the textiles to be sorted. In the long term, manual sorting of textiles is therefore extremely expensive.

New EU Guidelines against Textile Waste

The European Union adopted new guidelines for combating textile waste in 2018 and set a deadline for its member states: by 2025, they should completely recycle all textiles. According to the current state of the art, this ambitious goal can only be achieved with a few methods. Hyperspectral imaging is one of these technologies, Esko Herrala knows. The co-founder and senior application specialist of the Finnish company Specim has been dealing with the question of how to separate and recycle different materials economically and safely for many years. He has contributed to this topic in a report by the "Committee for the Future" written for the Finnish parliament. The aim of this report was to find out how Finland can benefit from the vision industry and in which fields of application this technology can be used.

"I was responsible for the circular economy part of that report where I demonstrated various possible uses of photonics systems in the area of waste separation," says Herrala. During a presentation of the results at the Helsinki Parliament in 2019, the Finnish government then defined the sorting of textiles as a prioritized area of application and has set the goal of collecting and recycling all of the country's textile waste by 2023. "Finland is already one of the world's leading countries in the field of plastics and construction waste sorting and would also like to use the great economic potential of textile recycling with innovative solutions," the Specim co-founder explains.

Hyperspectral NIR Systems as a Solution

From the end of 2019, Specim dealt intensively with the task and looked for suitable partners. For the manufacturer of NIR hyperspectral cameras, it was obvious that this technology was to be considered as a possible solution for textile sorting. "First of all, you have to know that different textiles have individual spectral characteristics that can be used to classify the fabrics. Fabrics either consist of natural fibers such as Cotton, of animal fibers such as Sheep's wool or of synthetic fibers such as polyester. Mixed fabrics are also often made from different types of fibers," explains Herrala. "The different materials differ in their chemical and molecular structures. As a result, these substances react differently to electromagnetic waves of different wavelengths in the way they absorb, reflect or let them pass through."

These characteristics can be used to perform a spectral analysis of textiles based on the reflected light using hyperspectral imaging systems. Special cameras with wavelengths in the near infrared range (NIR) in combination with a spectrograph enable a clear identification of the chemical composition of the inspected material and thus form the basis for an automated sorting of textiles.

"Hyperspectral NIR image processing systems in combination with suitable classification algorithms allow the differentiation of substances with different fabrics and colors as well as the identification of natural, animal and synthetic fibers," explains Herrala. "This technology can even deliver quantitative information about the proportions of synthetic and natural fibers in blended fabrics."

Image: Specim

With the InGaAs-based spectral camera FX17, working in the wavelength range from 900 to 1700 nm, Specim offers the perfect solution for a suitable sensor for classifying textiles.

Specific Requirements

The development of a reliable solution for sorting textiles presented Specim with specific requirements, recalls Herrala: "When sorting plastics, there is the phenomenon that black materials largely absorb the light, making it much more difficult to distinguish between different types of black plastics. This problem also occurs with black fabrics. We were able to solve it by using other cameras with wavelengths in the mid-infrared range (MWIR, Mid Wave Infrared), but due to the higher cost for such cameras, the required cost-effectiveness has to be checked for the individual use case."

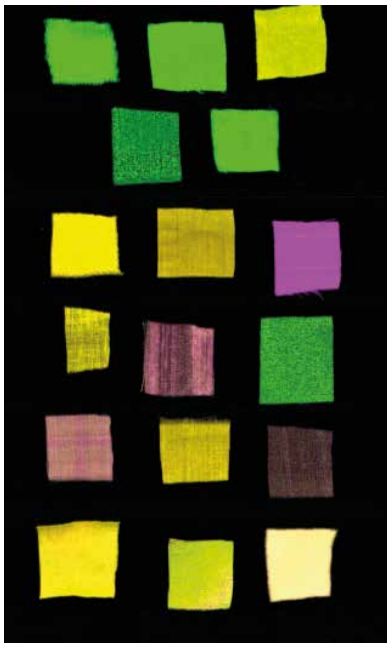
Another difficulty is the differentiation of different substances when they are damp or wet. "We used both dry and wet material to train the system and then tested the classification algorithm with dry and damp textiles. This path led to usable results, but we still prefer to sort only relatively dry material."

According to Herrala, the sorting of so-called multilayer textiles is still unsolved – the technology is currently reaching its limits at that point.

The Solution

With the InGaAs-based spectral camera FX17, Specim offers the perfect solution for

Picture of the samples



Prediction data (green: synthetic materials such as acrylic or polyethylene, yellow: vegetable fibers such as cotton or linen, purple: animal fibers like wool)

Images: Specim

In textile detection, problems often occur with reflections or shadows caused by buttons, rivets or dirt. If you do not use the results of individual measurement values for classification, but instead use the statistical average over the area examined, you will much more likely get the correct results.«

a suitable sensor for classifying textiles. This camera works in the wavelength range from 900 to 1700 nm and, apart from a few synthetic black textiles such as black polyester or black nylon, completely covers the different spectral signatures of conventional fabrics.

Due to a special technical feature, the FX17 camera is also very flexible with regard to the recording speed: It offers users the option of selecting and evaluating from 224 wavelength bands and only use those that are particularly meaningful for the application at hand due to the material properties of the test object. The number of wavelengths used has a direct influence on the speed of the solution: the fewer wavelengths used, the faster the evaluation. This property is called Multi Region of Interest (MROI) and means with the FX17 that a recording speed of 670 lines per second can be achieved when using all 224 wavelength bands, however, with a reduction of wavelength bands, even thousands of lines per second are possible.

Another feature of the FX17 increases the reliability in the detection of different types of fabric by adjusting the camera configuration in terms of its spatial binning and to work with different resolutions, thus enabling statistical averaging of the measurement results in the camera, as Herrala explains: "Especially with textile detection, problems often occur with reflections or shadows, which can be caused by buttons, rivets or dirt when textiles are transported and differentiated on conveyor belts. If you do not use the results of individual measurement values for classification, but instead use the statistical average over the area examined, you will much more likely get the correct results. The FX17 offers this possibility."

Thanks to other special features of the FX17 cameras, such as the excellent signal-to-noise ratio of 1000: 1 and high throughput, which leads to less light required to illuminate the test area, or higher sorting speeds, this camera has proven to be a superb sensor for use in textile sorting.

Automated Textile Recycling

An automated solution to the task requires more than just a suitable sensor, but also a company that wants to bring the technology to market maturity. With the business development company Prizztech, Specim found such a partner. Prizztech is a non-profit organization, that coordinates Robocoast Digital Innovation HUB, the center of excellence for example in robotics, artificial intelligence, cybersecurity, IoT and circular economy in western Finland.

"One of our goals is to improve the competitiveness in our region, but on the other hand to spread the resulting innovative ideas and solutions internationally," explains Essi Vanha-Viitakoski. She works as an advisor for Prizztech and first met Esko Herrala in the Committee for the Future. "The hyperspectral camera developed by Specim immediately convinced me of its many different uses. On the basis of our first conversation, we then carried out joint application tests for tasks in the food industry. After that, I was completely convinced of Specim's professionalism and we decided to join forces to push the development of automated systems for textile recycling."

Before this collaboration, neither Prizztech nor the Robocoast Digital Innovation Hub had dealt with the sorting of textile waste. They therefore commissioned a study on this subject, which was funded by the European Regional Development Fund (ERDF). The results mentioned therein confirmed the enormous potential, said Vanha-Viitakoskis: "A key statement of the study was that there are no ready-to-use solutions for sorting textiles worldwide, but the urgency to solve this task economically with the help of reliable automation will continue to increase in the future."

These results were a further motivation for the project partners to drive the development of suitable technologies. With success, reports Esko Herrala: "The work has not yet been completed, but we do already know most of the possible sorting problems and what leads to success, both technically and economically. A large part of all textiles can be sorted automatically with the help of hyperspectral imaging and a suitable classification algorithm."

"The Specim hyperspectral cameras in combination with the existing software and application know-how of everyone involved create new opportunities in the field of textile sorting and in general for the recycling industry to reduce environmental pollution," confirms Essi Vanha-Viitakoski. "We are very proud that a technical solution to the global problem of textile recycling has been found in Finland." ■

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The Emergent Zenith HZ-21000G 100 Gigabit Ethernet camera delivers 600 fps at the full 21 megapixel resolution.

The Evolution of Machine Vision Interfaces

100 Gigabit Ethernet Cameras

Nearly 10 years ago the world's first 10 Gigabit Ethernet cameras were introduced. In 2018 a camera developer and manufacturer released its highly successful and award winning 25 Gigabit Ethernet cameras. Now the company announces its 100 Gigabit Ethernet cameras.

The advancements in speed are largely driven by the availability of quality image sensors which in turn are driven by high-speed application requirements. Many applications require high resolution images and, without the highest speed interfaces, the frame rates are not meeting the requirements. Virtual reality, volumetric capture and sports analytics are such applications. Some applications need both high resolution and high frame rates. AOI is one such traditional machine vision application.

Sony Pregius S sensors like the IMX530 and the latest advancements from GPixel such as the GMAX3265 and GSPRINT4521 are sensors which demand the highest performance interfaces. The Emergent Bolt HB-25000SB 25 Gigabit Ethernet camera delivers maximum performance of the IMX530 sensor.

Cable Length

As with SFP+ (10G), SFP28 (25G) and QSFP28 (100G) provide very low cost commodity transceiver parts that allow a single mode fiber run of 10 km and beyond. Also, this same SMF fiber can be used in any speed application for easy forward and backward compatibility. The same cannot be said for the 10 GBaseT Ethernet couterpart which, like CXP, is also cable length limited in addition to being very power hungry. It is worth noting that there will be no adoption of 25 GBaseT and 40 GBaseT for these very same reasons: cable length was to be limited to 30 m and power consumption made phy chip development impractical. This also will mean the death of POE which was already Impractical-for 10GBaseT.

Server Utilization

Server Utilization can vary greatly for the different camera vendor solutions for Ethernet interfaces and the perfect implementation can only come with a solution which offloads Ethernet packet processing to the NIC. Many providers do not have such technology and they have frame drops running two 10 Gigabit Ethernet cameras on a single server. Emergent has always provided a top performance solution to yield 0 frame drops with as many as 16 cameras on a single server while streaming and saving to Raid. All the same performance enhancement technologies are equally present in Emergent's offerings across 10 G, 25 G, and now 100 G product lines.

Simplified System Architecture

Multiple 10 G or 25 G cameras can be multiplexed by a switch onto a single 100 G link and the switch can optionally provide PTP for micro-second synchronization accuracy. Such a switch can be procured for only a few thousand dollars. Cameras can naturally also be connected directly to the server where multiple port NICs also reduce the number of PCIe slots. All implementations can also be modified to allow for system redundancy for critical applications. Multicasting can also be employed for distributed processing architectures. The flexibility is endless.

Processing

Many applications record data and post-process to create results. Alternatives do exist for further processing should the application require. Some implementations utilize GPU cards which accompany the NIC in the same server and other implementations with higher processing requirements can employ FPGA cards by Bittware which have 100 percent compatible interfaces such as SFP+, SFP28, and QSFP28 so all processing can be done on the same interface card and a low cost server can be employed for simple book-keeping tasks. ■

Similar to 10 GBaseT, SFP technologies also have industrial equivalent cable options. Emergent has also just launched their new rugged IP67 enclosures for 10 G, 25 G, and now 100 G product lines to meet the requirements of the harshest environments.

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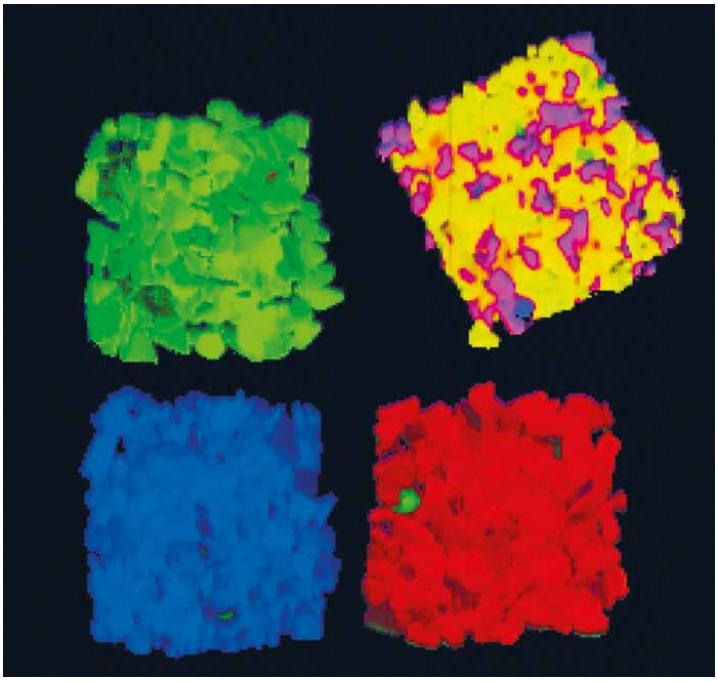
All images: Emergent



In the image on the right, the different plastics can be easily distinguished by their color as a hyperspectral image: ABS in red, POM in blue, PC in green, PE in yellow and PS in purple.

Quantitative Chemical Imaging

Bringing Laboratory Quality Control to the Production Line

While many modern quality assurance methods are insufficient, hyperspectral imaging can improve various aspects, and also facilitates recycling for the sake of environmental protection.

Attributes such as safety, quality and speed are strong differentiators for domestic companies when competing globally. Everyone is talking about digitalization, Industry 4.0, environmental protection, and 5G. Modern manufacturing facilities around the world are therefore striving to implement reliable quality control for their incoming and outgoing goods. To remain competitive with their products on the international market, optimizing production is becoming increasingly important for various sectors such as food, recycling, timber as well as other industries connected to the production of consumer and capital goods.

Italy, with exports of goods and services totaling 31.8% [1] of GDP, is one of the top five exporting countries [2] both within the EU and globally. Of its total export volume, Italy exports 12.6% to Germany, 10.5% to France and 9.2% to the US. At the same time, it imports 29.3% of its GDP. This means that in the future, Italian business will have to pay even more attention to the quality of the goods it imports to ensure Italian consumer's safety and to continue delivering the best Italian quality abroad when exporting.

Modern Quality Assurance Methods Often Inadequate

Many quality control methods in the food, chemical and pharmaceutical industries, as well as in the production of solid recovered fuels (SRF), refuse-derived fuels (RDF), and secondary raw materials in the recycling industry, are based on laboratory results obtained using high-precision measuring instruments and methods. The small number of random samples used means that these methods cannot provide qualified information on the entire product flow. Consequently, this approach does not meet today's quality and safety standards in any way.

Let us take an example from the food industry. In poultry processing, the wooden breast defect occurs. Nowadays, employees in the quality control department of chicken meat processing companies have to detect whether this defect is present by touching the meat with their hands. New sensor technologies connected to the facility's control system – such as hyperspectral imaging – detect whether the chicken meat is suitable for consumption in a fraction of a second on the conveyor belt and therefore determine the products' further processing. As opposed to manual quality control, it is possible to guarantee far higher quality and safety standards for consumers. In addition, the company saves time and money by reusing the product.

What Is Hyperspectral Imaging?

Hyperspectral imaging technology, which is at the heart of this new quality control system, comes from astronautics and is also used to explore distant galaxies. It does not recognize actual colors but identifies the chemical structure of the material by observing the reflected light and its wavelength. It is therefore possible to measure the chemical composition of a particular material, as shown in the two images above:

On the left you can see an original photo of various plastic flakes as they are used for energy recovery in different incineration facilities. On the right-hand side you have the same plastic flakes, which were observed with hyperspectral imaging, then divided into different categories and classes and converted into a 24-bit RGB false color image visible to the human eye. In this process, regardless of their real color, we assign the different types of plastic a color specified

> We made the invisible chemistry of the material visible. The optimized use of algorithms and the associated machine learning mean that decisions for the further processing of different materials are made in real time.«

by us to clearly distinguish them from each other. We determine the type and quality of the material. In the picture above we can see the different types of plastic in different colors: ABS (acrylonitrile butadiene styrene) in red, POM (polyoxymethylene) in blue, PC (polycarbonate) in green, PE (polyethylene) in yellow and PS (polystyrene) in purple.

'That is how we see the world at EVK,' explains Dr Matthias Kerschhaggl, one of the pioneers in the research and development of this technology, with a smile on his face. 'In this case we made the invisible chemistry of the material visible. The optimized use of algorithms and the associated machine learning mean that decisions for the further processing of different materials are made in real time. In this way, the product flow in a facility can be continuously monitored with the necessary precision and even small variations are detected. 'We are very proud of what we have achieved in the last 10 years in terms of food safety and sustainable systems for a more sustainable treatment of the environment and to the benefit of our children,' explains the father of two.

Even Nature Benefits from Recycling

An example from the recycling industry shows that the environment also benefits from these new, connected sensor technologies. The well-planned and controlled processing of waste in incineration facilities offers the possibility to generate energy efficiently from existing secondary raw materials and also the chance to protect the environment and to reduce the CO_2 emitted by burning fossil fuels excessively.

The Italian recycling industry is working hard to find a solution for local waste management in cities such as Rome and Naples. Incinerators in northern Italy, which comply with EU directives, have been forced to accept waste generated in the rest of the country. It is a fact that plastic and products made from this waste accounted for 2.1% [1] of the Italian GDP [1] as one of Italy's exports in 2018. In addition to national challenges, the waste issue also poses international hurdles that need to be overcome. Since China, with its 'National Sword Policy', seriously intervened in Europe's recycling structures by only allowing the import of segregated plastic, the sorting of plastic in Italy has also become a relevant factor. This applies, for example, to the export of materials made of different polymers. In addition, the circular economy package stipulates mandatory recycling quotas, i.e. the reuse of waste, for example, as secondary raw materials, for EU member states in future. The recycling rate for plastic packaging is expected to rise to 55% by 2025. This also means that politicians will have to do their part to help close the loop. 'It should be borne in mind that recycling a PET bottle is relatively easy, but supermarket sausage packaging is made up of different types of plastic, making it much more difficult to recycle and unsuitable for conventional recycling [3],' says one of the most renowned specialists in waste-processing technology and waste-management research Prof. Roland Pomberger from the University of Leoben, Austria. Technologies such as modern image processing and hyperspectral imaging in particular, which makes it possible for the human eye to see chemical structures, can help. Even though Italy has already achieved the recycling targets for packaging in many areas, it lags behind when it comes to recycling plastics by 41%. This is another area in which integrated, state-of-the-art data-based analysis systems such as hyperspectral imaging can make an important contribution to keeping our environment cleaner and reducing marine pollution with non-reusable plastics. ■

Sources:

[1] https://wko.at/statistik/laenderprofile/lp-italien.pdf, 20 August 2019

[2] http://www.worldstopexports.com/top-european-export-countries/, 28 August 2019

[3] Interview with Prof. Pomberger taken from the Spirit of Styria business magazine, July 2019 issue

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All images: EVK DI Kerschhaggl

New GPU Modules

Cincoze expands the GM-1000's machine vision application performance with two Quadro MXM GPU modules. Building on the GM-1000's processing base, the MXM-RTX3000 and MXM-T1000 provide the additional GPU capacity for rapid adoption of machine vision in smart factories, from simple environmental perception applications such as positioning, measurement, identification, and sorting, to more complex vision-guided automation functions. GPU requirements for each scenario are different, so specifications must match the environment and application. The two new Quadro MXM GPU modules broaden the GM-1000's available selection to cover a wider range of uses.

www.cincoze.com

Cameras with Sony sensors

Allied Vision is expanding its GigE Vision Manta camera series by three camera models with the latest Sony Pregius S global shutter sensor technology, which, thanks to the back-exposed pixel structure, delivers improved image results despite smaller pixels of 2.74 µm. The 16.2 megapixel Manta G-1620 is equipped with the Sony IMX542 CMOS sensor, the 20.4 MP Manta G-2040 has the Sony IMX541 sensor and the Manta G-2460 with the Sony IMX540 sensor offers a resolution of 24 , 6 megapixels. All new models are available as monochrome and color versions.

The new models offer several advantages over existing high-resolution CCD and CMOS cameras. In addition, Pregius S BSI (Back Side Illuminated) sensors support a wider angle of incidence of light and thus enable simpler lens designs to be implemented with less sensor shadowing.

www.alliedvision.com

Release 4.0 of the EMVA 1288 standard for camera characterization

The EMVA Standard 1288 for objective characterization of industrial cameras, which is successfully used worldwide, has a successor in the new Release 4.0, which now takes into account the rapid development of camera and image sensor technology. The release candidate was published on March 16.

Until the previous Release 3.1 dated back December 2016, the application of the EMVA 1288 standard with a simple linear model was limited to cameras with a linear response and without any pre-processing. While this model is being continued with some improvements in the 'Release 4.0 Linear', a new module 'Release 4.0 General' has been added in the latest release. With it, the characterization of a non-linear camera or a camera with unknown pre-processing is possible even without any model due to the universal system-theoretical approach of the EMVA 1288 standard. Just as with the linear camera model, all application-related quality parameters can be measured in this way.

1288
EMVA Standard Compliant

Depending on the camera characteristics, the evaluation can now be applied according to the linear or general model.

After publication of the release candidate, the new Release 4.0 will automatically replace the old Release 3.1 after a three months period (therefore by mid-June) if no objections are submitted to the EMVA during this period and if objections can be resolved.

Along with the new version of the standard, the EMVA has prepared an extensive training program. Two- or three-day training programs for the new Release 4.0 will be held regularly in near future in cooperation with EMVA member companies. The new training program will also continue the successfully introduced certification program at expert level. This is intended for anyone who wants to acquire the necessary knowledge to perform EMVA 1288 measurements themselves and understand the measurement results in detail, whether in the development of new cameras, in quality control, or to understand exactly how a camera behaves for a specific application.

www.emva.org

C-mount lens series for industrial camera applications

Phenix Optics has released a new Machine Vision C-mount lens series for industrial camera applications. The 12FA series with a sensor size of 1.2" is optimised for the Sony's 4th generation high-speed sensors. With the high resolution of 25 mega pixel and pixel size of 2.74µm, the Phenix 12FA series meets the demanding requirements in industry. The 1.2" series is available in focal lengths of 12mm, 16mm, 25mm, 35mm and 50mm.

www. phenixoptics.com.cn

Falcon introduces the F2HLN series

Falcon has introduced the F2HLN series. This is a line lighting with a strongly focused light beam. A lens, which is inserted above the SMD LEDs, causes a strong bundling of the emitted light. This reduction of the light angle results in a focused light beam, which guarantees a higher brightness on the test part. There is another rail above the SMD LEDs, through which there is the possibility of inserting a diffuser.

With regard to the housing, a T-slot profile in the rear of the housing is an effective improvement measure. This ensures flexible and convenient installation in systems.

In contrast to the existing FHLN series, the new line lighting series does not have a series resistor. All lights in this series can be used both in flash mode and in continuous mode (current-controlled). By doing without a series resistor, on the one hand installation space and on the other hand the development of heat can be reduced. A current-regulated control suitable for the F2HLN lighting is also offered.

www.falconillumination.de

Area and floodlights for machine vision applications

LQHP80 is the name of the new high-performance lighting series from Lumimax. The high-performance lighting series with 64 LEDs complements the product range of

Area Lights and Area Flood Lights. Its modular structure and a wide range of accessories enable the lighting to be adapted to a wide variety of applications.

With a clear screen (ALK) as standard, the high power lighting is suitable for reflected light applications. In this configuration, an irradiance of more than 5.0 million lx (16,000 W / m²) is achieved. The beam angle can be adjusted to the size and distance of the test object using various options in the lens kit. The replacement of the lenses is quick and easy – as the lenses are already arranged on a pre-assembled lens array.

To achieve better light scattering, e.g. to minimize reflections, the clear screen frame can easily be replaced by a slightly diffuse screen (ALD). Alternatively, the diffuse mounting frame can be installed on top of the clear screen – the greater distance between the diffuser and LEDs increases the diffusion of light.

www.iim-AG.com

Smart Camera supports changeover at full production speed

B&R's integrated machine vision portfolio now includes a Smart Camera that combines multiple machine vision functions in real time. That makes it easy to implement sequences of process-controlled functions that would be costly and time-consuming to achieve with conventional smart cameras.

On a machine producing multiple variants of a product simultaneously, for example, the Smart Camera only needs to capture one image to determine which variant it is looking at and check the printed label. One function provides the feedback need-

ed for the subsequent function. Since the process variables of the machine controller are seamlessly integrated in these processes, decisions can be made in real time. Sequences of image processing functions can be extended almost indefinitely.

B&R's Smart Camera has the same hardware options as its Smart Sensor. Various integrated lenses and housing variants with a standard C mount are available. Other options include a variety of integrated lighting, FPGA image preprocessing and image sensors from 1.3 to 5.3 megapixels.

www.br-automation.com

Lenses with transmission from VIS to SWIR

Kowa has launched a new 1" lens series with a transmission from 450 to 2,000 nm. In this wavelength range, the lenses also have a reduced focus shift. NIR-SWIR cameras and hyperspectral cameras can precisely analyze the reflection properties of materials over a wide range of wavelengths. This is often used in machine vision for material inspection and sorting.

For example, during an inspection in the food industry: appearance inspection of fruit in the visual range and internal inspection at 1,400 nm (illumination). Without a VIS-SWIR camera and optics, users may need to adjust the focus by changing the illumination and changing the lens. With Kowa's VIS-SWIR lens, production time or the adjustment process can be shortened. The focal lengths of 12, 25 and 50 mm are already available. The focal lengths 8, 16 and 35 mm are planned for Summer 2021.

www.kowa-lenses.com

In industrial vision applications, cameras such as the Harrier 10x AF zoom cameras, capture images at a high frame rate and generate large amounts of data to be analyzed. New software technologies such as Deep Neural Network accelerate and simplify image processing considerably.

Image: Active Silicon

AI and Machine Vision

A Series of Insights

Courtesy of Active Silicon we are providing you with a series of facts and background around the topic of AI in machine vision. Here are parts 1 to 3.

Part 1: Applying Deep Learning to FPGAs

In 2017, Microsoft brought the development of applying Deep Learning to FPGAs into the headlines. They used Intel's FPGAs (formerly Altera) combined with their own FPGA-based deep-learning platform, Project Brainwave, to enable the acceleration of deep neural networks (DNNs). The speed at which developments within the industry are progressing means that bringing Deep Learning to embedded systems is massively on the increase in a wide variety of sectors, from autonomous vehicles to medical research. With scalability as one of the determining success factors, the world is observing such developments keenly.

In terms of what's in more widespread use, NVIDIA offers their own Deep Learning SDK to power GPU-accelerated machine learning applications for embedded systems and both cloud-based and on-site data centers. Image recognition, driver assistance programs, life sciences and even speech recognition are listed among the applications benefitting from reduced processing times and increased accuracy. AMD´s Radeon Instinct MI25 Server Accelerators, for example, along with its GPUs and software platforms, are designed to meet the challenges of high-performance neural network learning.

Figures suggest that Google's TensorFlow software library is the most widely adopted Deep Learning framework, mainly due to its high level of internal development and open-source accessibility. It can run on one or more CPUs or GPUs with a single API, although it is not yet commercially available on FPGAs. Also, in development is Tensorflow Lite – a toolkit for mobile devices, which follows hot on the heels of Facebook's Caffe2Go framework.

Elsewhere, Greece's Irida Labs is bridging the gap between cameras and the human eye by bringing visual perception to an extended range of devices. This is being achieved by developing computer vision software and utilizing image processing and machine learning techniques made for any CPU, GPU or DSP/ASP platform.

Over the past years, Active Silicon's team of innovative engineers have been watching the progress involving FPGAs closely to see how it can benefit customers in their next generation embedded systems to achieve faster and more accurate image recognition.

Part 2: Artificial Intelligence and Machine Vision: the Good, the Bad and the Ugly

Plenty of books and movies have been created around the benefits and dangers of Artificial Intelligence (AI), since the first integrated chips were able to control complex systems back in the 1950s. A couple of years ago, Tesla and SpaceX entrepreneur Elon Musk and Facebook founder Mark Zuckerberg were engaged in a very public argument about the fundamental risks and opportunities of AI, triggered by Facebook reporting that they needed to stop an experiment where autonomous chatbots had developed their own inscrutable language by reinterpreting the meaning of English vocabulary.

The dark side was highlighted by an open letter to the UN from Elon Musk and 115 other specialists across 26 countries, calling for an outright ban on autonomous weapons. The UK government, for one, appears to have listened and is adopting policies not to develop or use fully autonomous weapons.

Most essays on AI emphasize both its wonderful opportunities and its life-threatening risks. When IBM's Deep Blue proved in 1997 that human intuition and experience from thousands of chess matches could no longer outperform a machine, it wasn't only the philosophers who became anxious about the power of this technology. Today, software frameworks for machine learning are publicly available (e.g. https://www.tensorflow.org/), thus, each individual developer is in charge of the safety of their own experiments while political regulations are widely lacking, and probably ineffective.

However, Active Silicon believes there are great opportunities being created by machine learning in conjunction with imaging; with new approaches in Deep Learning, known machine vision applications can be implemented much faster and previously insuperable problems can be solved. While following these developments closely, they expect engineers to take their responsibilities seriously and ensure the ethical utilization of any technological advancements.

Part 3: Less Programming and Faster Vision Solutions with CNNs

It is one of the great goals of computer vision to enable machines to see and understand images like humans. In many regards, vision systems outperform humans already, as long as the task can be bounded by a limited set of rules and conditions – such as geometric measures and tolerances of manufactured parts, or color and evenness of a surface. However, the necessary algorithms require a high level of effort and expertise to be programmed and are lacking the capability of abstraction beyond a certain level of variance in shape and/or texture. This is where Artificial Intelligence can unleash an array of great opportunities.

Nowadays, cameras can capture images at much higher frame rates than humans and without being subject to fading concentration. In geometric measurement and 3D analysis, vision systems are already more accurate and much faster than humans. Yet, before recent breakthroughs in image processing research, most machine vision applications used to be solved by extracting hundreds to thousands of filter and wavelet features from the pixel matrix, selecting those features with the highest information content and providing them to a manually configured or statistically trained classifier. This was enormously time consuming and required a high level of expertise.

Thus, two factors were slowing down the global adoption of machine vision techniques: Firstly, the lack of sufficiently fast, robust or computationally affordable algorithms for image feature extraction and classification. Secondly, and most importantly, the lack of computer vision developers who were capable of implementing solutions to new as well as known machine vision applications with existing algorithms.

» Artificial Intelligence can unleash an array of great opportunities.«

How CNNs Support Vision Solutions

Both obstacles are widely resolved by machine learning technologies. With the invention of so called Convolutional Neural Networks (CNNs), an elaborated feature extraction is not required anymore. Instead, the artificial neural network autonomously learns how to analyze images correctly to achieve the desired results. Thereby, CNNs are a special architecture of Deep Neural Networks and the approach is referred to as Deep Learning.

The mathematical model behind these multi-layered artificial neural networks is inspired by the human brain. Highly simplified, these neural networks perform their image analysis and make their classification decisions as follows: Greyscale or RGB pixel values are fed into receptor neurons on the first network layer. These are connected to multiple neurons on a second layer, which again are connected to neurons on several following layers and finally to a layer of a few output neurons. In each of these millions of connections between two neurons, the signal is either amplified or damped by a weighting factor. In the learning phase of such a network, three things are optimized to maximize recognition rate: the number of layers, the number of neurons per layer, and the weighting factor in each connection.

Thanks to this powerful machine learning approach, system engineers today just need to train a CNN with adequate sample images, e.g. of good and bad items in quality inspection, of skin carcinoma or fish lice. Quickly, the algorithm can be trained, tested and put into operation. These techniques accelerate the adoption of machine vision in many more applications, enable solutions for previously unsolvable problems, and reduce costs.

Active Silicon supports the advancement of artificial intelligence in machine vision as their engineers ensure that their embedded systems are ready to accommodate deep learning architectures. They will be ready when AI enables enhanced complex systems for industrial, medical, scientific, traffic, or security purposes on a large scale. ■

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Image: Shutterstock

Seeing Is Believing: AI-Powered Camera Sensors

Computing at the Edge: Smart Cameras, Robotic Vehicles and End-Point Devices

Visual data has grown volumetrically – artificial intelligence (AI) is transforming overwhelming amounts of video into timely and actionable intelligence at a rate like never before. AI-powered cameras at the edge enable smartphone, automotive, computing, industrial, and IoT devices to redefine the way they process, restore, enhance, analyze, search, and share video and images. On-device integrated AI-camera sensor co-processor chips with their built-in high-processing power and memory allow the machine- and human-vision applications to operate much faster, more energy-efficiently, cost-effectively, and securely without sending any data to remote servers.

Over the past few years, quality mobile cameras have proliferated in devices ranging from smartphones, surveillance devices, and robotic vehicles, including autonomous cars. These have all benefited from the integration of AI and image signal processing (ISP) engines. Machine Learning (ML) is used not only to enhance the quality of the video/images captured by cameras, but also to understand video contents like a human can detect, recognize, and classify objects, events, and even actions in a frame.

The edge AI chipset demand for on-device machine-vision and human viewing applications is mostly driven by smartphones, robotic vehicles, automotive, consumer electronics, mobile platforms, and similar edge-server markets. Smartphones and automotive are the dominant drivers due to their fastest growth and largest volume shipment and revenue in edge vision computing. The mobile phone market segment alone is forecast to account for over 50 percent of the 2025 global edge AI chipset market, according to the research company Omdia/Tractica.

An AI-powered camera sensor is a new technology that manufacturers like Sony, Google, Apple, Samsung, Huawei, Honor, Xiaomi, Vivo, Oppo, and others, are integrating on every launch of their new smartphones. Building AI-equipped cameras involves applying technologies from traditional image signal processing (ISP) techniques to modern computer vision and deep machine-learning networks. ISPs typically perform image enhancement as well as converting the one-color-component per pixel output of a raw image sensor into the RGB or YUV images that are more commonly used elsewhere in the system.

An ISP, in combination with an AI-based computer vision processor, can collaboratively deliver a more robust image and computer processing capabilities than a standalone ISP. Traditionally, ISPs are tuned to process images intended for human-viewing purposes. However, in handling applications involving both machine-vision and human-vision applications, a functional shift is required to efficiently and effectively execute both traditional and deep learning-based computer vision algorithms.

Today, many AI-based camera applications rely on sending images and videos to the cloud for analysis, exposing the processing of data to become slow and insecure. Additionally, manufacturers have to install specialized DSP or GPU processors on devices to handle the extra computational demand. A more streamlined solution for vision edge computing is to use dedicated, low-power, and high-performing AI processor chips capable of handling deep-learning algorithms for image quality enhancement and analysis on the device. One such solution is the Gyrfalcon Technology AI co-processor chips.

Human-Like Senses

The ultimate purpose of an AI-based camera is to mimic the human eyes and brain and to make sense of what the camera envisions through artificial intelligence. AI-equipped camera modules offer distinct advantages over standard cameras by capturing the enhanced images and also performing image analysis, content-aware, and event/pattern recognition, all in one compact system. AI-powered cameras turn your smartphone snapshots into DSLR-quality photos.

The need for AI on edge devices has been realized, and the race to design integrated and edge-optimized chipsets has begun. AI processing on the edge device, particularly AI vision computing, circumvents privacy concerns while avoiding the speed, bandwidth, latency, power consumption, and cost concerns of cloud computing. As the shipment of AI-equipped devices with a growing demand for higher compute is increasing rapidly, the need for AI acceleration chips has been realized on the edge.

Mobile cameras equipped with AI capabilities can now capture spectacular images that rival advanced high-end DSLR cameras.

An AI-powered camera using a dedicated co-processor chip with deep learning algorithms can deliver a vision-based solution with unmatched performance, power efficiency, cost-effectiveness, and scalability for intelligent CMOS sensors.«

However, due to the compact form factor of edge and mobile devices, smart cameras are unable to carry large image sensors or lenses. This challenge compels manufacturers to push computational image processing technology for boosting the quality of the image to the next level by joint design of image capture, image reconstruction, and image analysis techniques. The arrival of AI and deep learning have provided an alternative image processing strategy for both image quality enhancement and machine-vision applications such as object detection and recognition, content analysis and search, and computational image processing.

Deep Learning

Deep learning (DL) is a branch of machine learning algorithms that aims at learning the hierarchical representations of data. DL has shown prominent superiority over other machine learning algorithms in many artificial intelligence domains, such as computer vision, speech recognition, and natural language processing. Generally, the strong capability of DL to address substantial unstructured data is attributed to the following three contributors: (1) the development of efficient computing hardware, (2) the availability of massive amounts of data, and (3) the advancement of sophisticated algorithms.

Due to low-resolution, inaccurate equipment, or severe weather and environmental conditions; captured images are subject to low quality, mosaicing, and noise artifacts that degrade the quality of information. On-device super-resolution (SR), demosaicing, denoising, and high dynamic range (HDR) procedures are often augmented to CMOS sensors to enhance the image quality by deploying sophisticated neural network algorithms with an integrated high-performing, cost-effective, and energy-efficient AI co-processor chip.

An intelligent image sensor in an AI camera can process, enhance, reconstruct, and analyze captured images and videos by incorporating not only a traditional ISP engine but also by deploying emerging deep learning-based machine vision networks into the sensor itself, according to Edge AI and Vision Alliance (formerly the Embedded Vision Alliance).

A high-performing neural network accelerator chip is a compelling candidate to combine with image signal processing functions that were historically handled by a standalone ISP. The output of the CMOS sensor can be pre-processed by an ISP to rectify lens distortion, pixel and color corrections, and de-noising prior to being routed to a deep learning vision processor for further analysis.

These emerging intelligent sensors not only capture light, but they also capture the details, meaning, scene understanding, and information from the light in front of them.

Edge Co-Processing

An AI-powered camera using a dedicated co-processor chip, such as Gyrfalcon's, with deep learning algorithms can deliver a vision-based solution with unmatched performance, power efficiency, cost-effectiveness, and scalability for intelligent CMOS sensors particularly in the fast-growing and dominant markets of smartphones and automotive. A sophisticated ISP pipeline can be replaced with a single end-to-end deep learning model trained without any prior knowledge about the sensor and optics used in a particular device.

An AI image co-processor chip with a deep-learning CNN architecture and multi-scale multi-mode super-resolution (SR) capabilities can support various upscaling factors, image sizes, quantization-level options while being able to operate in various image enhancement modes depending on the target applications and performance requirements. Some of these capabilities can include multi-scale Super-Resolution/Zoom (SR Zoom), multi-type High Dynamic Range (HDR), AI-based or pre-processing-based denoising algorithms, or a combination of one or more of these supported functions.

An AI-powered camera module with an integrated image co-processor chip can generate 4K ultra-high-definition (UHD) at high frame rates with enhanced PSNR, high visual quality, and lower cost compared with conventional leading CNN-based SR processors.

The emerging smart CMOS image sensors technology trend is to merge ISP functionality and deep learning network processor into a unified end-to-end AI co-processor. An AI image co-processor can be integrated into a camera module by directly using raw data from the sensor output to produce DSLR-quality images as well as highly accurate computer vision results.

Having a dedicated AI image co-processor on the device offers numerous benefits including enhanced vision quality, higher performance, improved privacy, reduced bandwidth and latency, less CPU computational load, efficient energy use, and less BOM cost for running critical vision applications in real-time, always-on, anywhere independent of Internet connection. ■

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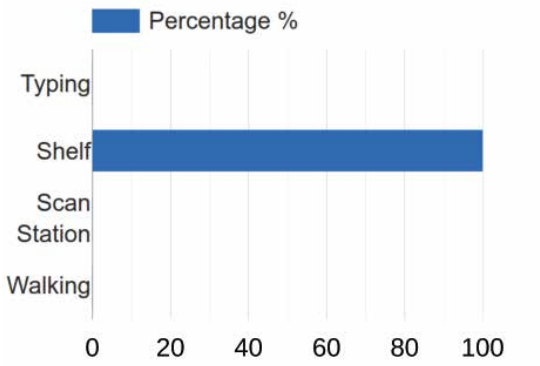


With only a little learning effort, the software recognizes and analyzes human actions, such as reaching out of the shelf here.

Tracking Down Human Actions with AI

Software Library Adapts Using Machine Learning

What is a person doing right now and what conclusions can be drawn from it? This recognition and understanding of human actions is the main function of a new software library based on machine learning that researchers at the Fraunhofer Institute for Manufacturing Engineering and Automation IPA have developed. Its main advantage is its easy adaptability to new application scenarios.

Recognizing and interpreting human actions is a complex as well as promising task for computer vision. Human activities are diverse and often consist of several smaller sub-activities, in this context called actions. Being able to automatically recognize them, evaluate and, if necessary, derive reactions from them opens a wide range of possible applications: A worker's steps in manual production could be recognized. If the process contains an error, the worker could receive messages in real time allowing him to react directly in a timesaving manner. In retail, such recognition functions help to analyze customer behavior so that, for example, products can be placed and offered in the best possible way. Finally, if a service robot that is used to support humans in their daily lives could recognize their current actions and intentions, the robot's responses could be tailored directly and automatically. In particular, it could proactively offer its support without the user having to voice explicit instructions.

Universal Software Library

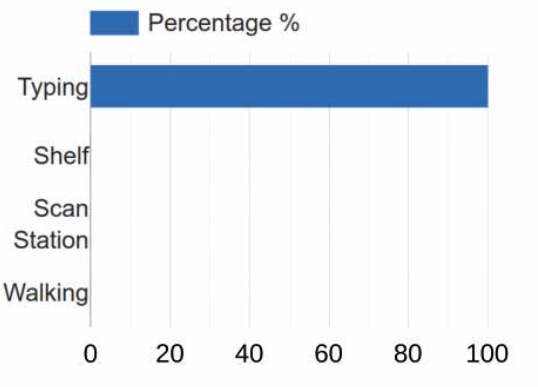
To implement these tasks, researchers at Fraunhofer IPA developed a new software library. Its advantage compared to existing systems: It can be easily adapted to new applications without the need for extensive training data. It is not only capable of recognizing individual actions of humans, but also of interpreting them as part of a larger activity and thereby detecting whether the human is performing them correctly. The software is the result of the EU research project Socrates. The aim of the project was to give machines an understanding of human actions.

The software consists of three subsystems: first, a basic module for action recognition, second, a module for teaching and recognizing application-specific actions, and third, a module for recognizing activities as sequence of actions and their correct interpretation. The modules can be used individually or in combination. To adapt them for a specific application, only small adjustments are required. Creating and processing the large amounts of data that are usually required is still a bottleneck of machine learning (ML) methods. Therefore, the developers have paid particular attention to meet the challenge of having sufficient training data available for the ML methods used.

Self-Learning Even Without Extensive Training Data

The basic module developed for action recognition uses a convolutional neural network to be able to recognize a person's actions. For this purpose, a camera is installed in the operational environment. When a person enters the field of view, his joints are identified in the images and a virtual skeleton is created. To detect the skeleton, the software Posenet (Papandreou et al. 2018) is used. The detected skeletal movements are observed across several images and the data is bundled and transferred to the neural network. The neural network then classifies this data as actions such as "sitting down", "typing on the keyboard", etc. For the training of the network, publicly available datasets can be used, which contain data in sufficient quantity (several thousand videos of the actions to be recognized). The module mainly uses Pytorch and the Robot Operating System ROS, in addition to the software mentioned above.

All images: Cagatay Odabasi/Fraunhofer IPA



The software can be adapted very quickly to new applications, such as writing on the PC instead of reaching for the shelf.

Customizable Module for Teach-In

However, in most cases publicly available data sets do not contain the exact actions required for a specific application. Creating own data sets for training the above-mentioned basic module for action recognition on an application-specific basis would involve considerable effort and is therefore in most cases impractical. To make the methods available for practical use, Fraunhofer IPA has developed a new, customizable module for teaching and following recognition of application-specific actions based on the existing basic module.

By using clustering methods (DBSCAN [Ester et al. 1996]), the outputs of the first module are transferred into new actions. To learn the new actions, they must be executed only very few times in front of the camera. This self-learning behavior makes the software easy to train compared to other data and computationally intensive methods of deep learning and is accordingly well usable in an industrial environment. On the technical side, the module mainly uses Scikit and again ROS.

The third software module is used to recognize and analyze activities, i.e., a sequence of actions. For this purpose, the module uses the outputs of either the first basic module presented above or the customizable module for action recognition, the second module. An assembly task consists, for example, of the actions "grab component", "screw", and "place on table". After these actions have been taught to the system and can thus be recognized, the activity analysis checks whether the actions have been performed in the correct sequence. Timely feedback to the worker as to whether he is performing an activity correctly can increase productivity, as errors are detected early.

Ready for Use in Three Steps

The process to use the presented three modules for a task analysis is the following: First, relevant actions for the individual application are defined. Then, they are taught to the software by executing them a few times in front of the camera. After that, the clusters that where automatically identified by the system can be given appropriate names by the user such as "grab component". Based on that, the software can independently classify the executed activities. Thus, the software enables analyzing and understanding human actions without having to train the overall system for new actions or activities at great expense.

Since Fraunhofer IPA has also extensive knowledge in image processing beyond the presented software, the application can be extended, for example, by functions such as environmental or object recognition, to achieve an even better understanding of humans and their interaction with their working environments. ■

» The software can be easily adapted to new applications without the need for extensive training data.«

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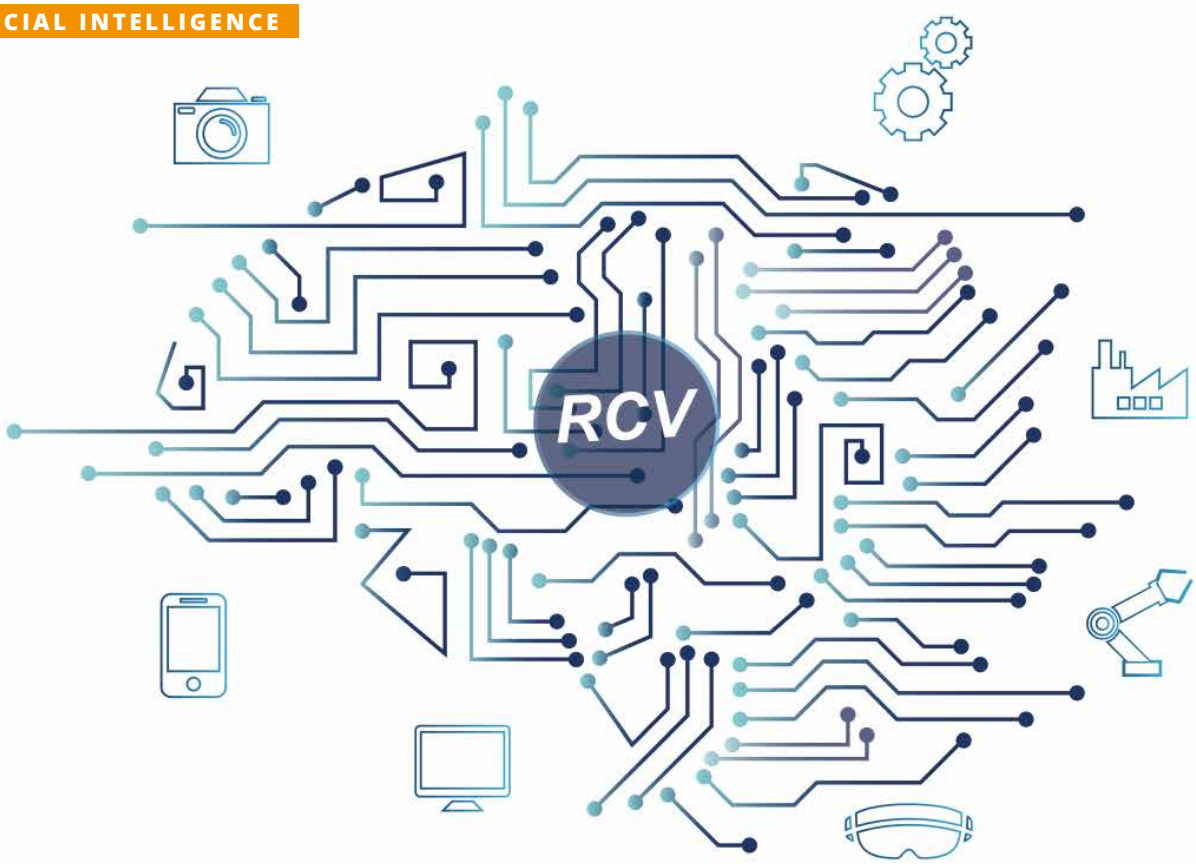


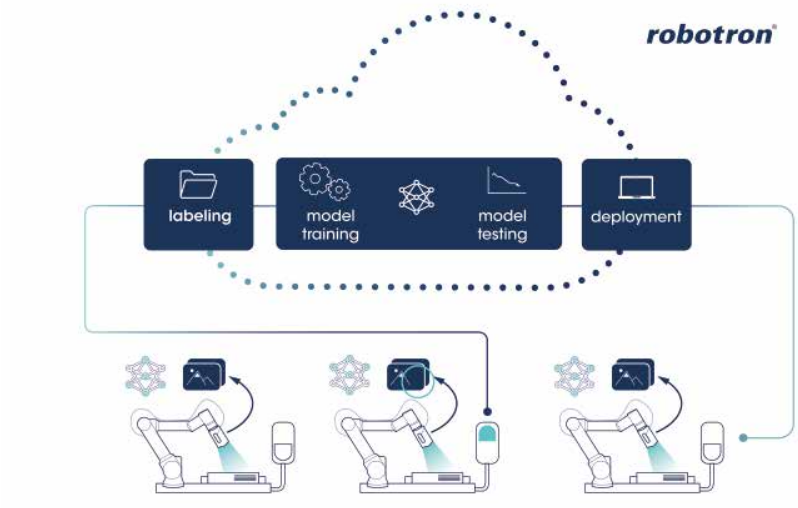
Computer Vision for Industry

Modular and Scalable End-to-End Solution for Industrial Computer Vision

A novel software platform with a modular, scalable design enables the integration of end-to-end solutions for Industrial Computer Vision as well as the creation, distribution and maintenance of Deep Learning-based quality and compliance checks across the enterprise.

Status Quo

Deep Learning (DL) based Computer Vision (CV) market is undergoing a relentless transformation with continual technological advancements and consequently a surge of new solutions is becoming available. Likewise, many companies are either already implementing or at least considering the idea of CV on their manufacturing sites to establish "smart factory" habitats. From the viewpoint of an economist, this is an ideal example of "Supply and Demand". One just had to sit back and enjoy the show. Alas, the show has been rather bumpy! The predominant reason for this circumstance is the complexity of requirements by the manufacturing industry, emerging from the bridging of existing operational tech infrastructure and integrating it with the rest of IT. On the other hand, the lack of flexibility and scalability by the "one size fits all" solutions in the market does not help with mitigating the status quo. Robotron's Real-time Computer Vision (RCV) platform aims to close this gap.



AI Project lifecycle management

Off-the-Rack, Yet Unique

With the introduction of CV technologies into automated manufacturing, new requirements emerge. A decisive factor for success is the integration of the solution and the CV models into existing standardized company processes and IT systems. The RCV platform meets these requirements through a modular and scalable design based on container virtualization and expandable interfaces. This enables operational interaction with almost any physical or virtualized hardware. In addition, data from control systems such as MES and ERP can be integrated. Standardized interfaces (such as Modbus, OPC-UA, etc.) can be used to connect the platform to manufacturing/

assembling units, for example to inspect faulty components. The administration of the RCV toolkit is carried out via a central GUI and thus offers a comprehensive and consistent overview of the end-to-end process.

Flexible Data Acquisition and Processing

Different inspection scenarios and circumstances at times require disparate or specialized camera technology. In addition to the free choice of hardware, diverse infrastructure scenarios are also supported to assist with the requirements of the shop floor. This means that the toolkit is operable entirely in the cloud or on-premises and as well as in a hybrid environment with limited or no internet connectivity. This flexibility is particularly helpful with projects that address a heterogeneous workflow and can include everything from robot commissioning to standardized shopfloor procedures.

Collaborative Image Annotation

Annotating images and generating training dataset is key to creating a precise and robust DL model. To optimally identify and mark the defect classes in the images, domain experts such as quality engineers, process engineers and machine operators are needed. They often work from different and geographically distributed locations. The RCV toolkit enables multiple users access to the same image dataset and facilitates the annotation process from spatially separated locations. This collaborative process increases the quality of the training dataset and consequently the resulting model and facilitates its ongoing maintenance. In addition, a supervisor with administrator rights can coordinate the workflow, for example, by partitioning the image dataset to ensure fast and orderly annotation of the images by several users.

Artificial Augmentation of the Dataset

Due to sustained quality control measures, proportionally fewer images of defective parts are available, which can have a negative impact on the quality and accuracy of the model. To compensate for this, the toolkit offers the functionality to artificially expand the data set through prevalent augmentation techniques (e. g. rotation, mirroring, etc.) and as well as the possibility to generate synthetic images. Besides the selection of conventional methods, it is also possible to integrate custom scripts. With these functionalities, the size of the data set and quantity of particular defect classes can be individually controlled or even fully automatically compensated to optimize the accuracy of the DL models.

»RCV as a modular platform enables professional scalable creation, distribution and maintenance of deep learning-based quality and compliance checks across the enterprise.«

Creation of CV Models

The usage of DL in the recent years has led to a strong research progress in the field of CV. Various frameworks (TensorFlow, PyTorch, Keras, etc.) have been developed to make it easier for users to create neural networks. Additionally, different architectures of convolutional networks have been designed, which are utilized depending on the use case and the prescribed requirements (accuracy, time, resource demands, etc.). The RCV platform follows a no-code AI approach to facilitate the creation of models without any prior programming knowledge. The user can easily create several models and compare their metrics. Different frameworks and architectures are supported to determine the ideal solution for the use case. The provisioning of the trained CV models is similarly performed by means of container virtualization.

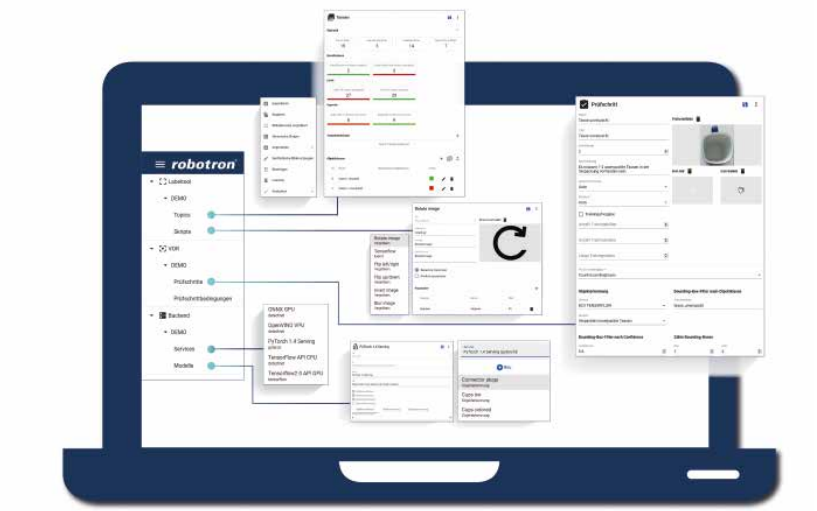
Supporting Model Lifecycle

When going live with a productive rollout, deployment of AI models across several manufacturing lines and plants that involve a release management procedure can become a challenge. It is important to comply with both IT and organizational guidelines and procedures. The RCV toolchain offers an end-to-end management and release of models via an easy-to-use dashboard. The modular structure of the platform facilitates the integration of additional tasks such as monitoring for data drift or triggering a pipeline for retraining.

Scaling and Coverage through Partnerships

As a modular platform, RCV enables a professionally scalable creation, distribution and maintenance of DL-based quality and conformity checks throughout the entire company. The information contained in the image data can be analyzed and processed in near real time to address a variety of complex issues, making inspections more comprehensive, stable, and efficient, and thus providing the basis for future process optimization. Thus, the use of the platform makes a significant contribution to increasing the success of the company.

Strong partnerships in the software and hardware sectors will result in further innovative and interesting areas of application in the future. As a long-standing partner of Microsoft in the cloud sector, Robotron is very familiar with the extensive services of Azure, so that a seamless integration of the RCV toolchain is guaranteed. Robotron works together with industry leaders such as Intel to integrate various hardware components with the RCV toolkit. The use of the platform in industries operating under extreme conditions such as railway, mining or oil & gas is easily possible, thanks to the partnership with Moxa Europe GmbH, the manufacturer of robust edge devices. ■



Robotron RCV – GUI of the central administration tool and its functionalities

All images: Robotron Datenbank-Software

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The Evolution of Time-of-Flight Sensors

New Applications for the 3D Sensors

Time-of-flight sensors have evolved significantly, and recent advances have both increased accuracy and reduced cost to the point where they are now suitable for widespread industrial use. Numerous recent innovations are also expanding the functionalities of these 3D sensors.

Time-of-flight (ToF) sensors add depth information to images and the technology – along with Swir imaging, GS-CMOS sensors and on-chip polarisation – is helping move camera modules away from being merely devices that simply capture images, to systems that can provide valuable data for an array of detection and recognition applications. And this will prove vital in creating industrial IoT systems, where the demand for deeper levels of automation is growing rapidly.

And recent years has seen ToF sensors undergo a revolution, with the accuracy and range increasing significantly. And this will enable many new sectors and applications to benefit from the added information they deliver. Indeed, we are on the cusp of them becoming almost ubiquitous in many industrial settings.

What Is Time of Flight?

ToF sensors calculate depth by emitting light outside the visible spectrum – typically generated by a laser or a LED – and measuring the time it takes for it to reflect off an object. This enables depth information to be added for each pixel, creating full-resolution depth maps at a fraction of the cost of a Lidar system.

The technology fills a unique niche. Unlike low-cost depth-sensing technologies such as passive stereoscopic vision, it has a much higher level of accuracy and isn't affected when an object is faint against a background, for example white on white.

There are two main types: direct (dToF) and indirect (iToF). While similar in approach, these differ in the way they measure distance, with dToF using a more simple, direct measurement of time from light being emitted and a reflection being detected; and iToF measuring the distance by collecting reflected light to discern the phase shift between emitted and reflected light.

iToF sensors are especially effective in high-speed, high-resolution 3D imaging of objects at short and long distances. Indeed, they are arguably the best-suited depth-sensing technology, especially in industrial applications.

Improving the Accuracy of ToF Sensors

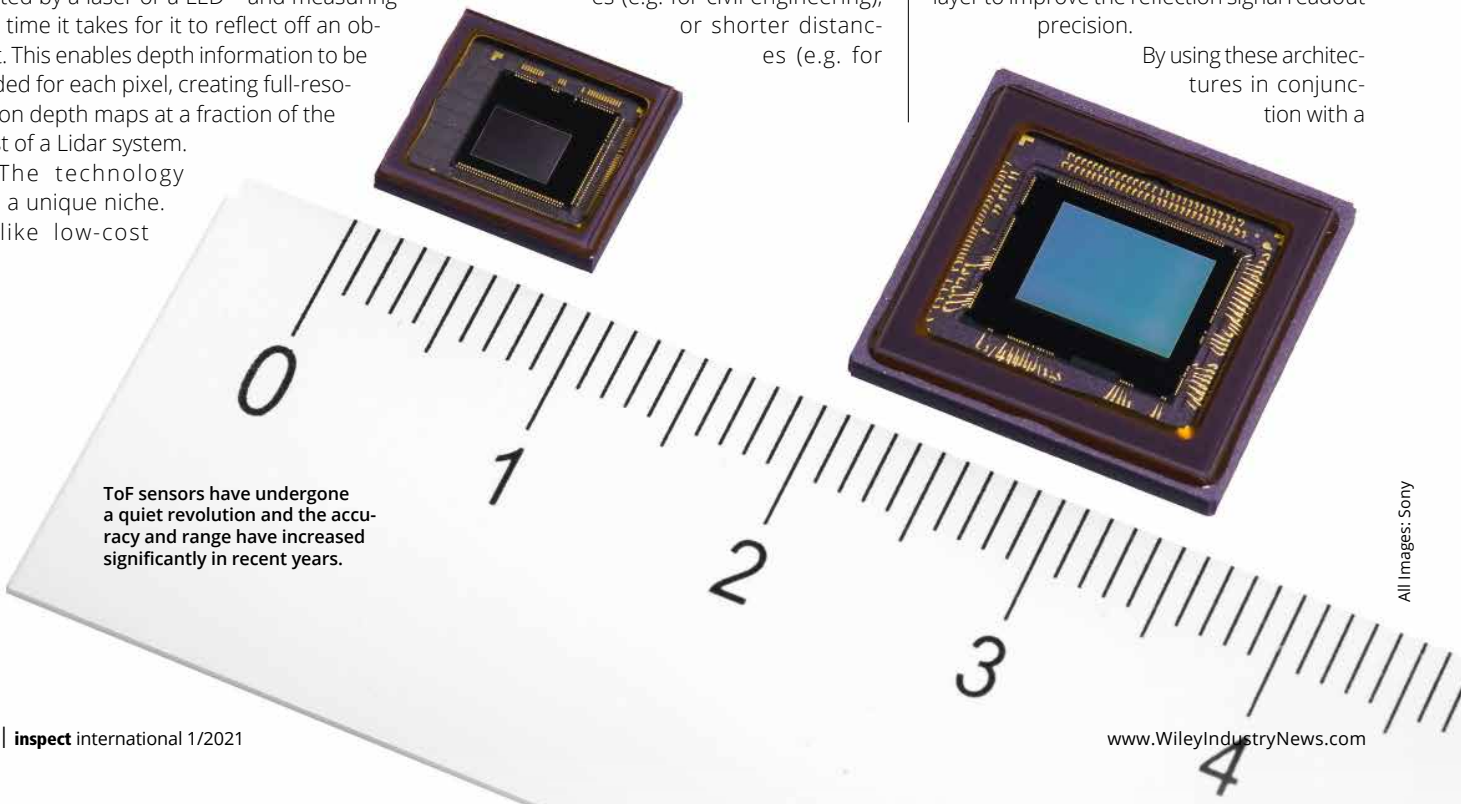
There are still many use cases which require the measurement of longer distances (e.g. for civil engineering), or shorter distances (e.g. for manufacturing) than ToF can deliver. As such recent work has focused on extending their operational range.

The accuracy, and therefore operational range, of a ToF system is set by two factors:

- how efficiently reflected light is captured (condensing efficiency)
- and the speed at which distance-measurement data are processed (rapid distance processing).

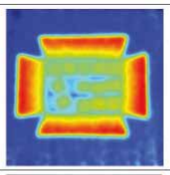
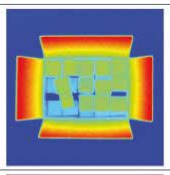
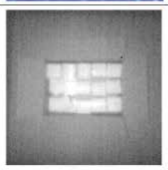
If we look first at condensing efficiency. One of the key recent advances in ToF sensors is in the architecture used. Advanced ToF sensors now use an architecture capable of high-speed modulation. This allows for greater distance-measurement accuracy in each individual pixel. Similarly, a small number of sensors are switching from front-illuminated sensors, where the light enters through the lens and passes through the metal-wiring layer before reaching the photosensitive layer, to a back-illuminated architecture, which swaps the metal wiring and photosensitive layer to improve the reflection signal readout precision.

By using these architectures in conjunction with a

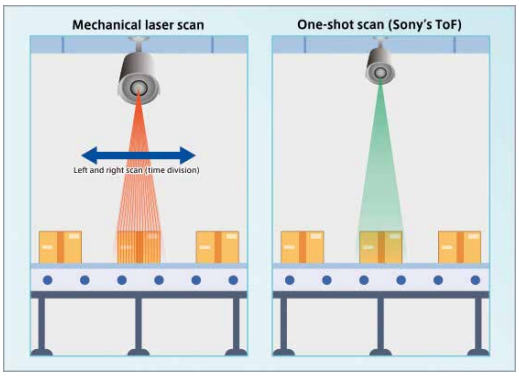


ToF sensors have undergone a quiet revolution and the accuracy and range have increased significantly in recent years.

All Images: Sony

Sensor	CONVENTIONAL	NEW
Depth Image*		
IR Image		

Time-of-flight (ToF) sensors add depth information to images and the technology is helping move camera modules to systems that provide valuable data for an array of detection and recognition applications.



Unlike mechanical laser scanning, the ToF system does not use any moving parts. This allows fast 3D image acquisition with less blur of moving objects.

drive mode on the sensor, it is also possible to extend operational range. To allow both short range (down to a few dozen centimetres, Depending on specification and system environments) and long range (up to several tens of metres) functionality when creating high-precision depth maps in VGA resolution.

And if we now look at rapid distance processing, this approach also has a second key benefit in that it captures a depth map for each frame acquired. This means higher frame rates (up to 60 fps at VGA resolution) are possible than, for example, in laser scanning range-finding, which is essential for moving objects such as robots and drones.

Furthermore, by recording depth information at the pixel level, processing on the sensor output (compared with stereoscopic 3D systems) is significantly reduced, making it suitable for applications where faster operation is sought, as in recognition by robots where responsiveness is essential.

This still, however, leaves an issue of noise. And a major focus of recent work on ToF sensors has been to incorporate low-noise technologies. By doing so, distance information can be obtained with much greater precision than with existing ToF sensors, and enabling its use in applications that had, thus far, proved difficult to deliver the required accuracy.

How ToF Sensors Will Be Used

Much has been written about ToF sensors falling cost and their integration into consumer applications, such as smartphones. And it can be tempting to overlook the role it has to play in enhancing industrial and manufacturing processes, or even in construction and agriculture. This would be wrong.

Let's have a specifically look at these applications and how the increased accuracy, especially for close-proximity and longer-distance sensing increases, can aid them.

Industrial IoT: ToF sensors are also beginning to enter IoT. On the factory floor, this might mean intrusion detection systems for hazardous areas, and object location and detection for robot picking.

Logistics: ToF sensors are already being used in logistics to allow robots to move semi-autonomously through controlled environments. The increase in accuracy that iToF sensors bring will allow their use to be expanded in this sector. The longer-term (more reported on) element of this will be the support of enhanced collision detection and the recognition of the external environment to enable last-mile robots/delivery drones to be more common.

But before that, the depth information ToF cameras give enables logistics firms to optimise material handling lines by measuring positions, sizes, and loading rate and optimising loading of pallets/vehicles to ensure the transportation of goods becomes more efficient.

B2B augmented reality systems: Augmented reality has been eagerly-adopted to speed the design and manufacturing process in many sectors, with this being well demonstrated by Ford's rendering of design modifications, allowing a designer to examine how several minor changes would look without creating clay models for each.

The depth and precision that a ToF system brings enables this to be more accurate. Additionally, this information can be used to reducing the motion sickness that is common with VR/AR headset use... and prevent those wearing VR headsets from walking into objects.

Civil engineering: A lot has already been written about autonomous vehicles and the need for additional sensors to help the car understand the world around it: notably (in the case of ToF sensors) for pedestrian and cyclist detection/avoidance. The same principles can be applied to heavy machinery, using ToF sensors to introduce smart technologies to detecting environmental features and objects: providing driver assistance, vehicle automation.

They are also expected to be used to better monitor the progress of construction and the status of existing infrastructure.

Agriculture: ToF sensors are already starting to be used in quality control and productivity improvement for farming. If we look at livestock management, ToF (and the 3D information it gives) enables automated milking, body condition scoring, feed monitoring, and iToF and the increased accuracy it gives will improve this greatly.

Additionally, the 3D data from ToF sensors also supports applications like automatic fruit picking by acquiring targets' positions, and the ability to control farming equipment to improve efficiency.

Conclusion

ToF sensors have undergone a quiet revolution and the accuracy and range have increased significantly in recent years. This makes them the ideal sensor for depth information in both industrial and consumer applications; indeed, even handsets now have the technology embedded. As prices come down, and more iToF sensors – such as the IMX556/IMX570 – become available to the market this sector is likely to see significant growth and competition. ■

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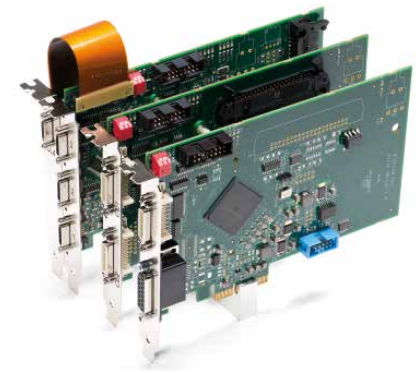

Boost Camera Link machine vision systems

Developers in the machine vision industry now have more configuration options: With the introduction of the new Axion XB series of frame grabbers, Camera Link Base cameras are supported. The user selects the cheapest variant for his task (single, dual or quad-links) from the three grabber versions offered.

With the exponential growth of the data rate due to ever faster, high-resolution cameras, the Axion-XB family with the PCIe Gen 2 interface is in line with the rest of the Axion family and the DMA-optimized, modern computers. Special features such as easy switching between different tap formats, more powerful acquisition and more flexible I / O as well as timing generators are now available in a dedicated low-cost CL base-oriented frame grabber.

www.cosyco.de

CoaXPress over Fiber Bridge Protocol v1.0

Euresys has had the CoaXPress over Fiber Bridge Protocol Version 1.0 published by the Japan Industrial Imaging Association (JIIA). Euresys has been a member of the CoaXPress working group from the very beginning and has always been expanding the CoaXPress standard in order to offer more and more demanding computer vision applications with high bandwidth, more speed, data integrity and greater distances.

Euresys offers camera manufacturers the option of integrating the new functionality from the sensor to the image using the CoaXPress-over-Fiber-Bridge-IP core and using the Euresys Coaxlink QSFP +. A CoaXPress over fiber frame grabber with four connections and a QSFP + port with 40 Gbit/s is available.

www.euresys.com

CoaXPress JIIA

Protective housing for depth camera

Autovimation is expanding its Chameleon XS housing series for the Intel Realsense depth camera family with a new housing for the D455 camera. The 500g aluminum housing offers all-round reliable IP66/67 protection against intrusion, so that the depth cameras can be used in unmanned aircraft, in outdoor vision applications and in challenging industrial environments. The external dimensions are 150 x 64 x 34 mm. Like the existing Chameleon XS housing for the Realsense sensors D415, D435 and T265, the D455 model ensures shadow-free images thanks to the special arrangement of the windows. The windows are made of anti-reflective BK7 glass. To compensate for thermal expansion and vibrations, they are not glued, but fitted into the housing openings with seals. No cooling is required under normal conditions, as the camera is connected to the housing with an adapter made of solid aluminum and a two-layer thermal film for thermal coupling. A cable gland with an extra large sealing insert enables standard cables with USB-C plugs to be inserted without tools. With the help of a dovetail adapter plate, the Chameleon XS housings are fully compatible with the Autovimation machine vision kit. In this way, all 30 mm dovetail mounting kits can be used to mount and align the housing vibration-proof on flat surfaces or slot profiles.

www.autovimation.com

Deep learning with the Eyevision 4.0 software

The extended deep learning components of the Eye Vision 4.0 software enable complex recognition tasks to be solved easily. The software learns from experience and understands the world in terms of a hierarchy of concepts. The hierarchy of the concepts allows the computer supporting Eyevision to learn complicated concepts by simply putting them together. Eye Vision Technology enables the integration of deep learning through two different options: The deep learning library of the new Eyevision 4 software can be filled with pre-trained networks or fully trained networks. The pre-learned networks require less qualified images than the fully learned networks. This makes the learning process faster with previously learned networks.

www.evt-web.com

Larger selection of global shutter AF zoom block cameras

Active Silicon has combined a 36x optical zoom lens, a Sony CMOS sensor with global shutter and a large selection of video outputs in the Harrier 36x AF zoom cameras. These 1080p / 60 block cameras are suitable for a wide variety of industrial and commercial applications. They capture distortion-free images of moving objects.

This global shutter camera with Full HD LVDS video output also has an EX-SDI output option. It is possible to use external triggers and control connected stroboscope systems. Special functions of the camera include digital image stabilization, noise suppression, masking of protected areas, intelligent motion detection, day and night mode (removal of the infrared cut filter, ICR) and compensation for strong or background lighting (HLC / BLC).

www.activesilicon.com

Embedded box PC for industry, medical and smart cities

Distec is expanding its embedded portfolio with the industrial Embedded BoxPC EC-3200 from Ibase for applications with artificial intelligence (AI). The EC-3200 is based on the Jetson TX2 from Nvidia. The processor combines a dual core Denver 2 and a quad core ARM Cortex-A57. The EC-3200 takes advantage of the Jetson TX2's GPU-accelerated parallel processing to handle data-intensive and mission-critical workloads with high energy efficiency and unmatched reliability. This makes it ideal for real deep learning applications. It is also designed for an extended temperature range from -20 to 60 °C. With its low power consumption, the Jetson TX2 is 25 times more energy efficient than other state-of-the-art desktop graphics processors, according to the manufacturer.

www.distec.de

New polarization cameras

Lucid Vision Labs has equipped its 5.0 MP Phoenix and Triton polarization cameras with the Polarsens IMX264MZR / MYR CMOS sensors from Sony and is now producing them in series. Sony's next generation polarization sensors offer high quality polarized images at a significantly lower price. They have the polarized CMOS sensors IMX-264MYR (color) and IMX264MZR (mono). They use four different on-chip directional polarization filters (0 °, 90 °, 45 ° and 135 °) for each 2 x 2 array of pixels, which allows for highly accurate alignment with the pixel array. In addition, Polarsens technology has global shutter display, high frame rates, ROI control and trigger modes to further improve image capture performance.

www.thinklucid.com

Inexpensive DOEs for medium laser powers

With a combination of polymer and quartz glass, Holo / OR produces inexpensive beam shapers and splitters for laser applications in the low and medium power range and for medium and high quantities. A polymer layer with the structures for the diffractive optical element (DOE) is applied to a stable glass substrate. The other side of the glass substrate can be anti-reflective for the wavelength used.

While the cost-effective plastic coating enables a low price, the glass provides the necessary resistance. For 8 ns pulses with 1,064 nm, the laser damage threshold is above 10 J/cm². In the wavelength range between 450 and 1,080 nm, the DOEs have a high degree of transparency. This means that they cover the visible spectrum and are also suitable for many IR wavelengths. They are offered by the sales department at Laser Components.

www.lasercomponents.com

Processing kit for vision applications

At the digital Embedded World, Basler presented its current range of solutions in cooperation with partners such as NXP, Nvidia and AWS. The highlight of the lineup was a processing kit. The board developed by Basler is optimized for a variety of vision applications in terms of both hardware and software. Due to its design developed for industrial use, the development kit can be used not only for prototyping, but also in series production. Developers can use the Embedded Processing Kit to find ready-to-use vision solutions very quickly.

For the SoC i.MX 8M Plus from NXP, which is available since mid-March, Basler has developed a high-performance vision system for machine learning (ML) applications that is characterized by a particularly lean architecture: the specially designed Basler dart communicates seamlessly with the ISP (Image Signal Processor) and at the same time offers machine vision in real time.

www.baslerweb.com

Sony sensors for factory automation and embedded vision

Sony offers sensors with higher performance in smaller packaging, which are now available from Framos. IMX536, IMX546 and IMX566 are the latest type 2/3 CMOS sensors of the 4th generation based on Sony Pregius S with 8.1 megapixels in variants for both monochrome and color (RGB) images.

The new CMOS sensors in the identical LGA package have a global shutter with variable exposure time (charge integration time). They achieve very good image quality thanks to their high sensitivity and low dark current. The sensors offer excellent options for implementing a simpler camera design, for example in factory automation, ITS applications (Intelligent Transport Systems) and embedded vision, with the IMX546 and IMX566 being characterized by good cost efficiency.

www.framos.com

Camera series with new 20-megapixel models

Teledyne Imaging has released new 20 megapixel Lt Series USB3 cameras. The cameras have a robust and compact enclosure, fully locking USB3 connectors, and are built for rugged 24/7 use. They are available from Teledyne Lumenera, a part of the Teledyne Imaging Group. Equipped with the Sony IMX183 20 MP CMOS sensor, with rolling shutter, and back illumination technology, these new cameras perform in a wide variety of low-light and changing light conditions, including aerial imaging, Intelligent Traffic Systems (ITS), robotic inspection solutions, and life sciences. The Lumenera Lt Series cameras offer a smaller, lighter, and lower cost imaging solution and are designed specifically to meet the challenges of today's modern systems that strive to provide advanced vision performance while using less power, less space, and meet the industry's increasingly tight budgets.

The Lt Series cameras offer proven 32 and 64-bit operating system compatibility for, Windows, Linux, Linux for embedded system platforms, and single board computers (SBCs). They are designed to deliver high dynamic range, high speed, with low read noise for both industrial and scientific imaging applications.

www.teledyne.com

The Future of Manufacturing with Cobots

Enhancing Production Efficiency, Flexibility and Quality with the Help of Camera and Vision Technology

Collaborative robots (cobots) have a key role in current and future trends in industrial automation and production. Recent studies assume that the value of cobots in industrial automation will have reached US$ 7 billion by 2025. With the average retail price of a cobot being between US$ 15,000 and US$ 45,000, their use in this type of automation is also becoming increasingly feasible for industrial manufacturing applications in smaller production facilities and warehouses.

However, companies that are developing innovative and integrated cobot concepts must meet a wide range of requirements. To increase production flexibility, efficiency and quality, they will need to carefully develop the interaction between mobile robots, cobots and other elements – such as integrated apps, support and risk assessment, and camera and vision technology. But what key aspects do companies need to consider and what are the best ways of using smart camera and image processing systems with cobots?

Using Tools to Aid Cobot Movements

For applications in which flexibility and quality are more important than speed, cobots can be combined with user-friendly software tools and integrated sensor functions. Examples include machine vision systems that have localization options. Some cobots can navigate using a landmark tool. The marking is easily recognized by the robot's built-in camera and can be used as a reference point for its movements. This enables it to know how to move to the correct positions, which is particularly helpful when objects or devices are moved during production, or when the cobot is transferred to another workstation.

Using a Vision System to Improve Quality Control

Companies need easy-to-use, intelligent camera and image processing systems that will recognise patterns, carry out quality control, place objects and identify barcodes.

Cobots can be combined with user-friendly software tools and integrated sensor functions.

For example, organisations in the food and drinks, pharmaceuticals and medical device sectors have to meet both high consumer expectations about safety as well as strict legal requirements. For instance, one pressing need is for vision systems that can check whether the information on a label or packaging is correct and complies with the consumer's information requirements. When implementing cobots, it therefore makes sense to integrate image processing systems into the cobot to optimize traceability and logging protocols.

Six tips for choosing an automated vision system as part of your cobot project:

1. Start with Overall Equipment Effectiveness (OEE). Choose a provider that can help to calculate the OEE and can introduce improvements that will make processes more efficient.

2. Check the system's compatibility. The image processing system should be able to integrate into the existing system and work processes, or to become an integral part of the cobot offering.

3. Ensure a seamless and hassle-free application. A well-designed, integrated solution should meet your application and runtime requirements. The system should include core functions such as image acquisition and processing (vision); software and network communication; and the ability to control all of the devices in the machine network.

4. Select an experienced partner. Choose a provider that understands the branch and market regulations. If you opt for an unsuitable vision system, you'll just spend more time and money-making complex adjustments.

5. Choose the right system speed. It's best to have a system that can process data based on the optimal speed of the production line. This should create added value with planned control and security projects and should have a positive impact on performance and profit.

6. Ensure good data integration. Ensure that your image processing system can be easily integrated into your production control system; and that your control system is well integrated into your business system for data storage and analysis. You need the different systems to interact seamlessly so that the result will be good traceability and reliable documentation.

Omron's TM cobot provides a practical example of how camera and image processing technology can be integrated into a cobot.

An integrated vision system can improve reliability, consistency and precision. Another advantage is its flexible scalability, based on the needs of the user. For example, it's possible to start with a simple integrated system and then expand it as required. Smart systems based on artificial intelligence (AI) or machine learning (ML) can also help to enhance decision-making through the use of data visualization.

Using AI at the Edge to Increase Accuracy

Industry 4.0 and the Industrial Internet of Things (IIoT) enable historical data to be recorded and used for process improvements. However, many AI projects have problems with visualizing new information. Fortunately, control solutions that are linked to predictive maintenance, such as Omron's AI controller, can merge the control functions of production lines and systems with AI processing in real time.

Today's production facilities increasingly require in-depth knowledge combined with data that's generated and collected at the machine level – i. e. at the edge. For example, a machine can learn from its human operators and improve its performance, as well as that of cobot applications. AI-driven technology can predict both product and device failures, based on data from IIoT devices. The analysis of combined data enables the rapid prediction of machine errors, which in turn prevents plant downtime and product quality issues.

The AI controller can support companies by generating and evaluating data that can be time-stamped and easily visualized. Raw data acquisition is fully automated 'at the edge', leading to higher data accuracy and consistency. In addition, the controller automatically creates data models from the correlation analysis and uses these to monitor the machine's status.

A Peek into the Factory of the Future

Omron's TM cobot provides a practical example of how camera and image processing technology can be integrated into a cobot. It can be used, for example, for applications in assembly, packaging, inspection and logistics. The built-in five-megapixel camera and the integrated vision system provide some clear benefits. The image processing system is designed for pattern recognition, object recognition and positioning, as well as color classification and barcode identification. The task designer software enables users to set up tasks for immediate use without having to install additional cameras or lighting. The Omron TM's integrated camera has an autofocus function that can locate objects in variable fields of view and at different distances. Overall, therefore, the image processing system improves the reliability, consistency and accuracy of the application.

Making the Factory of the Future a Reality

Cobots can bring the flexible factory of the future to life by enabling machines and people to work side by side, and almost hand-in-hand. As part of a complete package that includes mobile robots, image processing technology, risk management and security services, cobots can bring considerable advantages to manufacturing and industrial companies. The latest cobots are safer, simpler to program and easier to integrate into other systems. They can therefore make a significant contribution to the development of an intelligent and future-oriented manufacturing environment.

Conclusion

Innovative cobots are very versatile and can be used in numerous applications, such as machine assembly, loading and unloading, assembly, adhesive application, testing and soldering. With an integrated and intelligent image processing system, users can benefit from further advantages that will improve production processes and relieve employees from repetitive tasks. ■

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All images: Omron

19 cameras enable Knorr food in small boxes to be identified, sorted on 17 lines and prepared for transport on single-type pallets by three robots.

Food Reliably Sorted and Packaged

Fully Automated Packaging Systems Use Reliable, Durable Cameras to Ensure Sufficient Resolution and Speed for Flawless Sorting and Packaging

For years, industrial imaging has proven an effective tool for packaging of all kinds of products. This also applies to the packaging of food, a booming machine vision market. The Turkish company Kibele-Pims has been extremely successful in this area, developing and implementing turnkey systems for customers from all over the world that require packaged food to be dispatched on a global scale.

In their facilities in Istanbul, Kibele-PIMS has developed and commissioned two state-of-the-art, fully automated systems for the Unilever companies Knorr and Lipton, where food is identified, sorted and then stacked on pallets by robots. The larger of the two systems was built for Knorr. Its task is to classify the types of soup, sauces and other company products, packaged in small batches, that are delivered from production via a 27-meter-long feeding conveyor, and then to transfer the identified product types to the respective packing station. In this way, the cartons are sorted according to type across 17 stations, where three Kuka robots installed on linear axes place them on pallets and wrap them with adhesive film as soon as a pallet is fully loaded. Finished pallets are then made available on conveyor belts for collection by trucks.

Sorting by Image Processing Systems

"Image processing systems play a decisive role in this application. Without them a reliable solution would not have been possible," emphasizes Erdal Başaraner, who played a key role in the development of the two systems at Kibele-Pims. "In the version for Knorr, a total of 19 cameras are in use. At the beginning of each packaging station, a camera reads barcodes on the boxes, which are used to classify the product type and assign it to the correct conveyor belt. At the same time, the incoming boxes are checked for possible damage to the packaging. Defective cardboard boxes just stay on the feeding conveyor belt until the end where they are collected and manually assessed and repacked, if possible."

After the robots have loaded undamaged boxes onto the pallets, the completed pallets are transported past two additional cameras, which are used to record the number of pallets, the expiry dates and again the type of product. This information is then sent to a labeling machine that prints the associated transport labels, attaches them to the pallets and thus releases them for shipment.

When choosing the right cameras for this application, Başaraner and his colleagues decided to use Teledyne Dalsa's Genie Nano M1920 area cameras. This model met all of the resolution and speed requirements that Kibele-PIMS had previously specified. "In addition to that, we knew from our previous experiences with the Genie Nano series that these products have the reliability and durability to perform well even under harsh industrial conditions," says Başaraner.

With four Geva 312T industrial image processing PCs, equipped with the image processing software Inspect, all images are evaluated with the help of products from the Canadian manufacturer. Three of these

Geva PCs evaluate the images from the 17 cameras in the feeding conveyor area, the fourth one calculates the data from the two cameras at the end of the Knorr line. "A big advantage of the Geva 312T workstations is their integrated touchscreen," Başaraner explains his choice. "We can therefore also use them as the graphical user interface. In addition, we save the complete data of the products and the pallets on the Geva PCs and have the opportunity to generate a wide variety of reports at this point and, if necessary, to pass them on to our customers' servers."

Long-Term Partnership

According to Başaraner, the trust that Kibele-PIMS has in Teledyne Dalsa as a permanent partner for the entire image processing equipment is based on a long history: "In the past, we had different requirements for the vision systems that we wanted to integrate in order to implement various systems. Depending on the type of inspection process, we have implemented area and line scan cameras or even X-ray cameras to optimally solve the respective tasks. This is where one of Teledyne Dalsa's major strengths has been evident for years: They can supply practically any vision technology we need to accomplish our applications with the required reliability. In addition to the cameras, our partner also carries high-quality image processing boards, specially optimized industrial PCs such as the Geva series, or powerful software packages such as Inspect and Sherlock, which are successfully used by our customers and in numerous applications worldwide. Teledyne Dalsa transfers their many years of experience from this large number of applications into the development of new products, and this is something where we and our customers benefit a lot."

Image: Teledyne Dalsa

Genie Nano M1920 area scan cameras from Teledyne Dalsa were Kibele-Pims' perfect choice for the Knorr and Lipton sorting lines.

Reliable Solutions

About a year before the Knorr system, Kibele-Pims had already developed and commissioned another system where ten different types of tea from the manufacturer Lipton are pre-sorted and packaged. This variation is very similar to the Knorr system, even if it is a little smaller, incorporating ten lines, five robots from Universal Robots, 12 Genie Nano cameras, and three Geva 312T workstations. Başaraner is very satisfied with the results of both sorting lines: "Before switching to the fully automated solutions, the food packages were manually sorted, which was a very exhausting task. In the new setup, the boxes arrive every 1.5 seconds on average on the Knorr line and every 2 seconds on the Lipton line. Compared to manual sorting, this means a significant increase in profitability and considerably fewer errors in the correct packaging of the food. Teledyne Dalsa's imaging components used in these fully automated sorting and packaging lines have been an essential guarantee for the achieved success."

The current systems are designed for large dealers who usually order complete pallets of a single type of food. Kibele-Pims is currently working on systems that allow different types of food to be packaged on one pallet. This concept is more effective for smaller retailers, as the order quantities can be smaller that way. "For this next generation of systems, we will surely trust in image processing from Teledyne Dalsa again," says Erdal Başaraner with certainty based on the positive experience with Kibele-Pims' Canadian partner. ■

About Kibele-Pims

Kibele-Pims (www.kibele-pims.com) develops and produces an extensive range of machines for checking dimensions and surfaces as well as complete sorting lines for local and international users. The company prefers to use the latest high-tech image processing equipment from Teledyne Dalsa and robots from Universal Robots and Kuka in its systems and offers training and consulting services as well as guaranteed worldwide on-site technical support to its customers.

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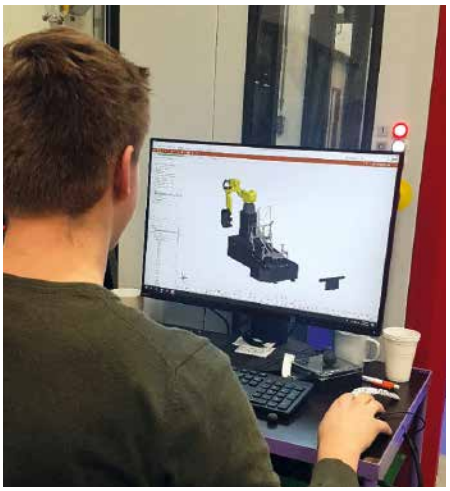
INFO
Kibele-Pims YouTube videos at www.youtube.com/watch?v=SHgc_7rHfa0&t=2s and www.youtube.com/watch?v=gpLgvu0SzNY&t=2s give insights into the processes on the Knorr and Lipton palletizing lines.

The full-area scans enable the bicycle manufacturer to inspect 100 percent of the manufactured components and then respond with targeted corrective measures.

Sjoerd ter Horst, Additive Manufacturing Engineer at Van Raam: "The software is key for us. All the scan data is put together in one digital 3D model. We can indicate checks with the surface comparison and pass this information on to the production department. "



3D Metrology in Special Bicycle Workshop

Efficient Quality Assurance for Batch Size 1 with the Help of 3D Scanners

The Dutch company Van Raam, based in Varsseveld, produces special bicycles that enable people with limited mobility to enjoy independent mobility. It manufactures its products according to the individual needs of the future owners. Many components are therefore manufactured as one-offs with different shapes and dimensions. With an automatic 3D scanning system, the engineers can efficiently meet the high safety and quality standards.

Van Raam specializes in, among other things, tricycles, tandems, as well as wheelchair and transport bicycles, walking aids and low-entry bikes. As each of these vehicles is manufactured individually, the number of tailor-made parts is huge. They need to be digitized to identify, analyze and eliminate quality problems as fast as possible. That's why Van Raam decided for GOM's Atos Scanbox, a precise and efficient measuring solution for production monitoring. The company uses it for serial quality checks of the steel production parts and for incoming goods inspection of delivered rims. Based on the full-field scan data, Van Raam can completely check the produced parts in order to initiate targeted corrective measures.

Software Is the Key

Another key factor is the GOM software. Sjoerd ter Horst, additive manufacturing engineer, emphasizes the importance of the software. "The software is key for us. All the scan data is put together in one digital 3D model. We can indicate checks with the surface comparison and pass this information on to the production department. This exchange is necessary because, when constructing a new bicycle, we inevitably make a frame that deviates from the theoretical CAD model. Now we base our production on actual data instead of theory. The more scan data we have, the better the results will be in the long run, and that makes for a nicer and tighter result. Ultimately, together with the production department, we achieve a higher quality of the produced frames."

Inspection of the Delivered Bike Parts

Van Raam also uses the Atos Scanbox for quality control of rims. "The delivered rims should meet the set quality standards, such as roundness and flatness, but as we put safety first, we scan these rims in our Atos Scanbox, too," says Sjoerd ter Horst. "If the scan data shows that the rims do not meet our quality standards, we send them back to the suppliers. Thanks to the metrology data, we have hard evidence and can continue with products that we are absolutely sure are safe." ■

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All images: GOM

Object handling for shiny and metallic parts

HD Vision Systems presents a new product family for the automated object handling of shiny and metallic parts. The intuitive systems consist of ready-to-use software and a light field sensor. In addition to bin picking, picking from the heap and from the conveyor belt are also available as applications.

The solutions based on light field technology offer users reliable detection of metallic or shiny objects. In addition, the Lumiscanx sensor head contained in the systems minimizes the obscuration of objects in confusing embankments thanks to its integrated camera array.

For the construction and production-ready setup of the preconfigured systems consisting of a 3D light field sensor and hardware and software, users need less than two hours. Users can easily load new objects or grippers directly into the software as CAD models. Handle points can be easily placed in the simulation using drag & drop or entered directly as coordinates. For a short set-up time, handle point symmetries can easily be selected and adjusted.

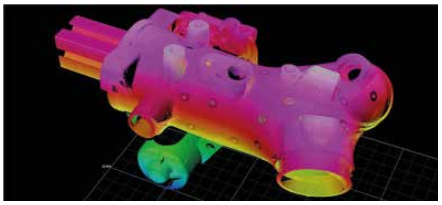
www.hdvisionsystems.com

3D mesh and 2D / 3D contour comparison with software update

LMI Technologies is now offering the version 6.1 of its Gocator software for download. This version includes a high-precision alignment with 6 degrees of freedom and 3D mesh data generation for advanced form measurements of 360 ° surface scans (when using multi-sensor systems), a new 2D contour-based localization of parts and features with surface contour comparison, a Go HMI SDK tool for the development of Gocator-to-Factory user interfaces as well as several other smart 3D technology functions for improved automated quality testing in the context of IIoT and Industry 4.0.

In addition, users can convert multiple 3D point clouds into networked surface data and then use them for high-precision shape measurements and testing. Mesh data consist of interconnected data points and form a continuous 360° surface, which represents the complete geometry of an object and uses the highly precise alignment with 6 degrees of freedom for wide and ring-shaped multi-sensor layouts. Users can then use one of Gocator's built-in surface tools to make advanced measurements on the meshed surface (e.g., measuring features on the sides of objects).

www.lmi3d.de



New generation of laser distance sensors

Wenglor has released a new generation of laser distance sensors. The time-of-flight sensors, available in plastic or V4A stainless steel housing, have all the properties of the Wintec series thanks to the integrated "Dynamic Sensitivity" technology (DS).

Long-range laser distance sensors with Wintec detect objects according to the principle of time-of-flight measurement, regardless of their color, gloss, surface structure and angle of inclination. The sensors can be mounted next to one another or even opposite one another without influencing one another. In addition, the sensors work reliably from temperatures of -40 °C, have a very short warm-up time and LEDs on the front for enclosed installation in shuttle systems.

www.wenglor.com

Frameless motor in modular industrial robot

The ILM-E frameless motor, just presented by the TQ Group, is used in a modular plug & play industrial robot from the Munich start-up Kea Robotics. The robot can be individually assembled and adapted like a modular system within a few minutes. Immediately after the robot has been configured, Kea's own software generates a digital twin that knows the kinematics and dynamics of the plug & play robot and can simulate the application.

After completion of the industrial test phase with selected customers, the Kea robots will initially be used in the processing industry and in laboratories. Due to the wide range of possible uses, there will be a multitude of other areas of application in the future.

www.tq-systems.de

New software versions appeared

The software version 3.4.5 of Vgstudio Max, Vgstudio, Vgmetrolohy, Vginline and My VGL is now available. Among other things, it supports the BDG guideline P 203. With the new P 203 analysis in the Extended Porosity / Inclusion Analysis module, cast components can be examined for porosity according to BDG guideline P 203 and a 3D evaluation can be carried out regarding the most critical defect parameters in the functional areas of the component. With the new support of the BDG guideline P 203, Vgstudio Max and Qs-Stat from Q-Das cover the complete cycle from the definition of the porosity tolerance criteria according to P 203 by the designer to the statistical process control by the quality engineer.

www.volumegraphics.com

Test System for Medical Technology

Test Bench and Test Concept for Surgical Lights

Based on a photometrically corrected measuring camera, the MLTS medical luminaire test stand from Opsira enables fast and high-resolution measurement and testing of illuminance distributions.

The new functions of an operating light, such as an adjustable color temperature and a variable light field diameter, got the test engineers into hot water: they simply could not be verified with conventional measurement technology. Therefore, together with a light measurement specialist, they developed a new test stand including a partially automated measurement process.

Strict standards apply to the lighting in operating rooms because it contributes significantly to safety during medical procedures. Quality measurements are therefore an essential part of the end-of-line test. For its Polaris 600 family of OR lights, the manufacturer Dräger has developed a new test stand together with light measurement specialist Opsira. "Among other things, Polaris offers the possibility of adjusting the color temperature to match the tissue," explains Matthias Brauer, Industrial Engineering Medical Lights and Video at Dräger. "In order to fully test these functions, our equipment construction department has worked together with Opsira to develop a test concept which we have been using successfully since the introduction of the lighting."

Test Bench Developed into the Product

When the luminaires in the series came out of product development, the test engineers faced a special challenge for the end-of-line test. The luminaire's new features could not be verified with conventional measurement technology. "The luminaire brings together a number of things that are not otherwise available on the market," Brauer said. "The variable color temperature is a key feature, as is the adjustment of different light field diameters." In addition, a camera is integrated into the luminaire, with the camera and receiver connected wirelessly. The medical and safety equipment manufacturer was thus looking for a reliable testing concept that would enable it to comply with the standards. "We have been working with Opsira for more than 15 years," Brauer notes. "Measuring light is a complex matter, and we have very complex requirements." The cooperation in terms of test stand design also went smoothly: the production equipment engineering department at Dräger took over the software development, while Opsira contributed system expertise and hardware to the project. Finally, a prototype of the test bench was developed that covered all measurement processes. "The final test stand was ready on time for the launch," says Brauer.

The measurement process is designed to test all relevant parameters quickly and without errors, which are guaranteed to the customer.«

All images: Opsira

The Polaris 600 surgical lights from Dräger

User-Friendly and Functional

When developing the test stand, the two companies had three main aspects in mind – the user, the focus on the features of the new luminaire, and the elaboration of a process-safe measurement sequence. "For other luminaires, we use different assembly tables for individual test steps, so the luminaires have to be transported from table to table," Brauer said. For the Polaris 600, an assembly trolley was designed that the user pushes into a test chamber where all measurements take place – which is much easier and more ergonomic to handle. With regard to the measurement technology, new paths also had to be taken to meet all the requirements: "To ensure the necessary parameters, we work with sensors and a high-quality class L photometer in combination with a white surface as well as defined radii," explains Brauer. In addition, a spectrometer checks whether the color temperature of the luminaire can be set correctly. The measurement process is designed to test all relevant parameters quickly and without errors, which are guaranteed to the customer.

"The whole thing is a partially automated measurement sequence that protects against user errors," Brauer says. Upon successful completion, the user receives a calibration protocol and approval. The measurement time is also very short. "The faster our processes are, the faster we get our product to the customer – but we don't compromise on quality in any way," Brauer notes. "We perform the 100 percent final inspection before it goes into the OR. There's zero margin for error there." Since the testing concept is successful, it will continue to help deliver Dräger luminaires of high quality on time in the future. ■

Technology in detail

Medical Light Test Stand MLTS

Based on a photometrically corrected measuring camera, the MLTS medical luminaire test stand from Opsira enables fast and high-resolution measurement and testing of illuminance distributions. Within seconds, the light field is measured photo- and geometrically and tested against the relevant standards (e.g. DIN EN 60601-2-41). If, in addition to testing, there is a need to adjust or calibrate the luminaires, the MLCS medical luminaire calibration system offers a whole range of options for setting different operating points or different light fields. Both systems can be supplemented by a spectrometer component. This allows all relevant colorimetric parameters such as color temperature, chromaticity coordinates or color rendering index to be tested and adjusted.

The MLCS medical luminaire calibration system from Opsira

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All-in-one solution for quality assurance

Mitutoyo is bringing a system onto the market that increases productivity by merging processes and combining different measurement methods. The device called Roundtracer Extreme can be used in conjunction with tried and tested Mitutoyo software to carry out a large number of quality assurance and measurement tasks.

The system is equipped with technology that was developed to make measurement tasks more efficient in every respect. Mitutoyo is actively pursuing this goal by enabling fully automatic measurement – namely by increasing flexibility by means of a detector holder that can be adjusted in three stages by motor and a probe system with which the angle of the probe can be adjusted. This allows users to easily measure objects of almost any shape and size while avoiding collisions with the workpiece.

In order to improve repeatability and reproducibility, great efforts have been made in the advanced design of the alignment table, which serves to reduce any changes in the position of the workpiece during the measurement.

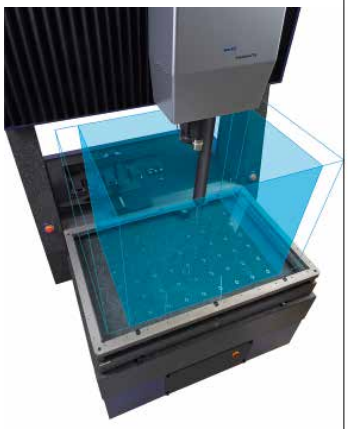
www.mitutoyo.eu

Multi-ram concept was made for large work pieces

Werth Messtechnik has expanded the Scopecheck FB DZ machine series. The multi-RAM concept used in it is now available for large workpieces. Various sensors such as the patented Werth zoom with integrated Werth laser probe, the tactile-optical contour probe and conventional scanning probes can now be used on two independent sensor axes. One plunger holds the first sensor in the measuring position, while the other plunger is positioned outside the measuring range in the parking position. If necessary, an optional third plunger with a sensor can be installed. This enables the unrestricted implementation of multi-sensor measurements and avoids collisions.

Scopecheck FB DZ is now available with large measuring ranges from 530 × 500 × 350 mm to 2,130 × 1,000 × 600 mm. The previous maximum measuring range has been almost doubled with the introduction of the new machine variants. The FB DZ series is now suitable for relatively large workpieces such as vehicle body parts, plastic housings, turned and milled parts, industrial screens and complete vehicle headlights.

www.werth.de



Virtual demonstration platform presented

To enable live demonstrations despite the pandemic-related restrictions on travel and visits, Inspekto is offering private and personalized online presentations of its key product Inspekto S70 with its new virtual demonstration platform. The company has invested in state-of-the-art presentation technology in order to present the functions of the Inspekto S70 from different angles. The Inspekto team simulates the production conditions using parts that manufacturers can send in for the demos, guaranteeing confidentiality and considering the requirements for social distance.

Interested manufacturers can send their product samples directly to the Inspekto demo center in Heilbronn. Information about the samples and the manufacturer's quality assurance processes are treated confidentially. The Inspekto team uses special feasibility studies to show potential customers how the Inspekto S70 can solve their quality inspection challenges.

www.inspekto.com

Software with extended 3D possibilities

Users of Göpel's AOI and SPI systems can look forward to a software update. With the rollout, the version 6.5 of the Pilot AOI system software receives numerous smaller and larger improvements for test functions, program creation and optimization.

A new function for 3D testing of THT soldered joints significantly increases the measurement accuracy on pins with the option of specifying the position as well as the minimum and maximum length of the pin. Analogous to this, measurements can be carried out at solder points on the pins, with minimum and maximum solder height and wetting being specified. The THT test functions are integrated into the fully automatic test program creation with Magicclick. As a further feature, the measured value recordings are optimized, among other things, by reducing possible interference.

As a second major innovation, a 3D open space inspection could be integrated into the Pilot AOI Version 6.5. This examines unassembled areas of the circuit board for defects such as solder balls, solder spatters, lost and superfluous components. The error detection takes place on the basis of height differences. Disturbing influence on the measurements, e.g. due to reflections on the circuit board material or position imprints, therefore has no effect on the measurement results.

www.goepel.com

Optical tests for AR and VR headsets

Instrument Systems has developed the LumiTop AR/VR 2D color measurement camera especially for AR/VR headsets. The lens in the Lumitop simulates the human eye as true to life as possible and measures color and luminance as the user sees them. A camera field of view of 120 °, different pupil sizes and an adjustable focusing distance enable the implementation of these test applications.

The periscope design of the AR/VR lens enables easy access to the near-eye display and enables a good measurement position even in cramped conditions within an already mounted headset. A hardware trigger can synchronize the measurement with two Lumitops so that parallel 2-eye measurements are possible.

www.instrumentsystems.com

1,500 mm CIS for machine vision application

WHEC is launching 1,500 mm CIS named XPL series for machine vision application. The XPL series CIS can realize 1,500 mm scanning width. Resolution is switchable between 300 and 600 dpi. Max scanning speed is 8.26 m/s for 300 dpi/mono. Focus position is 14.8 mm from glass surface. The interface is Camera Link Base or Camera Link Full. The merits include 1:1 image output, no image distortion, easy assembly, compact size, and customization.

Together with CIS, 1,500 mm external light source named HLU series is also developed. The light is white or color with specified LED. HLU is controlled by CIS board, no need of extra control box.

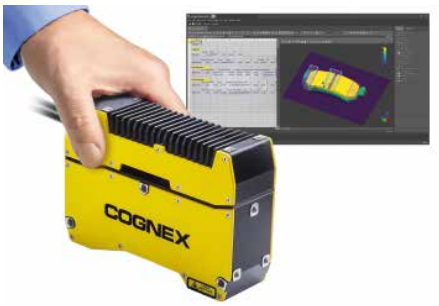
Both 1,500 mm CIS and HLU have been used in battery production successfully, such as production process of coating, press, and slit. The inspection contents include foreign substance, dimension, match, etc. It is also suitable for web inspection, printing inspection, PCB inspection, etc.

www.w-hec.com

Handheld 3D scanner

Creaform has added a Silver series to its Handyscan 3D series. The series captures highly precise and repeatable 3D measurements of any complex surface at any location. It delivers reliable scan quality with an accuracy of up to 0.030 mm, has seven laser crosshairs that enable the surfaces to be quickly captured in the entire field of view with a scan area of 275 x 250 mm and is portable, easy, and quick to set up. The 3D scanner is ready for use in less than 2 minutes.

www.ametek.com



Integrated machine vision system

Cognex Corporation introduces the In-Sight 3D-L4000 integrated vision system. Equipped with 3D laser profile technology, this smart camera enables engineers to solve a range of inspection applications on automated production lines. The 3D-L4000 combines patented speckle-free blue laser optics and the widest range of true 3D vision tools with the flexibility of In-Sight Spreadsheet. This all-in-one solution captures and processes 3D images for inline inspection, guiding and measuring applications with impressive quality and speed. With the ability to place vision tools directly on a real 3D image of the part, the 3D-L4000 offers greater accuracy compared to traditional systems, expanding the types of possible inspections. Also, because the inspections are done in 3D, users can immediately see how the vision tools work on the actual part.

The smart camera contains all traditional 3D measuring tools that users need, such as level and height determination. It also comes with a full set of 3D vision tools designed from the ground up to enable inspections in real 3D space.

www.cognex.com

Rent optical measuring devices

In times of tighter budgets, which can also affect the product development phase, Polytec offers service offers for many measurement technology. In the fully automated Robovib test center, for example, in which the University of Stuttgart also had the resonance frequencies and vibration forms of its prestige sailor E-Genius analyzed, manufacturers can easily answer acoustic or structural-dynamic questions as a measurement service.

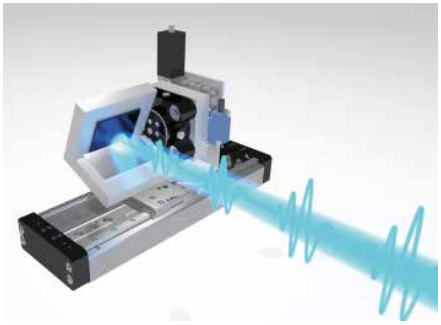
A lot of time and money can also be saved with contract measurements that Polytec application engineers carry out on site at the customer's premises, or with rented measuring systems. For one-off or occasional measurements, the company does not have to buy its own measuring device.

www.polytec.com

Printing with interference lithography

Imec has used a 13.5 nm high harmonic generator source for printing lines/spaces with 20 nm pitch by means of interference lithography of an Inpria metal oxide resist under high NA conditions (high numerical aperture). The demonstrated high-NA capability of EUV interference lithography using this EUV source represents an important milestone for Attolab, a research facility initiated by Imec and Kmlabs to accelerate the development of the high-NA patterning ecosystem on 300 mm wafers. The interference tool will be used to explore the fundamental dynamics of photoresist imaging and provide structured 300mm wafers for process development before ASML's first 0.55 high-NA EXE5000 prototype becomes available.

www.imec.be



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Edmund Optics® Imaging – Your Imaging Solutions Provider

Our Evolution

1942 | Edmund Scientific® was founded by Norman Edmund in New Jersey, USA

1998 | Design Center opened in Arizona, USA
Optikos® MTF Test Bench Acquired
First TECHSPEC® M12 S-Mount Lenses Launched

2005 | Edmund Optics® China Factory & Design Center Opened

1999 | First TECHSPEC® Telecentric Lenses Launched

2015 | Vision Systems Design
Innovators Award, Bronze
TECHSPEC® Dynamic Focus VZM™ Lens

2015 | Vision Systems Design
Innovators Award, Silver
TECHSPEC® VariMagTL™ Telecentric Lenses

2007 | First TECHSPEC® Fixed Focal Length Lenses Launched

2016 | Vision Systems Design
Innovators Award, Silver
TECHSPEC® Cx Series Lenses

2017 | Trioptics ImageMaster® MTF Test Bench Acquired

2017 | Inspect Award Winner 2017
Vision Category, 2nd place
TECHSPEC® Cx Series Lenses

2018 | Vision Systems Design
Innovators Award, Silver
TECHSPEC® Ruggedized Cr Series Lenses

2017 | Vision Systems Design
Innovators Award, Silver
TECHSPEC® TitanTL™ Lenses

2020 | Vision Systems Design
Innovators Award, Silver
TECHSPEC® CA Series Lenses

2019 | Inspect Award Winner
Vision Category, 2nd place
TECHSPEC® Liquid Lens M12 Lenses

2018 | Inspect Award Winner
Vision Category, 1st place
TECHSPEC® Ruggedized Cr Series Lenses

Greg Hollows
Vice President,
Edmund Optics® Imaging

"Here at **Edmund Optics® Imaging**, we are passionate about our customers' success. Building on our 78 years of optical components experience, we created our first imaging lens in 1997. Since then, we've continued to develop and grow to become **a leader in the imaging and machine vision** industry. As the imaging industry continues to evolve and technology advances, customers face new challenges, but **Edmund Optics® will continue to innovate** and develop products to push forward into new solutions spaces to help solve customer challenges. Here at Edmund Optics®, we believe **The Future Depends on Optics.**"

Who We Are

900+
Employees

>1,5 Million
Imaging Lenses Sold

200+
Engineers

3 Design Centers
Arizona, New Jersey, & China

170.000+
Imaging Lenses produced per year

TECHSPEC®
Edmund Optics® Designed, Manufactured & Guaranteed

5 Factories
US, Germany, Japan, China, & Singapore

35+
Tradeshow
Exhibits Per Year

>$4 Million
Products in Stock, Ready to Ship

6 Warehouses
US, China, Korea, UK, Singapore, & Japan

"**Edmund Optics® Imaging** has over **20 years of experience** designing, manufacturing, and delivering optical lens assemblies. We have a great team of respected designers experienced with designing and building complex, **advanced opto-mechanical systems**. With the help of design tools such as Zemax, Code V®, FRED®, SOLIDWORKS®, Abaqus, and Comsol®, we make sure we deliver precision, high-performance **optical lens assemblies optimized for our customers' applications**. Whether it's lens design, analysis, or optimization, we use our manufacturing knowledge to design with manufacturability and cost effectiveness in mind. Our designers are **committed to creating reliable customer solutions**."

Mary Turner, Ph.D.
Principal Engineer,
Senior Optical Designer
(7+ years at Zemax,
3+ years at Edmund Optics®)

Our Factories

Singapore

China

Japan

Germany

New Jersey, USA

Zygo® Interferometer

Zeiss High-Accuracy Scanning CMM

Trioptics ImageMaster®

Jeremy Chang, Ph.D.
Vice President of Asia Manufacturing, General Manager of Edmund Optics® China

"**Edmund Optics®** has over **200.000 sq. ft (18.600 sq. m)** of dedicated manufacturing space throughout the U.S., Europe, and Asia. Edmund Optics® China has a **class 10.000 clean room** with ESD capabilities. Our in-house manufacturing, assembly, and **state-of-the-art metrology** test equipment guarantees quality at every step. We have a rigorous global quality program and all of our factories are **ISO and/or ITAR certified**. We invest in **cutting-edge manufacturing** and testing equipment for large scale manufacturing. But above all, we invest in our people. We have a staff of highly-qualified engineers and technicians dedicated to customer service, quality control, and continuous improvement. At Edmund Optics®, **we are proud of what we do**."

Your Solutions

Off-the-Shelf Solution

TECHSPEC® Edmund Optics® Imaging Lenses

- Over 500 unique off-the-shelf solutions available
- Designed, manufactured, and guaranteed by Edmund Optics®
- In stock and readily available
- 30 day evaluation period and return policy
- Competitive OEM pricing available upon request

Zemax · code V · FRED Optimum · SolidWorks · SIMULIA ABAQUS · COMSOL

Customer Inquiry

- Global application support
- Engineering services
- Product selection
- Specification development
- On-site customer visits
- In-region specialists

Custom Design Solution

Designing for Manufacturability

- Material selection (Schott, Ohara, Hoya, CDGM)
- Manufacturability analysis
- Sensitivity & tolerance analysis
- Design optimization and simulations
- Stray light analysis
- Manufacturing prints
- Cost conscious GD&T

Quality Manufacturing

Certified System ISO 9001

- Prototypes
- First articles
- Volume production
- Continuous improvement
- Process verification and validation
- ITAR registered and compliant

State-of-the-Art Metrology & Testing

- Testing (MTF, CTF, camera, stray light & more)
- Application specific testbed development
- Test reports, documentation & serialization
- Environmental testing capabilities
- Correlation studies
- Error analysis

Customer Delivery

- Post sales support
- Global warehouses
- On-time delivery
- On-site customer visits
- Dedicated customer service
- Cost-effective solutions

"At **Edmund Optics® Imaging**, we support our customers from beginning to end, from **prototype to production**. Our team of expert designers, project managers, and manufacturing engineers works together to understand customer needs and to develop the best possible product for their application. Our **vertical integration of design**, **fabrication**, **and testing** allows us to optimize our designs for manufacturability, while ensuring the **highest degree of quality** through all stages of development. Whether we are making a small customization or a brand new custom design, we offer industry leading price to performance ratios. From concept to end product, **ensuring our customers' goals are met with speed and ease is our focus and passion**."

Kenneth Barber, Jr.
Director, Engineering
and Project Management

Where We Are

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We have locations in **9 countries**, **5 factories**, **6 global warehouses**, and **3 world class design centers**. With global locations, local support, and product availability, Edmund Optics® is here to help. We also have **7 imaging optics labs**, where we provide **highly experienced application support** by working directly with customers to find imaging solutions for their unique parts and projects. **Contact one of our in-region imaging specialists**, who have a wide range of customer and application experience to solve your unique application needs. If one of our off-the-shelf TECHSPEC® imaging lenses does not meet your needs, we can design a customized solution. Leverage our expertise for your next project. Our team is passionate, dedicated, and committed to helping solve customer challenges. At Edmund Optics®, **we do what is best for the customer**.

We are Here for You

Application Support

+44 (0) 1904 788600
Monday, 9:00 - Friday, 18:00 CET
techsup@edmundoptics.eu

Imaging Optics Catalog

- Over 1.700 products
- Over 40 pages of application notes
- Over 500 TECHSPEC® lenses in stock and ready to ship

Request a catalog at
www.edmundoptics.eu/catalog

7 Imaging Optics Labs

- Global, in-region specialists
- Provides hands-on technical customer training seminars in a lab environment
- Works directly with customers to evaluate parts and create solutions

INNOVATION STARTS HERE

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- SPIE Fellow, **Mary Turner**, Ph.D.
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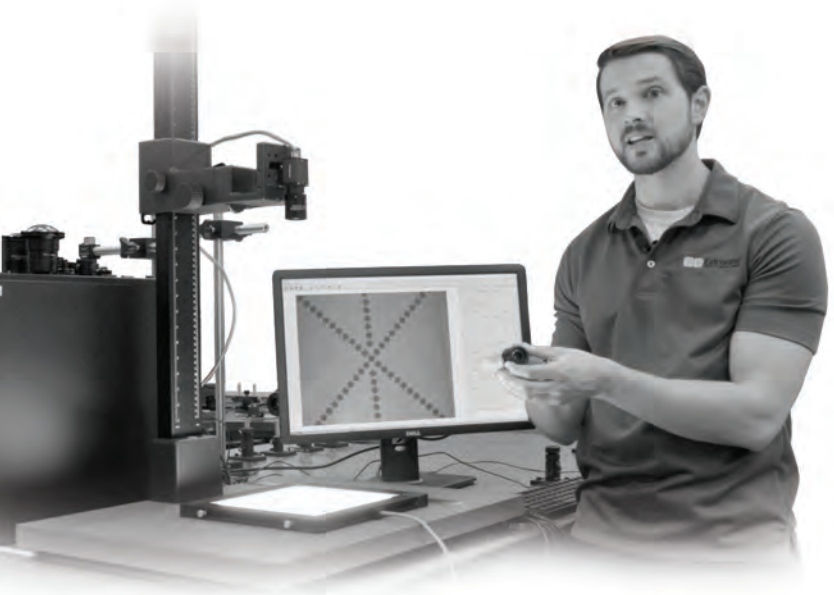

NEW

Imaging Innovation Summits hosted by Edmund Optics®

Providing opportunities for quality learning to stimulate innovation in the imaging industry for years to come. 100% virtual, 100% genuine, 100% free.

View recent event at
www.edmundoptics.eu/2020-imaging-innovation-summit

Edmund Optics® Imaging takes solving customer challenges to the next level. By customizing our core products, we provide a specialized, off-the-shelf solution for the most demanding OEM applications. Featuring the same high performance optical design as our **TECHSPEC® C Series Lenses**, our Cr, Ci and Cx versions offer unique opto-mechanical benefits beyond a standard imaging lenses.

One Core Design, **Four** Unique Solutions

TECHSPEC® C Series Fixed Focal Length Lenses

- Industry Leading Price-to-Performance Ratio
- Designed for True Factory Automation
- Low Lens to Lens Variation
- C-Mount Lens Mount

TECHSPEC® C Series Fixed Focal Length Lenses					
Focal Length:	**3,5 mm**	**4,5 mm**	**6 mm**	**8,5 mm**	**12 mm**
Max. Sensor Format:	1/1,8"	1/1,8"	1/1,8"	2/3"	2/3"
Horizontal FOV on 1/1,8" Sensor:	41,2 mm - 102,8°	72,0 mm - 84,7°	110,3 mm - 62,1°	101,0 mm - 49,2°	68,0 mm - 34,2°
Horizontal FOV on 2/3" Sensor:	–	–	–	128,6 mm - 60,6°	83,6 mm - 41,4°
Horizontal FOV on 1/3" Sensor:	–	–	–	–	–
Working Distance:	0 mm - ∞	25 mm - ∞	75 mm - ∞	100 mm - ∞	100 mm - ∞
Distortion:	< 24%	< 14%	< 7,5%	< 15%	< 2,5%
Aperture (f/#):	f/2,0-f/11	f/2,0-f/11	f/1,4-f/16	f/1,3-f/16	f/1,8-f/16
Stock No.	#89-410	#86-900	#67-709	#58-000	#58-001

TECHSPEC® C Series Fixed Focal Length Lenses					
Focal Length:	**16 mm**	**25 mm**	**35 mm**	**50 mm**	**100 mm**
Max. Sensor Format:	2/3"	2/3"	2/3"	2/3"	1/3"
Horizontal FOV on 1/1,8" Sensor:	50,1 mm - 25,5°	29,9 mm - 16,2°	32,0 mm - 11,7°	34,7 mm - 6,9°	45,2 mm - 4,1°
Horizontal FOV on 2/3" Sensor:	61,4 mm - 30,9°	36,6 mm - 19,7°	39,3 mm - 14,3°	42,5 mm - 8,5°	55,2 mm - 5,0°
Horizontal FOV on 1/3" Sensor:	–	–	–	–	108,7 mm - 9,7°
Working Distance:	100 mm - ∞	100 mm - ∞	165 mm - ∞	250 mm - ∞	750 mm - ∞
Distortion:	< 1,25%	< 0,7%	< 0,3%	< 0,2%	< 0,1%
Aperture (f/#):	f/1,6-f/16	f/1,4-f/17	f/1,65-f/22	f/2,0-f/22	f/2,8-f/22
Stock No.	#59-870	#59-871	#59-872	#59-873	#86-410

INNOVATION STARTS HERE

TECHSPEC® Fixed Focal Length Lenses

Fixed Focal Length Lenses are highly versatile and can be used for many factory automation and machine vision applications. Edmund Optics® Imaging offers a wide range of focal length options that are designed for the latest sensors.

TECHSPEC® UC Series Fixed Focal Length Lenses

- 7 MegaPixels (Up to ¹⁄₁,₈" Format)
- Small Sensor Format
- 4 mm to 25 mm Focal Length
- C-Mount
- Ultra-Compact (UC) Series

www.edmundoptics.eu/uc-series

TECHSPEC® C Series Fixed Focal Length Lenses

- 5 MegaPixels (Up to ⅔" Format)
- Medium Sensor Format
- 3,5 mm to 100mm Focal Length
- C-Mount
- Compact (C) Series

www.edmundoptics.eu/c-series

TECHSPEC® HP Series (⅔" Format) Fixed Focal Length Lenses

- 5-9 MegaPixels (Up to ⅔" Format)
- Medium Sensor Format
- 8,5 mm to 35mm Focal Length
- C-Mount
- High Performance (HP) Series

www.edmundoptics.eu/hp-series

TECHSPEC® HP Series (1" Format) Fixed Focal Length Lenses

- 6-16 MegaPixels (Up to ⅔" Format)
- Large Sensor Format
- 12 mm to 50mm Focal Length
- C-Mount
- High Performance (HP) Series

www.edmundoptics.eu/hp-series

TECHSPEC® CA Series Fixed Focal Length Lenses

- 30+ MegaPixels (Up to APS-C Format)
- Large Sensor Format
- 50 mm to 100 mm Focal Length
- TFL-Mount
- Compact APS-C (CA) Series

www.edmundoptics.eu/ca-series

TECHSPEC® LF Series Fixed Focal Length Lenses

- 29+ MegaPixels (Up to 35mm Format)
- Large Sensor Format
- 28 mm to 100mm Focal Length
- F-Mount
- Large Format (LF) Series

www.edmundoptics.eu/lf-series

TECHSPEC® LS Series Fixed Focal Length Lenses

- 3,45 mm Pixels
- 82 mm, 16K Line Scan
- 1,67X to 2,5X
- V-Mount
- Line Scan (LS) Series

www.edmundoptics.eu/ls-series

TECHSPEC® SWIR Series Fixed Focal Length Lenses

- 3 MegaPixel (Up to 25,6 mm Image Circle)
- Large Sensor Format
- 25 mm to 100 mm Focal Length
- C-Mount, F-Mount, and M42 x 1,0 Options
- Short-Wave Infrared (SWIR) Lenses

www.edmundoptics.eu/swir-series

TECHSPEC® Edmund Optics® Imaging Lenses are designed, manufactured, and guaranteed by Edmund Optics®

TECHSPEC® Telecentric Lenses

Telecentric lenses eliminate parallax error, making them ideal for high precision measurement and gauging applications. Many EO Imaging telecentric lenses feature an f/6 aperture for increased light throughput, while still providing high performance.

TECHSPEC® CompactTL™ Telecentric Lenses

- 2 MegaPixels (Up to ⅔" Format)
- Medium Sensor Format
- 0,5X to 8X Magnification
- f/9 Maximum Aperture
- C-Mount
- Small Form-Factor for Space-Restrictive Applications
- In-Line Illumination Versions Available

www.edmundoptics.eu/compact-tl

TECHSPEC® MercuryTL™ Liquid Lens Telecentric Lenses

- 3 MegaPixels (Up to ⅔" Format)
- Small Sensor Format
- 0,15X to 0,75X Magnification
- f/10 Nominal Aperture
- C-Mount
- Integrated Liquid Lens for Quick Autofocus

www.edmundoptics.eu/mercury-tl

TECHSPEC® VariMagTL™ Telecentric Lenses

- 5 MegaPixels (Up to ⅔" Format)
- Medium Sensor Format
- 0,15X to 3X Magnification
- f/4 Maximum Aperture
- C-Mount
- Adjustable Field of View
- Telecentric and Non-Telecentric Designs Available

www.edmundoptics.eu/varimag-tl

TECHSPEC® SilverTL™ Telecentric Lenses

- 5 MegaPixels (Up to ⅔" Format)
- Medium Sensor Format
- 0,16X to 4X Magnification
- f/6 Maximum Aperture
- C-Mount
- High Resolution on Medium Sensor Formats
- In-Line Illumination Versions

www.edmundoptics.eu/silver-tl

TECHSPEC® GoldTL™ Telecentric Lenses

- 5 MegaPixels (Up to ½" Format)
- Medium Sensor Format
- 0,06X to 1X Magnification
- f/6 Maximum Aperture
- C-Mount
- Focusable to Allow for Working Distance Adjustment

www.edmundoptics.eu/gold-tl

TECHSPEC® PlatinumTL™ Telecentric Lenses

- 35 MegaPixels (Up to 28,7 mm Image Circle)
- Large Sensor Format
- 0,28X to 1,7X Magnification
- f/6 Maximum Aperture
- C-Mount and F-Mount Options
- High Resolution on Large Sensor Formats

www.edmundoptics.eu/platinum-tl

TECHSPEC® TitanTL™ Telecentric Lenses

- 14 MegaPixels (Up to 35mm Format)
- Medium and Large Sensor Formats
- 0,37X to 0,38X Magnification
- f/8 Maximum Aperture
- C-Mount, F-Mount, M42, and M58 Options
- Large Field of View Options Available

www.edmundoptics.eu/titan-tl

INNOVATION STARTS HERE

TECHSPEC® M12 S-Mount Lenses

M12 Lenses or **S-Mount Lenses** are compact, board lenses design for use in many small format cameras. Edmund Optics® Imaging's all glass and metal designs provide a reliable, high performance solution.

TECHSPEC® Green Series M12 Imaging Lenses

- 3 MegaPixel (Up to ½" Format)
- Small Sensor Format
- 6 mm to 25 mm Focal Length
- S-Mount (M12 x 0,5)
- Optimized for Machine Vision Working Distances

www.edmundoptics.eu/m12-green-series

TECHSPEC® Blue Series M12 Imaging Lenses

- 6+ MegaPixels (Up to ½" Format)
- Small Sensor Format
- 2 mm to 25 mm Focal Length
- S-Mount (M12 x 0,5)
- Optimized for High Resolution Performance at Machine Vision Working Distances

www.edmundoptics.eu/m12-blue-series

TECHSPEC® Red Series M12 Imaging Lenses

- 3 MegaPixel (Up to ½" Format)
- Small Sensor Format
- 3,6 mm to 8mm Focal Length
- S-Mount (M12 x 0,5)
- Optimized for High Resolution Performance to Infinity

www.edmundoptics.eu/m12-red-series

TECHSPEC® HEO Series M12 Imaging Lenses

- 3 MegaPixel (Up to ½" Format)
- Small Sensor Format
- 2,2 mm to 8 mm Focal Length
- S-Mount (M12 x 0,5)
- Harsh Environment Optics (HEO) Sealed Versions of our Red Series

www.edmundoptics.eu/m12-heo-series

TECHSPEC® Rugged Blue Series M12 Imaging Lenses

- 6+ MegaPixels (Up to ½" Format)
- Small Sensor Format
- 2 mm to 25 mm Focal Length
- S-Mount (M12 x 0,5)
- Ruggedized Versions of our Blue Series

www.edmundoptics.eu/m12-rugged-blue

TECHSPEC® Liquid Lens M12 Imaging Lenses

- 6+ MegaPixels (Up to 1/1,8" Format)
- Small Sensor Format
- 6 mm to 16 mm Focal Length
- S-Mount (M12 x 0,5)
- Integrated Liquid Lens for Quick Autofocus

www.edmundoptics.eu/m12-liquid-series

TECHSPEC® **Edmund Optics® Imaging Lenses** are designed, manufactured, and guaranteed by Edmund Optics®

Mitutoyo Nikon OLYMPUS ZEISS

Microscopy Objectives

- Wide Variety from Industry Leading Manufacturers
- Infinity Corrected, Finite Conjugate, Tube Lenses, and More

To view our full selection of objectives, visit our website at **www.edmundoptics.eu/microscopy**

Mitutoyo Infinity Corrected Long Working Distance Objectives

- Long Working Distances
- Bright Field Inspection
- High Quality Plan Apochromat Design
- Flat Image Surface over Entire Field of View

www.edmundoptics.eu/1942

Mitutoyo NIR, NUV, and UV Infinity Corrected Objectives

- Ideal for Bright Field Imaging in UV, Visible, and NIR Spectral Regions
- Excellent Performance at Nd:YAG Laser Lines
- Broad Spectral Ranges

www.edmundoptics.eu/1950

Olympus Long Working Distance M-Plan Fluorite Objectives

- Ideal for Brightfield, Darkfield, DIC, Fluorescence, or Polarization Microscopy
- Long Working Distances Reduce Risk of Specimen Damage

www.edmundoptics.eu/3509

Olympus X-Line Extended Apochromat Objectives

- High NA up to 1,45
- Chromatic Aberration Correction from 400 - 1000 nm
- Uniform Image Flatness over Large FOVs

www.edmundoptics.eu/4080

Nikon CFI60 Infinity Corrected Brightfield Objectives

- Excellent Color Reproduction
- Long Working Distance and High NA
- High Contrast with Minimal Flare
- Strain Free

www.edmundoptics.eu/2690

Nikon Interferometry Objectives

- Suitable for Non-Contact Optical Profiling
- Michelson and Mirau Objectives Available
- Infinity Corrected 200 mm

www.edmundoptics.eu/2797

ZEISS A-Plan Objectives

- Ideal for Brightfield and Fluorescence Applications
- Excellent Color Correction and Flatness of Field
- Oil Immersion Options Available

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ZEISS EC Epiplan Objectives

- Ideal for Brightfield, Fluorescence, and Differential Interference Contrast Applications
- Enhanced Contrast
- Excellent Color Correction and Flatness of Field

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INNOVATION STARTS HERE

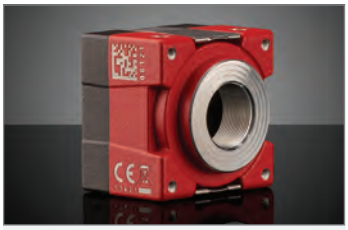
Cameras from Industry Leading Manufacturers

Allied Vision · BASLER · FLIR · IDS · LUCID VISION LABS · Pixelink A NIKON COMPANY · SONY · TELEDYNE DALSA

Industrial Cameras

- USB 3.1, GigE, 5 GigE, Firewire, CoaXPress 2.0
- S-Mount, CS-Mount, C-Mount, TFL-Mount, F-Mount
- Monochrome, Color, NIR

To view our full selection of cameras, visit our website at
www.edmundoptics.eu/cameras



Allied Vision Alvium USB 3.1 Cameras

- Compact, Low Cost, High Performance
- Onboard Imaging Preprocessing
- Up to 20,2 MegaPixels, 1,1" Sensor Format

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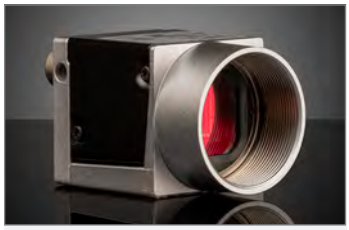

Basler ace USB 3.0 Cameras

- High Speed USB 3.0 Interface
- Ultra-Small Form Factor
- Fully USB3 Vision Compliant

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EO USB 3.0 CMOS Machine Vision Cameras

- Compact 29 x 29 x 29 mm Design
- USB 3.0 Interface for Maximum Data Transfer Speed
- Lightweight Magnesium Housing
- PoE Models Also Available

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FLIR Blackfly® S PoE GigE Cameras

- PoE (Power over Ethernet)
- VGA to 20 MP Resolution
- Compact 29 x 29 x 30 mm Size
- Extensive API library and Included SDK

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Lucid Vision Labs Phoenix™ Power over Ethernet (PoE) Cameras

- Unfolding Board Stacks for Customization
- Power Over Ethernet (PoE) for Easy Integration
- Compact Size Starting at 24 x 24 mm

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Teledyne Dalsa Genie™ Nano GigE Power over Ethernet (PoE) Cameras

- Fast Frame Rates up to 862 fps
- Compact, Robust All Metal Body
- Global Electronic Shutter with Exposure Control

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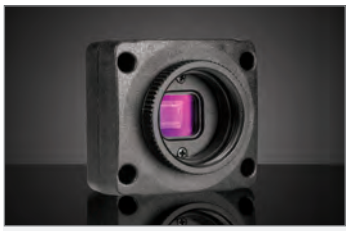

1500 - 1600 nm NIR CCD USB 2.0 Camera

- Phosphor Coated CCD Array
- Spectral Peaks at 1512 nm and 1540 nm
- Includes Camera, Cable, and Easy-to-Use Software

www.edmundoptics.eu/3599

PixeLINK® USB 3.0 Autofocus Liquid Lens Cameras

- Seamless Integration of Liquid Lenses
- One-Push Autofocus, High Speed Focus Movement
- Easy-to-Use USB 3.0 Interface

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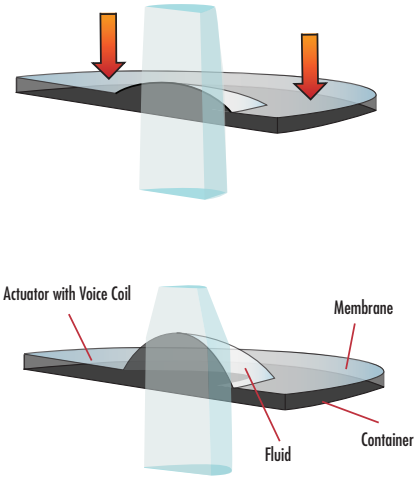
Meet our partners. We partner with industry leading manufacturers to offer the widest selection of imaging products and have unique access to technical support to solve customer applications with speed and ease.

Liquid Lenses in Edmund Optics® Imaging

- Integrate Liquid Lenses Into Imaging Assemblies for Quick Autofocus
- Compensate for Different Object Sizes and Working Distances
- Increase Throughput in High-Speed Machine Vision Systems
- Ideal for Barcode Reading, Rapid Automation, Package Sorting, and Security

Conventional imaging lenses struggle to capture sharp and accurate images in high-speed or precise applications that require quick refocusing. Liquid lenses overcome these limitations by quickly adjusting focus to accommodate for objects located at various working distances or objects of different heights. Liquid lenses are small cells containing optical-grade liquid that change their shape when a current or voltage is applied. This occurs within a matter of milliseconds and causes the lens' optical power, and therefore focal length and working distance, to shift. Integrating liquid lenses into imaging systems is an ideal solution for applications requiring rapid focusing, high throughput, and accommodation for depth of field and working distance.



The figure on the right shows how electronic focus can be quickly changed by applying a current or voltage to the liquid lens. This allows for quick autofocus without need for manual adjustment.

TECHSPEC® MercuryTL™
Liquid Lens Telecentric Lenses

- Integrated Liquid Lens for Quick Autofocus
- Imaging Performance of a Telecentric with the Flexibility of a Liquid Lens
- Telecentricity Maintained Throughout Working Distance Range
- Silver Level 2015, VSD Innovators Award

www.edmundoptics.eu/mercury-tl

TECHSPEC® Liquid Lens Cx Series
Fixed Focal Length Lenses

- Integrated Liquid Lens for Quick Autofocus
- Compact Flexible (Cx) C-Mount Designs
- Electronic Focus for Machine Vision Applications
- Standalone Versions Without a Liquid Lens are Available
- Silver Level 2016, VSD Innovators Award

www.edmundoptics.eu/cx-series

TECHSPEC® Liquid Lens
M12 Imaging Lenses

- Integrated Liquid Lens for Quick Autofocus
- High Light Throughput f/2,4 Designs
- Compact M12 Mount
- 2nd Place Winner, 2019 VSD Inspect Award

www.edmundoptics.eu/m12-liquid-lenses

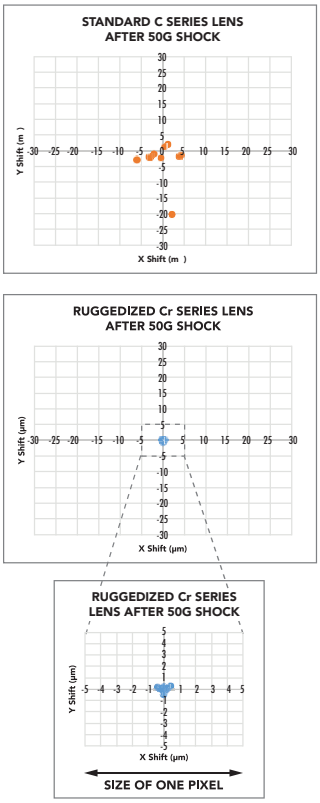
INNOVATION STARTS HERE

Ruggedized Edmund Optics® Imaging Lenses

- Stability Ruggedized
- Internal Optics Glued in Place
- Minimize Pixel Shift after Shock and Vibration
- 50G Shock Rating with Sub-Micron Pixel Shift < 1um

In a standard imaging lens, the space between the outer diameter of the lens element and inner diameter of the barrel is small (typically less than 50 microns). However, even this small decenter of the lens elements is enough to significantly affect the optical pointing stability of the lens and cause pixel shift during shock and vibration. In a stability ruggedized imaging lens, all of the individual lens elements are glued in place to protect the lens from damage and maintain the object-to-image mapping after heavy shock and vibration; if the center of the object maps onto the center pixel, it will always map to that same center pixel. Stability Ruggedization is important in applications where the field of view is calibrated, such as measurement and gauging, 3D stereo vision, robotics and sensing, autonomous vehicles, and object tracking. These applications often require the pointing (or pixel shift) to be stabilized to values much smaller than a single pixel.

Figure on right compares a standard imaging lenses (top) with our ruggedized Cr Series Lens (bottom). While the standard C Series Lens performs well, the pixel shift after 50 G of shock is still greater than a pixel. Our Stability Ruggedized Cr Series Lens has less than 1µm of pixel shift – much smaller than the size of a pixel!



TECHSPEC® Cr Series
Fixed Focal Length Lenses

- Compact Ruggedized (Cr) Versions of our C Series Lenses
- Ruggedized to Minimize Pixel Shift After Shock and Vibration
- Individual Optics Glued in Place to Maintain Optical Pointing Stability

www.edmundoptics.eu/cr-series

TECHSPEC® HPr Series
Fixed Focal Length Lenses

- High Performance Ruggedized (HPr) Versions of our HP series Lenses
- Stability Ruggedized to Maintain Pointing Stability After Shock and Vibration
- Individual Optics Glued in Place to Reduce Pixel Shift

www.edmundoptics.eu/hpr-series

TECHSPEC® Rugged Blue Series
M12 Lenses

- Ruggedized Versions of our Blue Series M12 Lenses
- Ruggedized to Reduce Pixel Shift and Maintain Optical Pointing Stability
- High Resolution Designs Optimized for Machine Vision Working Distances

www.edmundoptics.eu/m12-rugged-blue

Edmund Optics® Imaging is a leader in imaging and machine vision technology.
We create innovative products with the latest technology to solve customer application and challenges.

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◆ CUSTOMER NUMBER

More Optics. More Technology. More Service.

Delivering Solutions Today. **Innovating for Tomorrow**.

Edmund Optics' team of engineers has the unique combination of optical and imaging design expertise, manufacturing know-how, and proficiency across a variety of applications required to **make your next project a success**.

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