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COVER STORY

Fast 3D Sensor for Real-Time Cake Decoration

SPECIAL TOPIC

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Trade Show Season Ahead

It's the time of the year again. While summer moves on, preparations for the industrial vision shows this autumn are in full swing. The outlook is terrific: Vision Stuttgart is celebrating its 30th show with growing numbers of new and international exhibitors.

To attend Vision 2022 free of charge, go to the order page of the trade show and click on "Redeem your code". Then simply enter VISION22INSPECT in the yellow field on the right half of the screen and you're done. Vision will take place in Stuttgart from October 4 to 6, 2022.

A3's leading North American machine vision and imaging event, the Vision show, is back in Boston – also with growing numbers.

Looks like the industry has defied the global adversities of the last years. Recent supply chain disruptions will be influencing, yet not be preventing growth. An increasing number of start-up companies shows that there is still a wide field to plow, and the companies in our issue also show their successful developments, some of which are breaking through previous boundaries.

> «Looks like the industry has defied the global adversities of the last years»

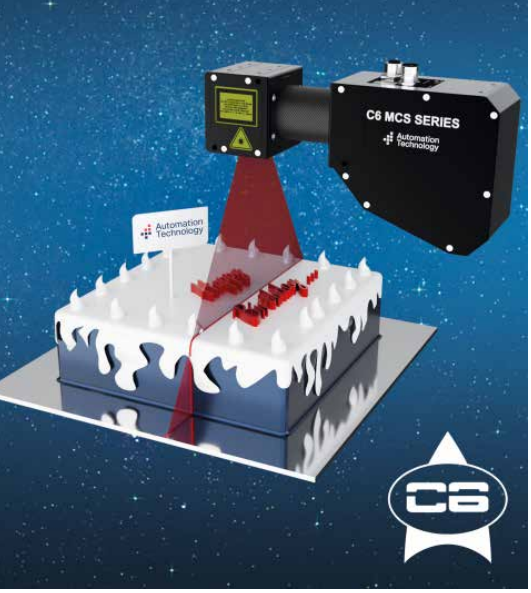
Did you know that in supermarkets in the US you can decorate your personalized cake in real time thanks to 3D laser line profiling? This is made possible with a machine called cake writer that creates frostings featuring the currently fastest 3D sensor from manufacturer Automation Technology. Read the Cover Story, p. 12.

Optotune's designers are combining a regular industrial camera and lens with a 2D fast steering mirror and a liquid lens, enabling an extreme expansion of the Field-Of-View (FOV) and the Depth-Of-Focus (DOF). This is necessary, for example, in forward-looking applications like autonomous driving.

Talking of the future, Sunex reminds us why not to neglect the lens in an embedded AI vision system as it can deliver to the overall system reliability and consistent image quality, especially in varying environmental conditions.

Enjoy reading this issue during the late summer days and keep watching out for the future at the upcoming trade shows!

Yours,
Sonja Schleif



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Edmund 80 YEARS OF OPTICS

Image: Edmund Optics

Marisa Edmund

Third Generation Takes Over

Marisa Edmund is the new Chair of Edmund Optics Board. She succeeds Robert Edmund who is retiring. Marisa will continue to serve as Chief Sales and Marketing Officer for Edmund Optics, taking the lead in expanding Edmund Optics' global sales presence, partnerships, and customer collaboration. She has over 25 years of experience in the photonics industry with Edmund Optics as a global leader in direct marketing, sales, organizational development, and strategic planning. Marisa obtained her BSBA from Georgetown University School of Business, receiving top honors, and then pursued her Master's in Business Studies at Stockton University. She is a Senior Member of SPIE, the International Society for Optics and Photonics. Marisa has also served as Vice Chair to the Board of Directors since October 2020.

www.edmundoptics.de

Image: Heidi-Maria Götz, IFSW, Uni Stuttgart

Director Prof Thomas Graf (left) and deputy director Prof Andreas Michalowski

Professorship for "Laser Technology in Manufacturing" Established

Since August 2022 Andreas Michalowski is professor at the IFSW at the University of Stuttgart, focusing on laser technology in manufacturing. This professorship was newly established within the framework of the InnovationCampus Future Mobility.

Andreas Michalowski studied physics at the Technical University of Dortmund, graduating with a diploma degree. He then worked as a research assistant at the IFSW, focusing on materials processing with ultrashort laser pulses, which was also the thematic focus of his doctorate.

In 2011 he started at Bosch Research as a scientist and was responsible for process fundamentals and simulation for machining with ultrashort pulses. Since 2018 he was senior expert responsible for virtual process development and later additionally for hybrid modeling (physics and machine learning) for laser material processing.

www.ifsw.uni-stuttgart.de

Events

WHEN / WHERE	WHAT / WHO / INFORMATION
September 27–29, 2022 Frankfurt, Germany	**Optatec** www.optatec-messe.de
October 4–6, 2022 Stuttgart, Germany	**Vision** www.messe-stuttgart.de/vision/en/ (Get a free ticket: VISION22INSPECT)
October 4–7, 2022 Stuttgart, Germany	**Motek** www.motek-messe.de/en/
October 11–13, 2022 Boston, USA	**The Vision Show** www.visionshow.org
October 27–28, 2022 Cork, Ireland	**5th European Machine Vision Forum** www.emva-forum.org
November 8–10, 2022 Nuremberg, Germany	**SPS - Smart Production Solutions** sps.mesago.com/nuernberg/en.html

Adimec's Co-founder Jochem Herman Retires

The camera manufacturer Adimec celebrated its 30th anniversary in July. At the same time as this anniversary, Jochem Herrman, co-founder and technical director of Adimec, is retiring. Co-founder Just Smit comments: "His vision and his mastermind meant a lot for the development, the success and the market acceptance of CoaXPress, which resulted in the achievement of the 2009 Vision Award by a consortium of companies headed by Adimec. Without Jochem's contribution this interface would not have been where it is now, in this structured way with all the competitive advantages for Adimec."

www.adimec.com

Image: Adimec

Camera manufacturer Adimec celebrated its 30th anniversary in July. Coinciding with this anniversary, Jochem Herrman (bottom center), co-founder and technical director of Adimec, is retiring.

Image: IFM

Signing the contract in Biel: (from left) Andreas Reber, Nicole Reber (both IFM), Prof. Dr. Bernd Buxbaum (Hidensity Group).

IFM Acquires 30 Percent Stake in Swiss Microchip Manufacturer

IFM acquires a minority stake in the Hidensity Group, the sole owner of Biel-based HMT Microelectronic. Together they want to further expand the area of innovation. HMT belongs entirely to the Hidensity Group, in which the German IFM Group, with 8,100 employees worldwide and an annual turnover of 1.25 billion euros, now has a stake. Hidensity has supported and enabled IFM's participation by selling its shares of 30 percent. The company was founded in 1994 by Andreas Reber and other partners. Reber even describes the step into a joint future with the IFM Group as "completing his life's work".

HMT Microelectronic is the oldest company in Europe that develops Asic designs on a contract basis. Asics are application-specific microelectronic circuits, colloquially known as microchips. HMT specialises in particular in mixed-signal asics (circuits that process analogue and digital signals), modules and microelectronic systems for sensors and actuators. The company, based in Biel, has 42 employees and achieves a turnover in the double-digit million range.

www.ifm.com

Image: Stemmer Imaging

Arne Dehn (l.), CEO of Stemmer Imaging, and Uwe Kemm, COO, celebrate their company's 35th anniversary.

Stemmer Imaging Celebrates 35th Anniversary

Stemmer Imaging is celebrating its 35th anniversary. Arne Dehn, CEO of Stemmer Imaging, summarizes the company's milestones: Accordingly, the introduction of the Common Vision Blox (CVB) software 25 years ago as well as the establishment of the first subsidiaries in England, France and Switzerland from 2004 onwards are among them. Furthermore, he mentions the takeover by the financial investor Primpule in 2017 including the subsequent IPO as well as the entry into the Spanish market through the acquisition of Infaimon in 2019.

www.stemmer-imaging.com

Image: Trumpf

Dr Markus Gräf (l.), Dr Christian Schmitz

Trumpf and the Cellforce Group Enter into Strategic Partnership

The high-tech company Trumpf and the manufacturer of high-performance battery cells for electromobility Cellforce, entered into a strategic partnership. "Our goal is to produce one of the most powerful battery cells in the world," says Dr Markus Gräf COO of Cellforce, a joint venture between Porsche and Customcells. "We will bring our experience in the production of battery cells to this partnership. Cellforce should benefit from our new application solutions at an early stage and can test our latest laser technology," says Trumpf laser technology CEO Dr Christian Schmitz.

Trumpf is already supplying laser systems to Cellforce, for the production of the high-performance battery cells. These will be used in a pilot plant. "We want to raise the energy density, performance and fast-charging capability of the battery cell to a new level," says Gräf. Cellforce's production facility, which is currently under construction near Reutlingen, Southern Germany, is scheduled to go into operation in 2024 with an initial capacity of at least 100 MWh per year. That is equivalent to high-performance battery cells for around one thousand vehicles.

www.trumpf.com

DPE Acquires Majority Stake in Sill Optics from Pinova

Pinova had taken over the company from its former owners in 2019 and successfully developed it. Under the leadership of Christoph Sieber, investments in recent years have included coating and clean room technology, and the management team has been broadened to equip Sill Optics for further growth.

Sill Optics is a manufacturer of precision optics used in laser material processing, additive manufacturing, medical technology and accompanying chip manufacturing processes, among others.

www.silloptics.de

Image: Sill Optics

The Sill Optics management: Christoph Sieber, CEO, and Benjamin Sauter, CFO

Image: Basler

Basler's main building in Ahrensburg

Basler Grows Strongly in the First Half of 2022

Basler AG today presented results for the first half of 2022. Turnover increased by 14 percent to 130.8 million euros compared to the same period in 2021. Order intake fell slightly by 3 percent to 147.9 million euros compared to the first half of 2021 (same period of the previous year: 152.4 million euro). Turnover for the full year 2021 was 214.7 million euros. Profit before tax decreased by 6 million euros to 14.8 million euro compared to the previous year (same period of the previous year: 20.8 million euros). Basler is targeting an average growth in turnover of 15 percent per year.

Turnover in the second half of the financial year depends mainly on the delivery situation of critical semiconductor components. In order to adequately take into account the aforementioned risks, the management is sticking to its forecast until further notice, even though the business level in the first half of the year was at the upper end of the forecast corridor. This assumes a group turnover between 235 and 265 million euros with a pre-tax return between 9 and 12 percent.

www.baslerweb.com

Image: Baumer

For Baumer Lasse-Pekka Thiem, Senior Product Manager Connectivity & Control is in the IO-Link Steering Committee.

Baumer Joins IO-Link Steering Committee

Baumer becomes an active member of the IO-Link Steering Committee. The company is represented there by Lasse-Pekka Thiem, Senior Product Manager Connectivity & Control. As an active member, Baumer wants to support the further optimization of the communication system in close cooperation with other sensor and automation companies. The Steering Committee controls the technology development of IO-Link and, in addition to the elected members, consists of the Steering Committee leader and the working group leaders Quality, Technology, Marketing, Profiles and Integration.

The Steering Committee now includes 18 companies that play a key role in the further development of IO-Link. The companies were elected to the committee on June 23 in Frankfurt at the IO-Link general meeting.

www.baumer.com

Image: Visiconsult

Stéphane Staat, Business Unit Manager at Actemium

VC Xray Expands Sales in France

VC Xray, a division of Visiconsult, has signed Actemium NDT-P&S as its French distributor. Actemium will offer its customers X-ray inspection solutions with maintenance and service support. According to Philippe Meynard, Sales Manager of VC Xray, Actemium with its service structure is the appropriate partner for sales in France. Actemium supports its customers in conception and implementation. In this way, user-specific projects are also possible.

Stéphane Staat, Business Unit Manager at Actemium, says: "Our company enters into solid and lasting partnerships to offer our customers quality solutions from leading manufacturers in the inspection and testing market. Therefore, the collaboration with VC Xray is a logical step for us."

www.visiconsult.de

Image: Physik Instrumente

Physik Instrumente has acquired an additional building in the immediate vicinity of its headquarters, into which various global corporate functions are relocating.

Physik Instrumente Creates Space for further Manufacturing Capacity

Physik Instrumente has acquired an additional building in the immediate vicinity of its headquarters, into which various global corporate functions are moving. This will free up around 1,000 m² of space for production at the main plant. The additional investment of around 10 million euros for the acquisition of the building and conversion and expansion work complements the global investment package of 53 million euros already launched in 2021 for further capacity expansion. PI is also pushing ahead with capacity expansion at the Eschbach and Lederhose sites in Germany and at its international locations. The expansion of the workforce is also well underway. As of the end of June, almost 100 of the additional 240 positions planned in Germany for 2022 have now been filled.

The company had already increased capacity by around 30 percent in 2021 and hired more than 170 new employees. All investments are the result of the "Maximum on-time Delivery" initiative with which PI is systematically improving its delivery capability.

www.physikinstrumente.com

Image: SVS-Vistek

The Headquarters of SVS-Vistek in Bavaria, Germany

SVS-Vistek Merged with Mikrotron

SVS-Vistek takes over all shares in Mikrotron GmbH retrospectively as of January 1, 2022. The two camera manufacturers belong to the parent company TKH Vision. The marriage is intended to open up new market segments. The new setup is intended to create synergies for the development and use of high-end cameras in particular, which stand out from the competition in terms of speed and resolution. All previous Mikrotron employees will find their place within the merged company and will help with the growth of the future SVS-Vistek at the joint location in Gilching. Mikrotron cameras will continue to be further developed, produced, distributed and supported under the well-known Mikrotron brand by the extended team at SVS-Vistek.

www.svs-vistek.com

Image: Messe Stuttgart

400 national and international exhibitors are expected at Vision 2022.

Show details

Vision 2022

When: October 4 to 6, 9 am to 5 pm daily

Where: Messe Stuttgart, halls 8 and 10

Navigation address: Messepiazza 1, 70629 Stuttgart

Parking: P26 (for Entrance West)

Code for free tickets: VISION22INSPECT

Further information: www.vision-messe.en

Setting Sail for International Machine Vision's Future

30th Vision Show 2022 Sees Strong Growth in the Number of Exhibitors

Vision, the world's leading trade fair for machine vision, will open its doors at Messe Stuttgart from October 4 to 6, 2022. New and international players are contributing to the show's growth. The same applies to Vision Start-up World.

"The machine vision industry is seeing dynamic development while continuing to increase in importance. As a result, the outlook for Vision 2022 is promising and expectations are high. We are delighted to welcome industry players to Stuttgart for the 30th iteration of the world's leading trade fair for machine vision", says Roland Bleinroth, President of Messe Stuttgart.

Anne Wendel of the VDMA Machine Vision sector group of the VDMA Robotics + Automation Association, underlines the development of the machine vision industry: "The robotics and automation industry and in particular the industrial machine vision industry, are experiencing full order books. According to a VDMA market survey, sales in the European machine vision industry increased by 17 percent in 2021. The prognoses for 2022 remain largely favorable despite lower expectations due to supply chain disruptions. The VDMA predicts that the German machine vision industry will grow by 5 percent and see sales of 3.2 billion euros. The robotics and automation industry as a whole is expected to see growth of six percent at 14.4 billion euros. This allows us to be optimistic for the upcoming Vision 2022 trade fair."

Growing Number of Exhibitors

So far, more than 300 companies – already more than last year – have signed up for Vision 2022. "The current level of registrations and reservations shows that the industry is enjoying great popularity. Overall, we expect the number of exhibitors to grow by around 25 percent on last year by October," says Florian Niethammer, Head of Trade Fairs & Events at Messe Stuttgart.

New Companies Bring a Breath of Fresh Air

As well as national and international key players, Messe Stuttgart has the privilege of welcoming many new players this year. Around 17 percent of the companies which have signed up will be attending Vision for the first time in 2022. The rising number of exhibitors is also reflected in the amount of space used for the fair. Every single one of two large halls' 25,000 square meters will be dedicated to machine vision.

High Number of International Exhibitors

The great international significance of Vision has already been demonstrated by the large proportion of international exhibitors: the percentage of exhibitors from abroad for the 2022 edition is currently at 56 percent, which follows an almost 50/50 ratio of national to international exhibitors in 2021. As a result, the world's leading trade fair for machine vision is returning to a structure that we are familiar with. This year, exhibitors from the US are especially heavily represented, followed by Japan, China, the Netherlands, and Switzerland. The positive mood of the exhibitors is clear to see.

Vision Start-up World on Track for Growth

After the successful debut of Vision Start-up World last year, the outlook for the second edition could hardly be better. An impressive total of 18 young companies have already registered. This significant level of interest reflects the industry's dynamic growth.

Another noteworthy development this year is the strong international presence: In addition to German exhibiting companies, numerous international start-ups – including start-ups from India, Israel, Japan, Canada and Latvia – have registered to attend. ■

Back in Boston

Oct. 11–13, 2022, the Vision Show from the Association for Advancing Automation Returns to Boston

The Vision Show is North America's leading machine vision and imaging event, showcasing the latest products, providing opportunities to meet leading companies, and offering educational sessions taught by top industry experts. For the first time since 2018, the show is returning to Boston Hynes Convention Center this October.

The show will feature the latest advancements in vision, imaging, sensing, machine learning, and embedded technologies, while offering real-world solutions to manufacturing and automation challenges. In addition to the learning opportunities offered by the conference, the free simultaneous trade show with over one hundred vendors offers the opportunity to learn about the new developments in embedded vision implementations from the major embedded vision companies.

Keynotes will be held by Kevin Blankespoor of Boston Dynamics and Jumbi Edulbehram of Nvidia.

"Vision and imaging systems are essential to helping companies solve challenges in manufacturing, logistics, food & beverage, the medical field, agriculture, and a range of other industries," said Jeff Burnstein, A3 president. "The Vision Show is where attendees will find solutions for using the latest vision and imaging technologies to boost productivity, improve product quality, and reduce manufacturing costs."

Truly Multifaceted

More than 3,000 attendees of the show originate from more than 45 countries. Their professions range from users of vision, sensing, and imaging technologies to system integrators and manufacturers of mobile and collaborative robots, artificial intelligence programs, augmented reality systems, and many more.

Over 140 exhibitors are expected to participate in the trade show this year, allowing attendees to meet community experts and key suppliers and learn about the latest innovations and get hands-on experience. ■

Show details

The Vision Show 2022

When: October 11–13, 2022

Where: Hynes Convention Center, Boston, USA

Address: Hynes Convention Center, 900 Boylston St, Boston, MA 02115

Additional information: www.visionshow.org

Image: Beehex Automation

3D Sensor for Real-Time Cake Decoration

Decorating a Customized Cake on the Spot with the Aid of 3D Laser Line Profiling

In order to respond to the popular cake frosting in the US, a startup company developed an automatic cake labeling system that relies on the currently fastest 3D sensor in the market developed in Germany. The sensor features a new resolution.

Anyone who has ever decorated a cake knows how much time the decoration takes if you want to achieve a nearly perfect result in the end and impress with your delicacy. Especially in the US, the so-called frosting of cakes is a big issue, because Americans love brightly colored decorations and food coloring which has always been a must in terms of cake design. It is precisely this fascination with decorations that the US startup Beehex Automation is dedicated to, and it wants to cause a sensation in America with its solution for designing cakes.

Making an Idea Reality

The idea: to develop a system for the automatic labeling of cakes that can be used in any supermarket. The challenge: an uncomplicated application that responds flexibly to the size, texture, and background while working reliably. The solution: food design using 3D sensors from AT – Automation Technology. The special ingredient: a novel 3D sensor technology which currently offers the world's fastest 3D laser line profiling thanks to the new C6 sensor.

For this C6 sensor the manufacturer developed a sensor chip with the novel feature "Widely Advanced Rapid Profiling" (WARP). The new imager offers a resolution of 3072 pixels per row and enables the C6 profiler to generate high resolution 3D scans. Furthermore, it is so fast that a profile speed of 38kHz or more can be reached depending on the height range of the application. This suddenly gives applications such as those in the food industry a completely new dimension.

Currently the World's Fastest 3D Sensor on the Market

"Our intention was to launch a 3D sensor that would be revolutionary in terms of innovation and that is exactly what we have achieved with the new C6 series. The new 3D sensors are unique in their combination of resolution and speed, so with their features we are opening up completely new horizons in 3D image processing," says André Kasper, founder and CTO of AT. And further: "Equally worth mentioning are also the Multipart and Multipeak features. Multipart enables the simultaneous output of up to ten different image features, and thanks to Multipeak, even highly reflective materials can be scanned without disturbing reflections."

And it was precisely this expertise that ultimately helped the startup company Beehex Automation, which had been looking for a partner from whose many years of expertise it would benefit in the field of 3D image processing: "We decided to work with AT because we have enormously demanding requirements due to the different nature of the cakes to be labeled, which not every component manufacturer can fulfill. However, with its C6 sensor, AT has a 3D solution in its portfolio that is, on the one hand, compatible with our software for evaluating the data and, on the other, can be used flexibly," explains

Image: Automation Technology

The novel 3D sensor of AT currently offers the world's fastest 3D laser line profiling.

Image: Beehex Automation

The system for the automatic labeling of cakes can be used in any supermarket.

Benjamin Feltner, Managing Director of Beehex Automation.

The contact with AT had been established through its American sales partner Movitherm, with whom AT has already been working for more than 15 years. "Especially in the field of 3D sensors, there is no other supplier worldwide that offers such modular solutions as AT. The company is one of the innovation drivers in the machine vision industry and has established itself with many global customers as a reliable manufacturer of high-quality components with its products. With such a partner at its side, a startup company like Beehex Automation will be able to quickly make a name for itself," mentions David Bursell, Vice President of Business Development of Movitherm.

Convincing Retailers

Since it is less common in the US than in Germany to buy one's cakes in a traditional bakery, Beehex would like to convince retailers in particular of its idea and establish itself in the food industry as the first point of contact for the individualization of cakes. "Cakes have been totally popular in this country for decades and always will be. People will still be interested in great cakes for the next hundred years. That's why this is a particularly exciting market for us to work in, where there are always challenging things to discover," Feltner continued.

He is particularly proud of the development of his team. Eleven people are now working on the constant further development of the cake application, which requires a great deal of patience and also a lot of technical know-how. The CEO further tells that they were even able to win engineers from large companies like Tesla for their idea, as they prefer to contribute their knowledge and want to see the company continue to grow. Above all, he says, the steep learning curve is the motivation that keeps everyone at our company constantly pushing forward.

Custom Design on Non-Standard Cakes

The startup company now has a comprehensive range of products that not only allows for an enormously wide spectrum of colors in terms of design, but also allows for any form of design that the customer would like their cake to be decorated in. "In the food industry, there are hardly any limits when it comes to designing cakes, and we had to come up with something that would make us better and faster than the competition in this industry. However, thanks to the long development time and the many optimizations, we are now the only ones in the USA to offer such a flexible, fast, and individual design service," Benjamin Feltner proudly reports.

Beehex Automation was originally a spin-off company from NASA, for which it had worked on a 3D food printing project at the time. Using this expertise, the founders came up with an application for cookie design that attracted the attention of a large bakery. Driven by the high demand for individual food decoration, Benjamin Feltner and his team finally decided to expand their portfolio to include cake design and now hope to convince supermarket giants such as Walmart of their cake labeling idea. ■

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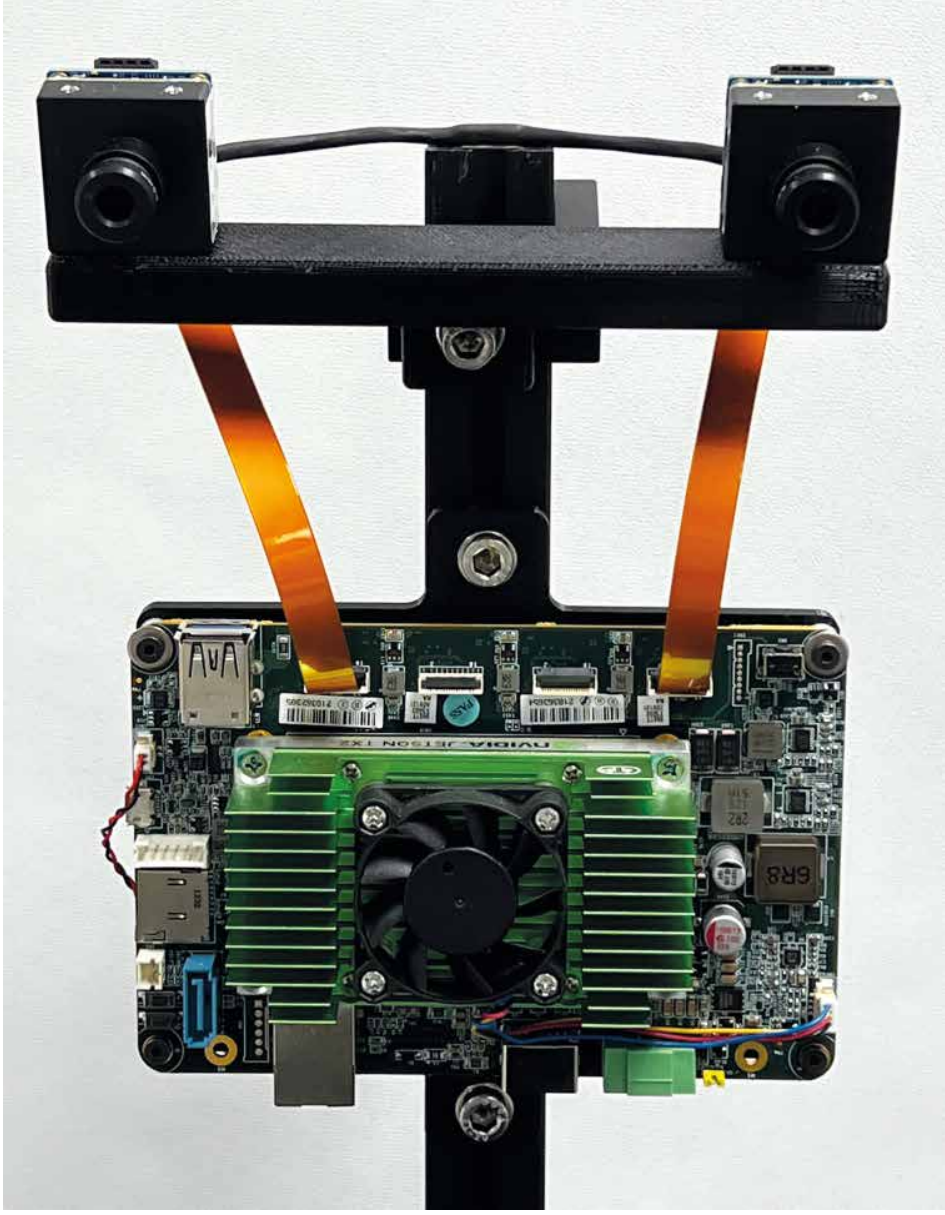
DIY Stereo System

How to Build a Custom Embedded Stereo System for Depth Perception Step by Step



This article first describes the main parts of a stereo vision system and then provides instructions on making an own custom stereo camera using off-the-shelf hardware components and open-source software. As this setup is focused on being embedded, it will compute a depth map of any scene in real-time, without the need of a host computer.

There are various 3D sensor options for developing depth perception systems including, stereo vision with cameras, lidar, and time-of-flight sensors. Each option has its strengths and weaknesses. A stereo system is typically low cost, rugged enough for outdoor use, and can provide a high-resolution color point cloud.

There are various off-the-shelf stereo systems available on the market today. Depending on factors such as accuracy, baseline, field-of-view, and resolution, there are times when system engineers need to build a custom system to address specific application requirements.

Stereo Vision Overview

Stereo vision is the extraction of 3D information from digital images by comparing the information in a scene from two viewpoints. Relative positions of an object in two image planes provides information about the depth of the object from the camera.

An Overview of a Stereo Vision System Consists of the Following Key Steps

1. Calibration: Camera calibration refers to both the intrinsic and extrinsic. The intrinsic calibration determines the image center, focal length, and distortion parameters, while the extrinsic calibration determines the 3D positions of the cameras. This is a crucial step in many computer vision applications especially when metric information about the scene, such as depth, is required. We will discuss the calibration step in detail in Section 5 below.

2. Rectification: Stereo rectification refers to the process of reprojecting image planes onto a common plane parallel to the line between camera centers. After rectification, corresponding points lie on the same row, which greatly reduces cost and ambiguity of matching. This step is done in the code provided to build your own system.

3. Stereo matching: This refers to the process of matching pixels between the left and right images, which generates disparity images. The Semi-Global Matching (SGM) algorithm will be used in the code provided to build your own system.

4. Triangulation: Triangulation refers to the process of determining a point in 3D space given its projection onto the two images. The disparity image will be converted to a 3D point cloud.

Design Example

Let's go through a stereo system design example. Here are the requirements for a mobile robot application in a dynamic environment with fast moving objects. The scene of interest is 2 m in size, the distance from the cameras to the scene is 3 m and the desired accuracy is 1 cm at 3 m.

You can refer to this article for more details on stereo accuracy. The depth error is given by: $\Delta Z = Z^2/Bf * \Delta d$ which depends on the following factors:

- Z is the range
- B is the baseline

- f is the focal length in pixels, which is related to the camera field-of-view and image resolution

There are various design options that can fulfill these requirements. Based on the scene size and distance requirements above, we can determine the focal length of the lens for a specific sensor. Together with the baseline, we can use the formula above to calculate the expected depth error at 3 m, to verify that it meets the accuracy requirement.

Two options are shown in Figure 1, using lower resolution cameras with a longer baseline or higher resolution cameras with a shorter. The first option is a larger camera but has lower computational need, while the second option is a more compact camera but has a higher computational need. For this application, we chose the second option as a compact size is more desirable for the mobile robot and we can use the Quartet Embedded Solution for TX2 which has a powerful GPU onboard to handle the processing needs.

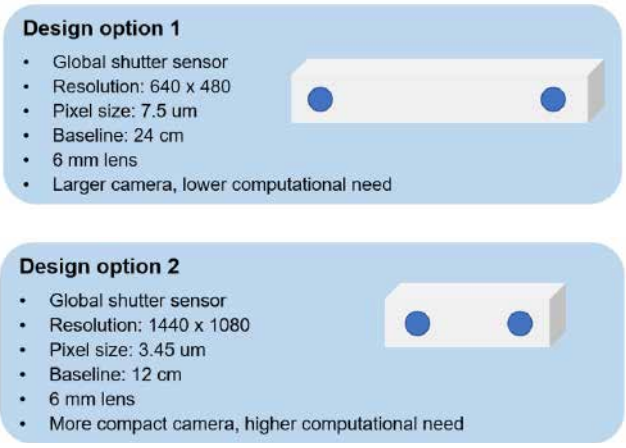


Figure 1: Stereo system design options for an example application

Hardware Requirements

For this example, we mount two Teledyne Flir Blackfly S board level 1.6 MP cameras using the IMX273 Sony Pregius global shutter sensor on a 3D printed bar at 12 cm baseline. Both cameras have similar 6 mm S-mount lenses. The cameras connect to the Quartet Embedded Solution for TX2 customized carrier board using two FPC cables. To synchronize the left and right camera to capture images at the same time, a sync cable is made that connects the two cameras. Figure 3 shows the front and back views of our custom embedded stereo system.

Both lenses should be adjusted to focus the cameras on the range of distances your application requires. Don't forget to tighten the screw on each lens to keep the focus.

Software Requirements

a. Spinnaker

Teledyne FLIR Spinnaker SDK comes pre-installed on your Quartet Embedded Solutions for TX2. Spinnaker is required to communicate with the cameras. Please refer to the QR Code at the end of the article.

b. OpenCV 4.5.2 with CUDA support

OpenCV version 4.5.1 or newer is required for SGM, the stereo matching algorithm we are using. Download the zip file containing the code for this article and unzip it to StereoDepth folder. Please refer to the QR Code at the end of the article.

The script to install OpenCV is OpenCVInstaller.sh. Type the following commands in a terminal:

```
cd ~/StereoDepth
chmod +x OpenCVInstaller.sh
./OpenCVInstaller.sh
```

The installer will ask you to input your admin password. The installer will start installing OpenCV 4.5.2. It may take a couple of hours to download and build OpenCV.

Calibration

The code to grab stereo images and calibrate them can be found in the "Calibration" folder. Use the SpinView GUI to identify the serial numbers for the left and right cameras. For our settings, the right camera is the master and left camera is the slave. Copy the master and slave camera serial numbers to file grabStereoImages.cpp lines 60 and 61. Build the executable using the following commands in a terminal:

```
cd ~/StereoDepth/Calibration
mkdir build
mkdir -p images/{left, right}
cd build
cmake ..
make
```

Print out the checkerboard pattern from this link and attach it to a flat surface to use as the calibration target. (www.ablwerbung.de/flir4.html) For best results while calibrating, in SpinView set Exposure Auto to Off and adjust the exposure so the checkerboard pattern is clear and the white squares are not over exposed, as shown in Figure 2. After the calibration images are collected, gain and exposure can be set to auto in SpinView.

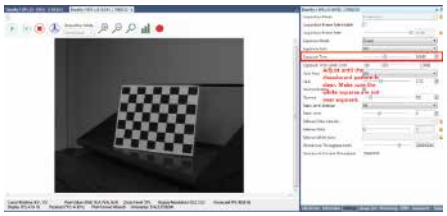


Figure 2: SpinView GUI settings

To start collecting the images, type:

```
./grabStereoImages
```

The code should start collecting images at about 1 fps. Left images are stored in images/left folder and right images are stored in images/right folder. Move the target around so that it appears in every corner of the image. You may rotate the target, take images from close by and from further away. By default, the program captures 100 image pairs, but can be changed with a command line argument:

```
./grabStereoImages 20
```

This will collect only 20 pairs of images. Please note this will overwrite any images previously written in the folders.
After collecting the images, run the calibration Python code by typing:

```
cd ~/StereoDepth/Calibration
python cameraCalibration.py
```

This will generate 2 files called "intrinsics.yml" and "extrinsics.yml" which contain the intrinsic and extrinsic parameters of the stereo system. The code assumes 30 mm checkerboard square size by default but can be edited if needed. At the end of the calibration, it will display the RMS error which indicates how well the calibration is. Typical RMS error for good calibration should be below 0.5 pixel.

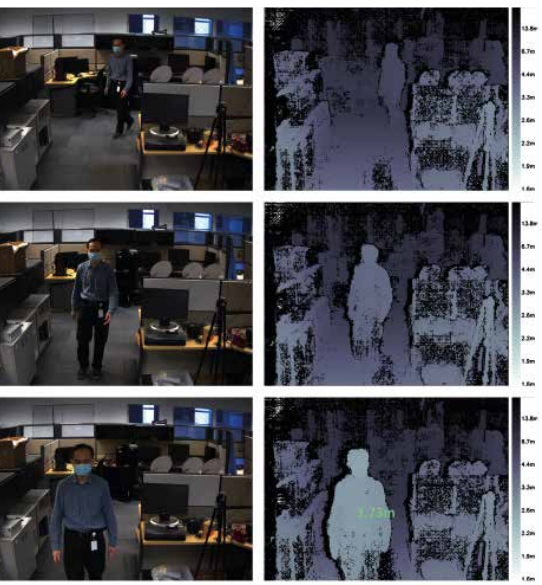
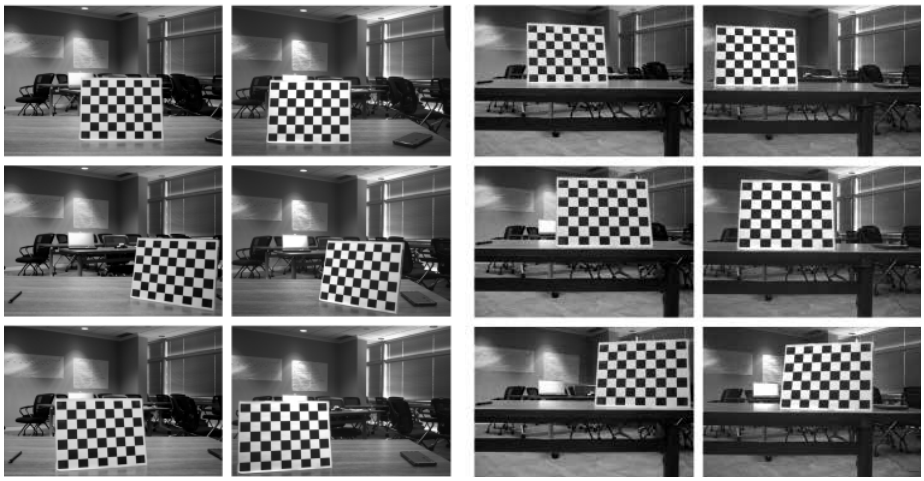
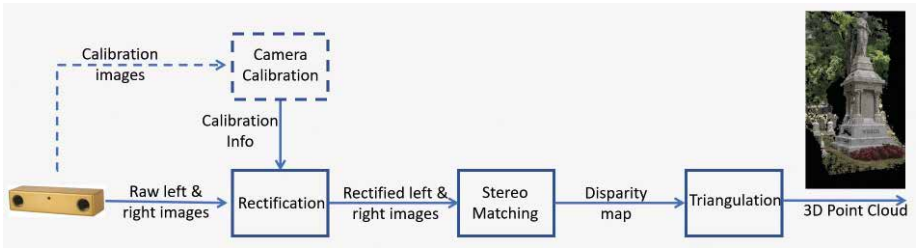


Figure 3: Sample left camera images and corresponding depth map. The bottom depth map also shows the depth at a particular point.



Collection of sample calibration images



Overview of a stereo vision system

Real-time Depth Map

The code to calculate disparity in real-time is in the "Depth" folder. Copy the serial numbers of cameras to file live_disparity.cpp lines 230 and 231. Build the executable using the following commands in a terminal:

```
cd ~/StereoDepth/Depth
mkdir build
cd build
cmake ..
make
```

Copy the "intrinsics.yml" and the "extrinsics.yml" files obtained in the calibration step to this folder. To run the real-time depth map demo, type

```
./live_disparity
```

It would display the left camera image (raw unrectified image) and the depth map (our final output). The distance from the camera is color-coded according to the legend on the right of the depth map. The black region in the depth map means no disparity data was found in that region. Thanks to the Nvidia Jetson TX2 GPU, it can run up to 5 fps at a resolution of 1440 × 1080 and up to 13 fps at a resolution of 720 × 540.

To see the depth at a particular point, click on that point in the depth map and the depth will be displayed, as shown in the last example in Figure 3.

Summary

Using stereo vision to develop a depth perception has the advantages of working well outdoors, the ability to provide a high-resolution depth map, and very accessible with low-cost off-the-shelf components. Depending on the requirements there is a variety of off-the-shelf stereo systems on the market. Should it be necessary for you to develop a custom embedded stereo system, it is a relatively straightforward task with the instructions provided here. ■

QR-Code for download of FLIR Spinnaker SDK

QR-Code for download of Open CV for FLIR Spinnaker SDK

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All images: Teledyne Flir

Image: Basler

Synergy of Boost Cameras and F-Mount Lenses for High Resolution

Boost cameras with sensors from Onsemi's XGS series and Basler F-Mount Lenses form a comprehensive hardware solution for applications with high demands on resolution and field of view, such as in factory automation and the electronics sector.

The F-mount lens has a blue dot for setting the aperture, so the user can start working immediately. In addition, with high resolution, fewer cameras are needed to cover a large object area. As a result, fewer images need to be stitched and the processing power is available for other tasks or can be saved.

www.baslerweb.com
Vision: Hall 8, Booth D50

Image: Edmund Optics

Lower Temperature Vluctuations due to Athermal Image Processing Lenses

The manufacturer and supplier of optical components now also has athermal image processing lenses from Techspec in its portfolio.

Passive athermalization is used in these lenses to achieve optothermal stability from -10 to +50 °C. This reduces effects due to thermal defocusing in applications with temperature fluctuations, such as when using the lenses in aerospace systems. It also ensures high resolutions over a wide temperature range. The lenses feature slimmer housings and optical elements that have been fixed with adhesive to avoid potential damage and pixel shift due to shock and vibration.

www.edmundoptics.com
Vision: Hall 10, Booth D50

Image: MVTec

Advanced Anomaly Detection Using AI

Halcon 22.05 is a further development of the deep-learning technology anomaly detection and thus optimises quality assurance

The release includes useful additions and enhancements to Halcon's core technologies. The Global Context Anomaly Detection feature can now "understand" the logical content of the entire image and detects new variants of anomalies such as missing, deformed or incorrectly arranged components. This enables the inspection of printed circuit boards in semiconductor manufacturing or the verification of imprints.

The addition of Halcon's Deep OCR lets users perform customised training on their own application data set. This makes it possible to solve even the most complex applications such as reading text with poor contrast (on tyres, for example). Furthermore, Halcon supports various standards for evaluating the print quality of 1D and 2D codes. Additional operators improve image contrast and image smoothing.

www.mvtec.com
Vision: Hall 8, Booth C56

Image: Thinklucid

Optimized Vision Cameras and Technologies

The machine vision camera manufacturer will showcase expanded camera series and new technologies at Vision.

The Triton series cameras feature Swir imaging with broadband Sony Senswir 1.3 MP IMX990 and 0.3 MP IMX991 InGaAs sensors that can capture images in both the visible and shortwave infrared regions. The Triton Edge, an all-in-one edge computing camera uses AMD Xilinx's Zynq UltraScale+ technology with multiprocessor functionality and user-programmable FPGA access. The Triton EVS camera uses Prophesee's Metavision event-based sensor.

The 65-megapixel Atlas10 features the Gpixel GMAX3265 image sensor. Furthermore, the 8.1-MP Atlas10 camera with Sony's IMX487 ultraviolet (UV) sensor will be shown for the first time. The IMX487 sensor with UV recording capability features the global shutter function and high-speed operation of Sony's Pregius-S technology.

www.thinklucid.com
Vision: Hall 10, Booth D41

Quality Control in High-Speed Production

Optimizing Print Cylinder Positioning in Floor Covering Production with a Complex Machine Vision System

Symbolic examples of wood-look floor coverings

The production process of floor coverings that look like wood has undergone an evolution that now requires accurate comprehensive testing. The imaging challenge can only be solved with a machine vision system that respects the special production conditions.

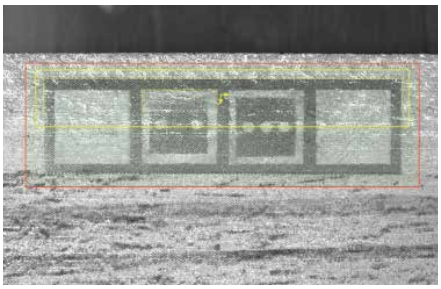
Wooden floors have always been extremely popular. In recent years, an increasing number of wood-look floor coverings have appeared in addition to the classic floors made from genuine wood. Over time, the quality of these floors has become so good that nowadays it is often almost impossible to differentiate them from genuine parquet at first glance. In order to achieve this impressive look, manufacturers must ensure a precise production process and conduct rigorous tests. To make this process even more efficient, Proksys created a complex Machine Vision system together with IIM, with specialised test algorithms for a manufacturer of printed floor covers.

Overcoming Production Challenges

Multiple challenges had to be overcome during the development process. Coloured markings were made on each floor covering at two positions during manufacturing, which reflected the position of the print cylinders. The offset can be determined in the X and Y-axes and at an angle with the aid of both markers. The position of the print markings must be reliably detected by the Machine Vision system. To do this, the markers should be kept within the target range. The markings are printed on both sides in the front and rear plate areas. The print cylinder position should be tracked over the measured and averaged marker offset, so that the individual coloured decoration layers can be printed as accurately, reproducibly and with as few fluctuations in quality and/or batches as possible. One of the difficulties arising from this is that the manufacturer has up to 200 different colour combinations in the range, and another is that the background of the test image is very disparate due to the wood look. The print quality of the markers also fluctuates greatly and sometimes their colours are only marginally different to the printed image of the floor covering. The production plant is also so fast that the test images can only be exposed at 0.0001 s (100 µs). Nevertheless, extreme brightness is needed in order to recognise even the slightest colour differences. To solve this application, the two Thuringian companies pooled their expert knowledge and developed a joint concept.

Special Lighting Requirements

Due to the high speed of the plant, there was a particular demand when selecting lighting components. As the designed Machine Vision system should not interrupt the ongoing production process, the test images were directly captured and analysed while active. Image acquisition that can undergo analysis is inconceivable with continuous or switched lighting. As well as extreme blurring due to movement, the luminous intensity is insufficient due to the above background conditions. Furthermore, the switch-on delay for switched lighting is too long for this



Recognising print markers and determining their position and angle

application at around 5 ms. For these reasons, lighting systems with integrated flash technology were selected. These flash lighting systems react extremely quickly to the trigger impulse of the camera, ensuring that the maximum light output is available within 2–3 µs. As well as the minimum switch-on delay, it is essential that these speeds are absolutely reproducible and can therefore be retrieved while keeping the process stable. The required exposure times of a maximum 100 µs are feasible with flash lighting systems. The moving object can simply be 'frozen' in place and appears to the human eye and camera as though it has come to a stop. This makes it possible to analyse the image capture while keeping the process stable. As the available space in the plant was also very small, the lighting systems had to have an extremely compact structure, as well as performance, in order to score points. For this reason, the decision was made to opt for the LQHP80 series from Lumimax in the light colour of white. These high-performance lighting systems possess adjustable flash times of 10 to 100 µs in

Compact LQHP80 flash lighting system with 16° optical heads for maximum irradiance

flash mode and a maximum flash frequency of 100 Hz, thereby fulfilling the aforementioned high requirements for an exposure time of only 0.0001 s. It is also possible to coordinate the spectral radiation characteristic, and therefore the light guide, with the background conditions with the aid of modular optical heads. The illuminance and FOV in particular need to be adapted for this. Changing the optical heads is uncomplicated and quick – instead of individual lens, a full lens array is used in the lighting system. By using 16° lenses, an extremely targeted and high-performance illumination level was generated for the floor coverings. Thanks to its minimal construction height, the narrow mechanical frame and a flexible 3D cable outlet, the components could easily be integrated into the plant despite even very limited installation surroundings.

Testing an Calibration

As well as the considered lighting concept, special test algorithms and optimal calibration were also necessary for solving the application. Proksys were specialists in this very subject. As system integration experts, they work across industries, select, configure and integrate extensive Machine Vision systems, thereby offering their customers ready-to-use solutions that are tailored to meet their needs. This know-how was also put into practice. In order to ensure an optimal analysis, the objective bias and corresponding scaling in the desired area of the laminate height is recorded and corrected with the aid of 2-point calibration. The field of depth to be displayed is 11 mm. Optimal requirements for referencing the settings have been met with the aid of a high-precision calibration plate.

The markings could therefore be accurately separated from the background thanks to a white balance and the high colour fidelity of the lighting, in combination with a strong algorithm that performs histogram analyses in each colour channel. Edge recognition was then performed in each channel and the information summarised in a pattern. Finally, the position of the pattern was adjusted to the frame, thereby controlling the print cylinder position.

Automated Plant Control

An intelligent Machine Vision system that could be integrated into the ongoing production process was developed. The plant can now be controlled automatically. The practical experience of the operator, which had previously focused on offsetting the parts produced, can be defined beforehand in an advance setup. This means that it is possible to adjust the print cylinders more quickly and accurately in relation to the plates to be printed.

In particular, the regional proximity of IIM image-printing laboratory has ensured an optimal selection of components with regards to performance parameters and installation space requirements. Together with Proksys, the Suhl lighting specialists have worked on a lighting technology concept and presented it as part of a feasibility analysis. To guarantee even more flexibility in future jobs, the series of the LQHP80 high-performance Spotlights used has been expanded to include additional sizes and performance classes.

Increasing Productivity

Overall, a decisive improvement has been achieved in quality controls with the developed Machine Vision system, which minimises failure and complaint rates and increases the level of quality. Thanks to the space-saving structure, the system was easy to integrate into the existing production process, thereby furthering the automation of processes. In this particular case, the productivity of the manufacture of printed floor coverings has significantly increased. However, this system can generally be used for all quick printing processes in a diverse range of industries. ■

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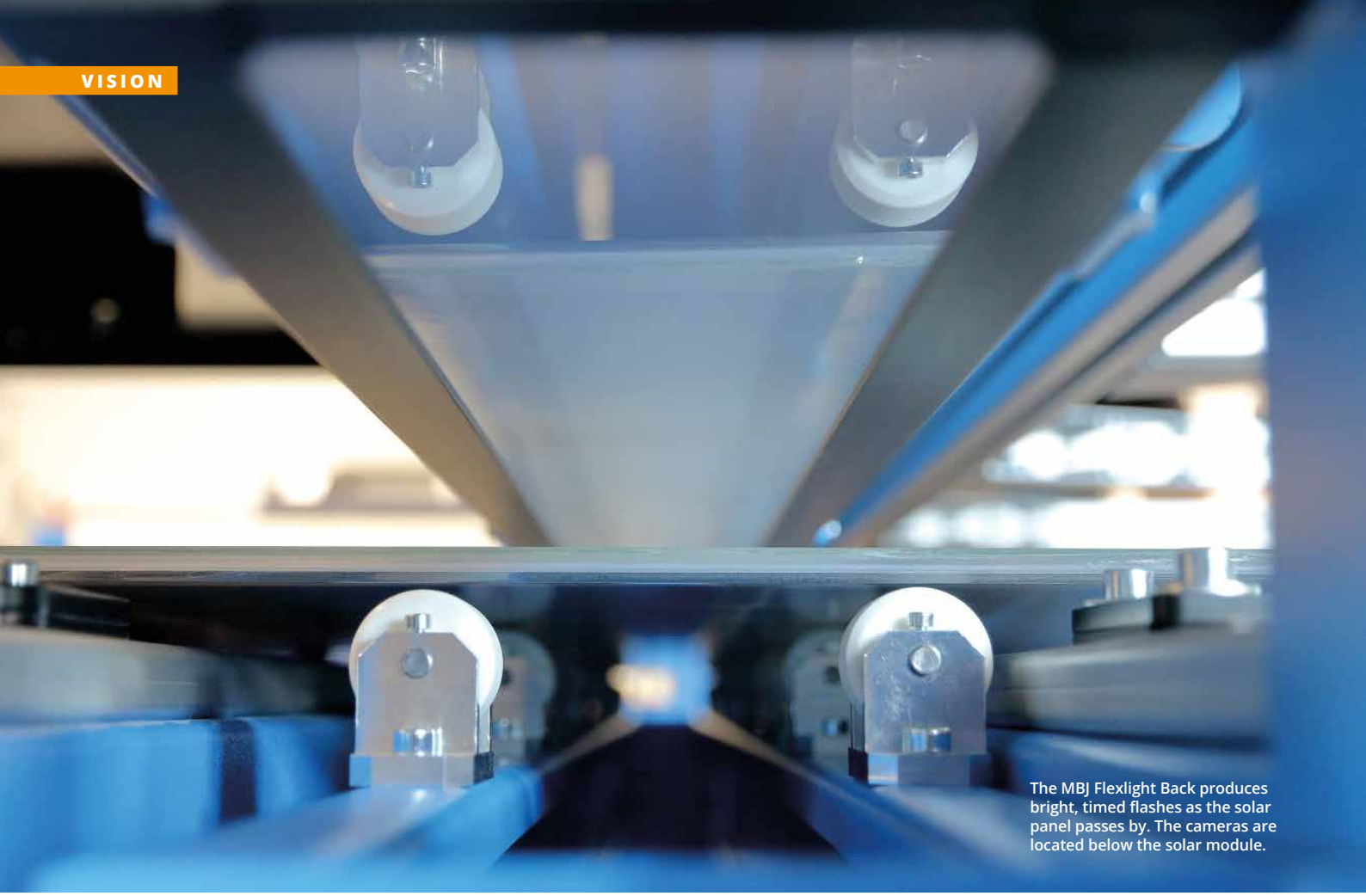
All images: IIM



The MBJ Flexlight Back produces bright, timed flashes as the solar panel passes by. The cameras are located below the solar module.

Automatic Cell Distance Measurement

LED Lighting in Inline Testing of Solar Cells

Customized 2.5 m long LED illumination provides the right light for micrometer-precise cell distance measurement in solar modules.

The Photovoltaics (PV) industry is continuously working on improving the efficiency and performance of solar modules. The goal is to further increase the power per area and reduce the manufacturing costs.

The power of a solar module is expressed in watt-peak. This is the power output when the solar irradiation is 1,000 W/m^2. A solar irradiation of 1,000 W/m² is achieved, for example, on a sunny day in midsummer. Because solar modules cannot be made arbitrarily large, manufacturers strive to maximize power per area. This is achieved, among other things, by using highly efficient solar cells and making the best use of the area when placing cells and electrical connections in the module. The position and spacing of cells and their connectors are precisely specified for production.

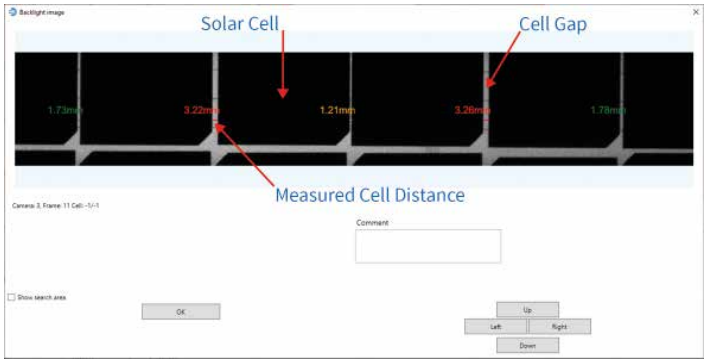
Cell Positioning

The positioning of the cells in the production line takes place in the stringer. In the stringer, the cells are connected with electrically conductive connectors, the ribbons, with gaps to each other of 1–5 mm. In the next production step, these "strings" are placed side by side on the front glass laid out with EVA film and are further electrically connected at the end or in the middle of the cell array. This connection is called the cross-connection. In the next step, another layer of EVA film and the backside film or glass is placed.

Before everything is laminated, i. e. before all layers are fused into an inseparable laminate, with the help of pressure and heat, it is important to check the position of the cells and the interconnection, as well as the perfect condition of the individual cells. After lamination, position corrections or replacement of broken cells are no longer possible. Since defective cells or faults in the cross-connection directly lead to power loss of the entire solar module, it is particularly important to find these before lamination.

This task is performed before placement of the 2nd EVA film and the backsheet/ back glass by the inspection system Solar Module EL-quickline from MBJ Solutions. In addition to an electroluminescence test (EL test), the inspection also offers the measurement of cell distances. While the EL test detects defects in the solar cells, the cell measurement measures the distances from cell to cell, cell to cross-connector and cell to glass. In addition, the edges of each solar cell are also inspected for the smallest cracks.

This is done fully automatically via a specially developed software which, in addition to measuring the cell distances, also offers AI-supported automatic defect detection for the EL test.



Cell gap measurements with automatic judgment: A solar module showing gap sizes larger than 3 mm will be color marked in the software and automatically forwarded to the repair station.

Cell Measurement

Since the module transport inside the machine obscures important areas of the module for cell measurement, the inspection is performed "between" the system and the upstream conveyor, while the module is being transported into the machine. The cell measurement works in transmitted light with diffuse illumination shining directly through the module into the cameras below. In the software, the cells then appear dark against a bright background.

In order to be able to measure the entire solar module area while it is moving, many partial images of the solar module are taken in rapid succession. The camera used is a Basler Dart camera with USB 3.0 interface and area sensor; the cameras' field of view is 70 mm. The captured images are directly transferred to the software and evaluated. The number of cameras depends on the length of the solar module to be inspected.

Lighting Requirements

The lighting must provide bright homogeneous illumination over a length of 250 cm and a width of 7 cm. To ensure razor-sharp images during rapid movement, the system can be operated with a loading speed of up to 500 mm/s, the lighting must also provide a fast and precise flash frequency. Due to the expected short flash times, given by the speed, a lot of light is needed.

The LED Flexlight Series

The Flex series from MBJ Imaging offers the possibility to build a customized illumination adapted to this application. The standardized modular system allows a high degree of individualization and adaptation to the inspection task at very attractive prices. The Flex illuminations are available as top, back and bar lights, which can be individually selected in width and length. In addition, LED color and beam pattern can also be customized. These options are ideal to adapt them to the given inspection task.

For the inspection task "cell measurement" a diffuse MBJ Flexlight back with white LED's (LED color white with 5000 K and CRI80) and an illuminated area of 250 cm length and 8 cm width was chosen. The illumination is controlled with LED controllers type CTR-51 also from MBJ Imaging.

The CTR-51 is designed for high frequency, high current flash applications. The flash energy is provided by an internal capacitor bank and the voltage regulation ensures a constant brightness intensity. The shortest feasible pulse length is 1 µs. The flash frequency is also

The 2.5 m long illumination from the MBJ Imaging Flex series mounted onto the Solar Module EL-quickline inspection system. The solar modules are measured in motion, during loading. Inside the machine, another inspection takes place: electroluminescence imaging.

sufficient for linescan applications and a flash current of up to 30 A is available.

Overcurrenting

The cell measurement works with a resolution of 200 µm per pixel at a maximum speed of 500 mm/s. This results in a flash time of 400 µs to get sharp images from the moving target and a duty cycle of one percent at a clock rate of 40 ms. To generate enough brightness for image evaluation in the images, the LEDs must be overcurrented 8 times.

LEDs can be overcurrented by a multiple given very short duty cycle without affecting the LED lifetime. How high this value is depends among other things on the cycle ratio. Under ideal conditions, an LED can be overcurrented up to 10 times for a very short period.

Due to the size of the lighting and the resulting number of LEDs, one CTR-51 is not sufficient to drive it. In total, more than 60 A are required to achieve the 8-time overcurrent. In order to have sufficient safety in current and also voltage, the LED strips of the lighting are divided into four separate strings. These are each supplied by a CTR-51. In total, four CTR-51 controllers are connected and triggered synchronized to have enough voltage reserve at 24 V voltage per controller.

Special Trigger

A trigger generator specially developed by MBJ ensures the correct timing: It sends the trigger for the camera to start grabbing as well as the slightly delayed trigger for the four CTR-51s. The delay is needed for the "rolling shutter" used by the camera. The camera images show, for example, solar cells in which the automatic cell measurement detected unacceptable deviations in the cell distances, or cell edge errors.

In a slightly modified application, solar modules are measured that are already covered with the back foil. The distances between the solar cells must be checked through this white opaque back foil. The back foil excludes illumination with white light, since this foil reflects almost 100 percent of the visible light. The back foil is also highly diffuse, making the diffuse Flexlight back not a good choice for the task.

A Flexlight Bar with a length of 250 cm, direct radiation and infrared LEDs is used for this task. The long-wave infrared rays can penetrate the back foil well and the direct radiation leads to a higher light intensity. A side advantage is that the infrared light cannot be seen by the human eye and thus an operator is not irritated by the flashes.

> **The cell measurement works in transmitted light with diffuse illumination shining directly through the module into the cameras.«**

If defects or deviations of a defined size or number are found in the solar module, it is automatically ejected from the process and diverted to a repair station. There, the corresponding cells, or even entire strings, are replaced and the module is reintroduced into the manufacturing process. The insertion takes place before the inspection system so that the repaired module is also checked again.

"The close cooperation with the customer and the existing knowledge at MBJ Imaging from many years of development work in the field of LED lighting and machine vision has led here to a fast and high-quality implementation of the customer project" explains Andreas Bayer, Managing Director of MBJ Imaging. ■

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All images: MBJ

Extended Range of Applications for the 10GigE Camera Series

With the integration of Sony's IMX487 UV-sensitive global shutter CMOS sensor, Matrix Vision is expanding the application possibilities of the GigE Vision cameras in the MV Bluecougar family.

Certain image processing applications, for example in semiconductor inspection or waste sorting, can be improved by using the UV spectrum or are only possible at all in this spectral range. The high-resolution sensor IMX487 with 8.1 MPixel, originating from the Sony Pregius S generation (Gen4), is available in the GigE camera

series MV-Bluecougar -X as well as in the 10GigE version MV-Bluecougar -XT. The sensors feature high image quality with small pixel size and high transfer rates. GenICam-compatible software support for the cameras ensures compatibility with existing image processing programs and thus also platform independence.

www.matrix-vision.com
Vision: Hall 8, Booth C30

Image: loss

AI-Based Code Readers With Self-Optimisation

The DMR410/420 code readers with automatic optimisation of the reading strategy enable high process reliability.

The reading strategy of the code reader continuously improves during the ongoing process; the more codes are read, the more strategies the integrated software generates or optimises completely independently. This makes the system insensitive to possible process fluctuations and eliminates the need for constant adjustment and the associated costs. For particularly difficult reading tasks such as highly reflective or round surfaces or very small Data Matrix codes, additional telecentric attachment optics or passive dome illumination are available.

The code readers can be set up to meet individual requirements and the various interfaces facilitate integration into systems. They are available in various technical versions with different sensor resolutions, lenses and illumination colours. The reading systems can be used for all Data Matrix codes in industrial sectors such as automotive, semiconductors, logistics and automation.

www.ioss.de

Image: Specim

Platform for Spectral Imaging

Specimone is a spectral imaging platform that can be used to create sorting applications without programming or in-depth knowledge of hyperspectral imaging.

It is compatible with machine vision standards such as GigE Vision and Cameralink, and offers integration with image processing software such as Halcon and Sherlock. It includes the Specim FX series hyperspectral camera, Specimcube processing hardware and Speciminsight, an offline software tool.

Specimcube is a processing platform that runs the classification models created by Speciminsight in real time. It receives data from Specim FX cameras and processes it in real time based on a classification model. The sorting results are streamed via GigE Vision to target systems, such as sorting machines and existing machine vision systems.

Speciminsight enables users to search and explore data, as well as create and validate classification models. The current feature set focuses on the needs of the sorting industry. It includes a PLS-DA classification algorithm and support for MROI functions, both of which benefit from the speed of FX cameras.

www.specim.fi

Work Safely with AI-Powered Real-Time Helmet Recognition

Embedded Vision Solution Increases Construction Site Safety

A robust system using embedded hardware, optimized computer vision software, and data analytics tools enables the automation of the helmet usage monitoring on a construction site.

When discussing construction, one has to recognize that it is one of the most dangerous industries in the US. Through the years, Personal Protective Equipment (PPE) has made its way into mandatory requirements of construction sites due to its importance to workers' safety. PPE may include safety glasses, earplugs, gloves, or helmets. Manufacturing technology transformation involves integrating PPE via the Internet of Things (IOT) to understand better how the equipment is used and even act when necessary, such as alerting when a worker enters a restricted zone to prevent potential dangers.

Not only does IOT apply to this field, but AI also is a great match. Given the advancements in deep learning algorithms and the immense amount of data created daily, AI techniques have greatly expanded to diverse tasks and environments, and countless industries have adopted these technologies. The field of computer vision has made enormous progress in recent years, developing great solutions for scene understanding. Construction sites are a great place to embrace them. For instance, this technology can contribute by giving insights into PPE compliance. PPE is essential for workers, so controlling its adoption is critical for minimizing risks to workers' health and employer's responsibility.

Tryolabs partnered with Seeed, a hardware innovation platform that works closely with technology providers of all scales providing quality and affordable hardware. For example, they offer various Nvidia products on their Jetson Platform. The goal was to leverage Seeed's hardware, mainly using their Recomputer edge devices built with Jetson Xavier NX 8GB module and develop a computer vision analytics solution that tackles a challenging task in the technology transformation field. More specifically, they picked the challenge of detecting safety helmets in real-time.

Controlling the Usage of Safety Helmets is Very Expensive

Specifically talking about the construction industry, PPE, such as safety helmets, helps prevent and minimize injuries on construction sites and in factories. Companies want to avoid all types of injuries, especially head injuries. These – sometimes fatal – injuries can lead to incurable, longterm health complications, such as memory loss, broken bones, and spinal damage. In 2012, more than 65,000 cases involving days away from work were a result of head injuries in the workplace. 1,020 workers died that same

> Proactive actions enable significant cost reductions in monitoring and control of construction sites.«

year from head injuries occurring on the job. Therefore, the use of equipment like safety helmets is mandatory in most of the world.

Many workers, however, do not recognize how truly dangerous not wearing the proper gear is. Whatever their reason may be, whether it is the environment that is too hot or too cold or that the helmet is uncomfortable, workers tend to take off their helmets despite the risk of getting hurt.

Unfortunately, shortcomings exist in continuously monitoring its use, and companies struggle with ensuring their employees follow safety rules. In most scenarios, this process is manual, making it very expensive and inefficient.

Usually, reactive actions need to be taken when manually controlling the usage of safety helmets. From a business perspective, significant cost reductions would be possible if proactive actions are available for the people in charge of monitoring and controlling the construction sites. Current technology plants the seed of curiosity to seek and explore better alternatives given our existing capabilities and resources. That's where the new solution comes in.

How Could AI be Leveraged to Improve the Business Process?

After understanding the problem behind the use case, Tryolabs designed and implemented the technology platform to deliver value and comply with all the business needs. The proposed solution involves a robust system in production using embedded hardware, optimized computer vision software, and data analytics tools. Combining these technologies enables the business to fully automate the process of monitoring helmet usage by having real-time statistics of the activity on the construction site.

By partnering with technology providers from hardware to the cloud, Seeed offers a wide array of hardware platforms and sensor modules ready to be integrated with existing IOT platforms. The proposed plan consists of creating an end-to-end solution to monitor the use of safety helmets in real-time and deploying it to a Jetson Xavier NX module provided by Seeed. This way, Tryolabs provides computer vision software, and Seeed provides all the edge devices needed to deploy the solution.

Solution: a Real-time Video Analytics Platform

From a technical perspective, it is essential to understand and communicate the decisions while building an end-to-end solution. Here are the details on hardware, software, and data involved in the project to give a good sense of what was needed to build a real-time video analytics platform.

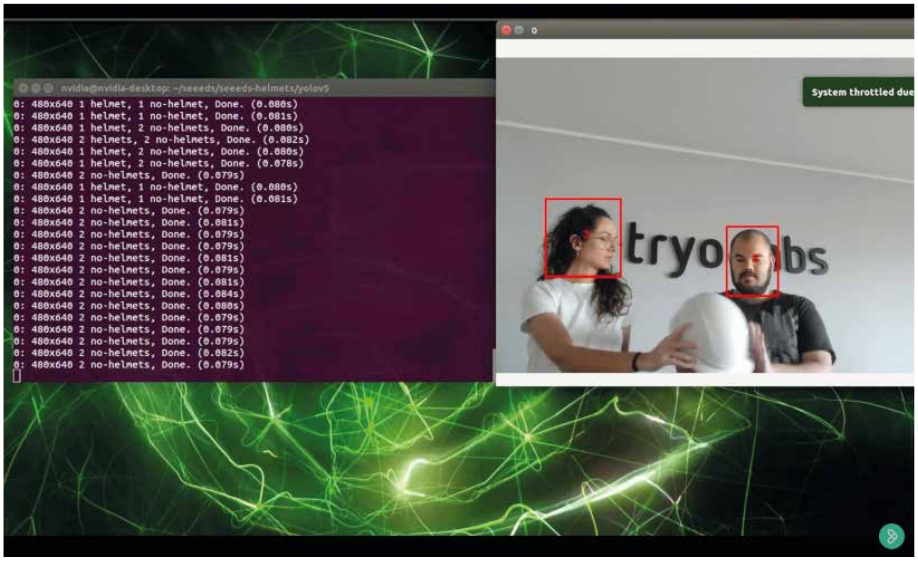
384-core NVIDIA Volta GPU

SOURCE: NVIDIA

Logitech C922 USB webcam

SOURCE: LOGITECH

A 384-core Nvidia Volta GPU, a 6-core Carmel ARM CPU, and a Logitech C922 USB Webcam were the main hardware components in this project.



Tryolabs' open-source tracking library Norfair enables to get more robust and less noisy criteria for the classification if someone wears a helmet or not.

The Jetson Xavier NX is a small but powerful module suited for AI applications in embedded and edge devices. It is equipped with a 384-core Nvidia Volta GPU, a 6-core Carmel ARM CPU, and two Nvidia Deep Learning Accelerators (NVDLA). It can attain an AI performance of 21 TOPS with a power consumption of 20 W (or 14 TOPS in a low-power mode with a power consumption of as little as 10 W). These specifications, combined with the 8 GB LPDDR4x memory with over 59.7 GB/s of bandwidth, make this module a suitable platform for running AI networks with accelerated libraries for deep learning and computer vision.

An AI Model was Trained to Continuously Monitor the Use of Safety Helmets

Yolov5 is one of the most used algorithms for object detection. It is capable of computing accurate detections and running fast, allowing its users to create real-time object detection applications. Since its beginning in 2016 with Joseph Redmond's publication, the Yolo algorithm has been famous for its performance. Its small size paved the way for mobile devices. The weights of a trained Yolov5 model are notably smaller than Yolov4's, making it easier to deploy Yolov5 models to embedded devices. Yolov5 is approximately 88 percent smaller in size than Yolov4. When running Yolov5 on an Nvidia Tesla P100 GPU, it can detect objects at 140 FPS, compared to its predecessor's max. capability of 50 FPS.

A Yolov5 Medium architecture was trained to continuously monitor the use of safety helmets on construction sites and factories. The detector can locate the faces of the people on a frame and classify them into the categories of "helmet" and "no helmet." Given a specific person on a video, this category should be highly correlated through consecutive video frames. Tryolabs' open-source tracking library Norfair enables to get more robust and less noisy criteria for this classification. By leveraging video tracking, we implemented a system of votes using the label associated with several consecutive detections to more confidently decide if a person is wearing a helmet or not. Therefore, evidence for several frames is needed to classify each person. A single misclassified detection is not enough to change the category in which a person is placed.

The Model can Learn Patterns that Generalize well

Quintillions of bytes of data are created daily, and AI models are taking advantage of this. The number of images uploaded to the internet daily has made possible the existence of public datasets for a wide variety of applications. Of course, having access to these images is not the only requirement for creating a dataset; when working with supervised learning, it also takes time and human effort to label each image with the correct annotations so that our computers can recognize the patterns we need them to learn. To make a detector that works well for the different environments, the images of this dataset must be taken from many diverse locations and under differing lighting conditions. In turn, our model can learn patterns that generalize well, unlike characteristics unique to a particular scene.

Fortunately, public datasets are already available to distinguish faces with and without helmets, such as the GDUT-Hardhat Wearing Detection dataset we selected for this project. This dataset includes 3,869 images, from which a subset of 2,916 images was selected for the training set, another 635 images were chosen for validation, and the remaining 318 images were set apart for testing purposes.

The results: Yolov5 vs. Faster R-CNN

We compared the Yolov5 and the Faster R-CNN architectures on a training job using this dataset, with most default settings. The training consisted of 26 epochs using multiprocessing and two Nvidia GeForce RTX 2080 Ti GPUs. Yolov5 vastly outperformed Faster R-CNN, obtaining better metrics in a much shorter time. In terms of inference time, both models performed similarly, taking around 0.08 seconds for each image on the edge device (12.5 FPS).

Conclusions

Monitoring helmet usage in different scenarios leads to valuable insights into taking preventive actions and saving time and resources. Tryolabs have discovered how to monitor the usage of safety helmets in various environments from an edge device using state-of-the-art detectors, creating a more efficient and affordable alternative than the more normal and rough manual process. ■

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All images: Tryolabs

Image: Smart Vision Lights

All-in-One Solution Receives US Patent

The Led lighting manufacturer has been awarded patent number US 11,328,380 B2 for its machine vision innovation, the Do All Light.

The Do All Light is an all-in-one solution that combines a dome light, two dark field illumination angles, NIR and RGBW ring lights, and a four-quadrant multispectral ring light in a single unit. The Do All Light is particularly suitable for robotics and other flexible automation systems.

The ring lights can be controlled independently and have red, green, blue, white and 850 nm NIR channels that can be mixed for any colour or for VIS and NIR inspections. The dome light provides diffuse illumination for electronics inspection and other final inspections where hot spots and shadows can be a challenge. The two angles of the dark-field ring lights can illuminate a wide range of scenes, from fine surface textures to larger features such as screws. Finally, the four-quadrant ringlight enables 3D photometric stereo inspection.

www.smartvisionlights.com
Vision: Hall 10, Booth D54

Image: IDS Imaging

Industrial Camera with Higher Transmission Speed

At this year's Vision, the company will present, among other things, the recently introduced Ueye Warp10 high-speed camera family.

The optimised uEye Warp10 camera family has ten times the transmission bandwidth of 1GigE cameras and about twice the speed of cameras with USB 3.0 interfaces. The TFL mount allows higher resolution sensors to be integrated than before – this means that detailed inspections with a high clock rate and a large amount of data will be possible over long cable distances.

IDS is also presenting the uEye XLS camera. This is a small variant of the uEye XLE series. Strictly speaking, these models will be the smallest IDS single-board cameras in the range. They are aimed at users who – for embedded applications, for example – need compact board-level cameras with and without lens holders in high quantities and at the same time have simple camera requirements.

www.ids-imaging.de
Vision: Hall 8, Booth C60

Judging Beauty

Assessing Product Quality with the Help of Artificial Intelligence

Deep learning can help to make decisions at the level of human experts, ensuring that food products meet the customer's visual requirements.

Consumers usually decide for or against a product on the basis of visual criteria – especially in the case of food. But how does the food producer decide whether a product appeals to the consumer? Does the bread have a nice crust? Are the Danish pastries well-shaped? Do those pretzels look appetizing?

Judging Food Quality

As a rule, the quality monitoring of foodstuffs is based on technical variables such as shape, moisture, color, weight, dimension, degree of ripeness or browning, which can be measured in various ways. The new Safe-Ident Quality solution from Strelen, on the other hand, checks non-quantifiable aesthetic aspects of a food product.

Deep-learning processes enable the system to make judgments like experienced QM staff. During production, this can already ensure that a product stands up to the critical eye of the consumer.

As long as the quality criteria of food products can be measured or weighed exactly, automation of controls is easy. Length, width, height, volume, weight, moisture, or exact color can be easily determined and compared to predefined target values. However, whether a product is beautiful or visually appealing and whether it attracts consumers to buy it cannot be easily determined by metrics. This requires human experts who, through a great deal of experience, can accurately assess the optical quality of a product. However, these experts will find it difficult to explain their assessments to colleagues or to describe exactly how they proceed. Far too many small details combine and condense in seconds in their expert's eye to reach a verdict. But neural networks can learn these patterns from the experts.

AI, Digital Image Processing, and Visual Quality Features

Artificial intelligence is used in many industries and is also opening up numerous new possibilities for the food industry – especially in the automated, computer-aided assessment of product quality. In combination with digital image processing, visual quality criteria can now also be reliably assessed.

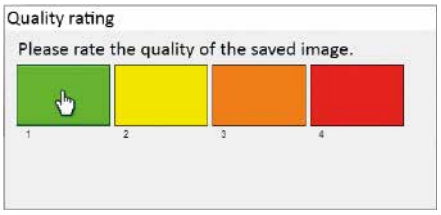
Neural networks are similar in structure to an organic brain. They are not programmed like conventional computer programs but learn their behavior based on patterns. If an experienced quality manager shows samples of food to a neural network and assigns quality classes to them, the neural network can recognize patterns and thus learn according to which criteria the judgments are to be made. After the learning phase, it is then able to make quality assessments that are just as accurate as those of the human specialist.

The Safe-Ident Quality solution checks non-quantifiable aesthetic aspects of a food product.

> Neural networks can recognize patterns and thus learn according to which criteria judgments are to be made.«

Assessing the Aesthetics of a Food Product

Strelen Control Systems has developed a solution to simplify the whole process of setting up such a neural network. The main goal of the development team: state-of-the-art high tech on the inside, simplest usability of the solution for the user on the outside.



A quality representative evaluates the product during teach-in in training mode, for example based on a four-level quality scale.

The result is Safe-Ident Quality: a test station in which product samples are placed, recorded with a camera, and then analyzed with just a click of the mouse.

To do this, the system first learns in the so-called training phase: a human expert classifies the captured images into quality classes; in the simplest case, two classes are sufficient, passed and failed, or good and bad. However, school grades or any other quality classes can also be assigned. Based on deep learning methods, Safe-Ident Quality learns to assess the quality of a product in the same way as the quality managers.

After completion of the training phase, analyses can then be carried out during or before production. These are quite simple for the operator: A sample is inserted into the test stand and the recording is started with one click. The system then indicates the quality level of the product. That way, it can be ensured during production that the end product will stand up to the critical eye of the consumer. The operator is unaware of the complex technical inner workings and the thousands of computing operations that take place inside. Each new image is archived, and the quality data thus obtained is automatically used to generate statistics that can be presented graphically for any desired time sequence.

Safe-Ident Quality is a solution that can reliably evaluate visual and aesthetic aspects of a product without having to program in the features for assessment in manual and detailed precision work – thanks to Deep Learning. ■

Strelen Control Systems

Strelen Control Systems have been developing solutions for inspection, analysis and quality control as well as for the automation and control of production processes – inline and offline – for more than ten years.

The system house has been active in the field of digital image processing in conjunction with artificial intelligence for more than ten years. Industry 4.0 applications and individual products are at the forefront of the innovative developments, which are successfully used in the food, pharmaceutical, and packaging industries, among others. Since a modern workshop is also attached, Strelen offers complete solutions with integrated image processing from a single source. Special attention is paid to to fast set-up ("plug and play") and ease of use to ensure that customers save time and reduce their workload quickly and easily.

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All images: Strelen Control Systems

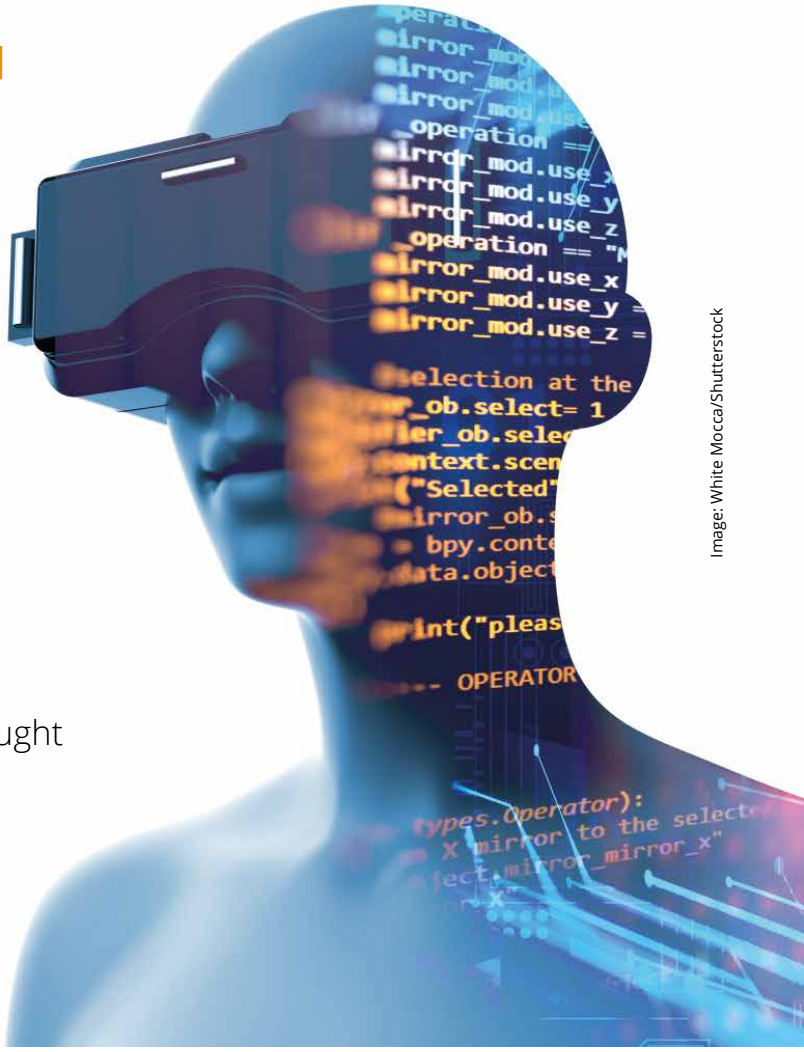

Image: White Mocca/Shutterstock

Lens Quality in AI Vision

Why not to Make the Lens an Afterthought in an Embedded AI Vision System

There is a variety of factors that drive image quality. Making the right choice across the range will help to simplify the challenges and the complexity of AI systems and increase imaging performance along the way.

Developing a machine vision or embedded AI systems and scaling them for deployment are already challenging tasks. Converging these to an integrated Embedded AI Vision System can keep scores of developers and engineers busy for quite some time. The selection of relevant sub-components has a significant impact on the engineering challenge and the final solution's complexity, performance, physical size, and power consumption. Regarding the optical path of an Embedded AI Vision System, making the right lens selection is a critical milestone and should not be seen as an afterthought, since the lens' performance and characteristics impact almost every aspect of the downstream vision chain. The right lens choice can positively impact the required AI algorithm complexity and final system performance, whereas the wrong lens choice can hamstring subsequent development.

Choosing the Right Lens

If applied AI for embedded vision aims to replicate human sensing and understanding, then the optical stack plays a significant role in achieving a human-like vision for any camera-based application. However, carefully selecting the right lens will pay huge dividends whether the intended application is in automotive, security, medical, robotics, or any other possible implementations when transitioning from the lab to the real world. For systems that will be deployed in an environment with low or changing light, or are exposed to a wide temperature range, the challenges to delivering consistent optical performance increase dramatically. A lens must excel along multiple vectors to support real-time or post-processing using AI algorithms.

Choosing the right lens is a critical step in system-level optimization and setting a roadmap to achieving desired outcomes. From our experiences across industries, applications, and clients, we found the following 1st order lens parameters to be critically important:

- MTF – Modulation Transfer Function is a standardized way to describe an optical system regarding sharpness and contrast and is a key performance indicator when comparing lenses. While commonly used to judge "how good" a lens is, it is not the only, and sometimes not even the best metric for determining what will work best in a given use-case.
- F/# – Essentially, the amount of light the lens lets in for a given focal length. The physical aperture, or "Iris" of an optical system defines the total light throughput and directly impacts the lens' ability to produce the required contrast and Depth of Field.
- Distortion – The concept of distortion describes how a lens maps a shape in object space to the image plane. Distortion must be referenced to something, which is sometimes called the "projection", or may be referred to as Rectilinear, F-tan, or F-theta distortion.
- Relative Illumination (RI) – Is a normalized %-value that represents the illumination of any field point relative to the point of maximum illumination, which is typically on-axis. A high RI value means "flat" illumination across the image plane, whereas a low RI may introduce dark corners or edges.
- Dynamic Range – Quantifies a system's ability to image high lights and dark shadows in a scene adequately, IE, a wide range of lighting values or conditions in the same image without being saturated or too dark.

Hyperspectral Lenses

As listed previously, MTF or the Module Transfer Function is a standardized way of comparing the optical performance of differ-

ent imaging systems. For AI algorithm-based systems, it is generally advisable to select lenses that have a fairly consistent MTF across the FOV (Field of View) and show a stable MTF behavior over temperature. The intended wavelength spectrum, which depending on the application, typically include visible (VIS) and/or near infra-red (IR), also has to be taken into consideration when comparing MTF performance. A lens that checks off all these boxes is a fully athermalized lens called hyperspectral, RGB-IR or Day/Night lens. Such a lens requires not only a deep design experience but also an in-depth understanding of material properties, advanced coating Know-How, and a manufacturing process expertise that has been optimized and advanced over decades.

Not all applications require such an advanced optical system, and it will be for the application domain expert to decide which component and how far to optimize the system. However, everything that can be optimized at the lens level "at the speed of light" reduces processing time and power later, possibly resulting in smaller and more energy-efficient computing systems. It is also much easier to start with good lens performance, rather than recreate "missing" data to compensate for poor optical performance since it is almost impossible to process enough to make up for lost data at the lens level (the often-cited concept of garbage in, garbage out applies here as well.)

Depth of Field

Other optical performance parameters such as the F/# and Relative Illumination (RI) also contribute to the consistency of imaging quality that any AI algorithm must deal with. Unfortunately, there is no "one size fits all." For example, the system architect has to decide whether to optimize a system for low-light performance with a low F/# or improve the Depth of Field (DoF), which defines the range from the near to the far object distance that is determined to be in focus, with a higher F/#. In this example, a high RI may contribute to a well-balanced system where the edge illumination would tolerate some "stopping down" (increasing the F/#) to increase DoF. Lens selection can quickly become a multi-dimensional optimization with various trade-offs.

Distortion

Distortion is one of the lens specs that software developers might often like to simply make go-away since a high and consistent number of pixels per degrees (px/deg) across the entire FOV would be preferred. But since distortion is unavoidable in many cases, Sunex has found ways to manipulate a lens' distortion profile to align best with and support the algorithm-specific requirements. Our Tailored Distortion expertise has often been applied to SuperFisheye lenses to correct barrel distortion of large FOV lenses, providing more px/deg at the field edges, while conversely the initial statement of striving to achieve a human-like vision has led to the development of FOVEA distortion lenses that mimic the human eye by increasing the px/deg density in the center while at the same time maintaining a wide field of view peripheral vision.

Dynamic Lens Ranges

Not just the 1st order lens design parameters, but also a combination of lens design considerations, coating choices, and surface treatment, contribute to the dynamic range of a lens, which can significantly affect the performance in extreme light situations. The dynamic range of a lens or system is defined as the ratio of the largest non-saturating input signal to the smallest detectable input signal. AI systems running on mobile autonomous systems, such as a delivery vehicle driving from broad daylight into a tunnel (or out), is an authentic example that benefits from a lens with an excellent dynamic range to support consistent results. An agriculture harvesting machine that, on the return leg, drives into the setting sun or stationary systems such as exterior smart infrastructure or security cameras that have to deal with passing light sources such as vehicles or the sun are further applications in need of a lens with high dynamic range. Many customers ask what dynamic range really means for the lens itself, since it is the imager (CMOS, CCD, etc), which is detecting the light, not the lens. The answer is that the lens must be very good in terms of stray-light, glare and ghosting. For a low dynamic range sensor, these image artifacts can be ignored because the sensor will not pick them up. However, in a HDR/WDR sensor, at best, stray light reduces the signal-to-noise level (contrast) of the image and at worst the artifacts themselves become apparent and may be interpreted as another light source, such as an oncoming vehicle, or could obscure real images.

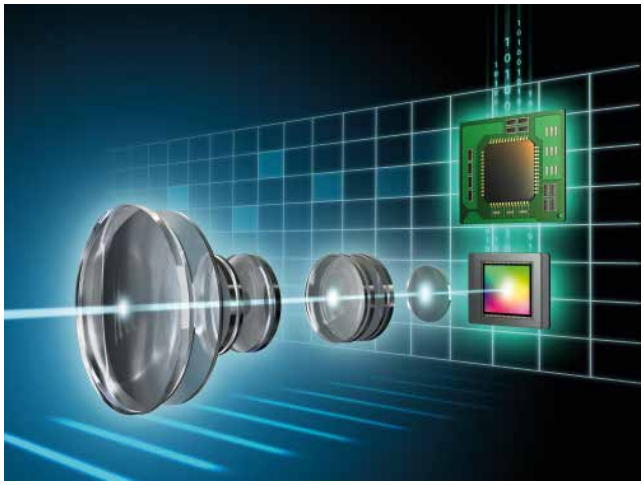

Image: Andrea Danti/Shutterstock

Sunex' lenses combine low F/#, high relative illumination (RI), high dynamic range (HDR), high MTF across the field, and a broad wavelength spectrum for consistent performance for many industries and applications.

Simplifying AI with the Right Lens

Who knows where the capabilities of embedded AI-vision systems will lead us in the future; can it ignore dust or dirt on the camera, overcome insufficient lighting, or potentially compensate for MTF changes due to thermal shift? While AI may eventually allow for more relaxed lens requirements like a human brain does, there is still no substitute for good image quality and we can clearly see the benefits and potential that an "AI-optimized" lens can deliver to the overall system reliability and consistent image quality, especially if the AI-based vision system is situated in varying environmental conditions. Needless to say, size constraints and piece price also factor in when designing the right system, and there is no need to "over-engineer" the final solution. However, the previously mentioned factors that drive image quality, when done right, have the potential to simplify the AI system complexity, optimize algorithms, reduce system latencies and power consumption, while enhancing imaging performance.

Sunex already has many lens designs that combine low F/#, high Relative Illumination (RI), high dynamic range (HDR), high MTF across the field, and a broad wavelength spectrum for consistent performance for many industries and applications. Often the initial engagement with their clients is to select possible options based on their existing portfolio of lenses to get real-world feedback on what optical performance is required in the real use-case. Based on this feedback, they review opportunities to optimize and adapt and existing lens or may jointly decide to pursue a purpose-built, custom lens design that matches the application and requirements. For many of the company's clients they also offer greater vertical integration by designing and manufacturing the entire sensor board, including fully automated active lens/sensor alignment. Sunex aims to collaborate to develop a system that can meet the expected performance, for an acceptable price, in the time frame needed. ■

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Image: Aries Embedded

OSM-compatible System-in-Packages for Industrial Controls and IoT

Aries Embedded presents with the embedded boards MSRZG2UL and MS-RZFive two system-in-packages (SiP) based on the single-core microprocessors RZ/G2UL and RZ/Five from Renesas.

The RZ/G2UL microprocessor contains a Cortex-A55 (1.0 GHz) CPU and a CortexM33 coprocessor, while the RZ/Five has a RISC-V CPU core (AX45MP Single) with 1.0 GHz.

In the smallest S size, the new MSRZ SiP SoMs concentrate extensive functionality on a board of 30 by 30 mm each. The modules are compliant with SGET's OSM standard and offer an LCD controller. They support 512 MB to 4 GB of DDR4 RAM and 4 GB of eMMC NAND flash. Interfaces include: MIPI-CSI, display output (Parallerl-IF), USB2.0 2ch, SD 2ch, CAN-FD and Gigabit Ethernet.

www.aries-embedded.com
Hall 8, Booth C08

Image: Acceed

AI Computing Platform for Intelligent Image Analysis

Nuvo-8111 is a series of computer platforms aimed at AI use. Available through the German distributor Acceed in several equipment combinations, the industrial box computer has three expansion slots and support for a high-end graphics card from Nvidia.

In contrast to the general CPU, the GPU (Graphics Processing Unit) is a processor specialized and optimized for computing graphics. The many smaller processor cores of the GPU, which are designed for more specialized tasks, show their strength in interaction when data processing processes can be divided among many cores. Industrial applications benefit in the area of intelligent image evaluation, for example for robot control, the coordination of vehicles and transport systems, but also in process analysis and complex simulations.

www.acceed.com

Image: Taicenn

Fanless Industrial Box Computer for Machine Vision

Taicenn Technology has expanded its TBOX-3 series of fanless industrial box computers for machine vision.

TBOX-3111 with PoE function is equipped with Intel Elkhart Lake Celeron J6413 quad-core processor with stronger graphics performance (Intel UHD Graphic Gen. 10). The TBOX-3111 has many I/O interfaces: It has 4 Intel Gigabit Ethernet (3 support Power over Ethernet (PoE) function), 2 serial ports, 32 digital I/O, 6 USB ports (2 USB 3.0), 1 HDMI and 1 VGA port. User-specific customization, such as adding fieldbus ports like Profinet, is also possible in smaller runs. The TBOX-3111 system supports optional expansion (1 Mini PCIe slot) for wireless communication such as 3G/4G or WIFI/BT. The fanless box PC offers a wide range voltage input from 9 to 36 volts DC.

www.taicenn.de

Image: EVK

Real-Time Material Detection with Hyperspectral Camera

The image processing expert presents the EVK Alpha G100 edge computing platform in combination with the EVK Helios EC32 hyperspectral camera.

The real-time capable data processing platform and the hyperspectral camera, which is characterized by its signal-to-noise ratio, enable the necessary solutions in real-time material recognition for industrial applications in harsh environments. A developed functionality extension, which enables classification in up to 100 material classes, also contributes to this.Tasks such as the classification of individual polymers in complex plastic streams, the evaluation of refuse derived fuels (RDF) as well as the extraction of contaminants and the analysis of quality defects in the food industry are the areas of application of the EVK solution.

www.evk.biz
Vision: Hall 10, Booth C11

Image: Gidel

Frame Grabber Series for High Bandwidths

The Gidel Hawkeye-CL frame grabber family is Camera Link Rev. 2.0 compliant and supports all 80-bit Camera Link modes.

It offers a range of options for different application needs, from plug-and-play high-performance frame grabbers to a system solution that includes acquisition, Open-FPGA image processing and a flexible, camera interface.

The Hawkeye-CL family is designed for high bandwidth and combines an acquisition rate of up to 25 Gb/s, a PCIe Gen. 3 x 8 host interface, image buffers of up to 16 GB, real-time compression and the ability to offload Regions Of Interest (ROI) for additional bandwidth utilisation.

It is supported by Gidel's Proc Vision Developer's Suite, which allows users to intuitively and easily customise their vision flows.

www.gidel.com

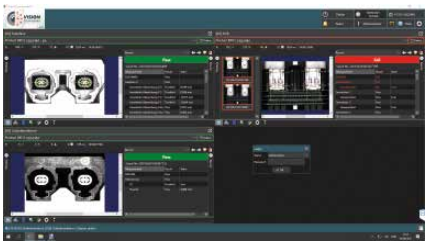

Image: Senswork

Universal Software for Deep Learning, 2D and 3D Image Processing

The PC-based image processing software for optical inspection, Vision Commander Gen V1.5, supports 2D and 3D cameras as well as scanners from a wide range of manufacturers. The software can perform up to eight inspections in parallel in separate viewing windows.

The results of the inspection are stored in real time in an SQL database. The database enables detailed analyses and data tracing in production. A flexible statistics module also provides an overview of the current quality status in production. With the internal product management, product-specific measurement and inspection characteristics can be created. All characteristic data is automatically transferred to the internal statistics and database module after each inspection cycle.

www.senswork.com

WILEY

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Image: IDS Imaging

Block-based Editor for App Creation Without Programming Knowledge

Software release 2.6 for the AI vision system IDS NXT focuses in particular on simplified app creation.

With the help of the new application wizard in IDS NXT Lighthouse, a complete vision app can be designed in just a few steps, which can then be executed directly on an IDS NXT camera. The also new block-based editor allows users to configure their own program sequences with AI image processing functions, such as object detection or classification, without any programming knowledge. Users can create simple sequences in minutes with this visual code editor without having to know the syntax of a specific programming language.

www.ids-imaging.de
Vision: Hall 8, Booth C60

Image: SVS-Vistek

Industrial Inspection in the Non-Visible Area

For many industrial inspection tasks in the non-visible range, SVS-Vistek has swir and UV industrial cameras as well as polarization cameras in its product range.

The exo990, fxo990 and exo991 swir cameras cover the visible VIS to the invisible swir range with a waveband of 400 to 1700 nm. They have a resolution of 0.3 MP or 1.3 MP, frame rates of 90 to 259 frames/s, a sensor format with a diagonal of 8.2 mm or 4.1 mm, temperature management and modern interfaces such as GigE Vision and CoaXPress-12. The technical basis is the Senswir sensors from Sony. The so-called Cu-Cu bonding leads to smaller pixel structures and thus to a higher resolution.

www.svs-vistek.de
Vision: Hall 10, Booth F30

Image: Vision & Control

Multi-Camera Image Processing Systems for Rack and Control Cabinet

With Vicosys 19001 and Vicosys 6300 Compact, the company presents two multi-camera systems for industrial image processing.

The Vicosys 19001 high-end multi-camera system is two U high and designed for installation in 19-inch racks. Its eight-core processor (Intel Core i7-10700E) ensures speed at 2.8 GHz. In addition, up to 16 cameras can be connected.

In the control cabinet of the vicosys 6300 Kompakt multi-camera system, Intel's Core i3-9100TE processor provides image processing at 3.20 GHz. The basic version has a GigE Vision camera interface (without PoE) and an Ethernet LAN connection. There are six USB 3.1 and two USB 3.0 sockets as well as two RS232 interfaces.

Both camera systems have additional slots for digital inputs and outputs, Profinet and other camera cards. **www.vision-control.com**
Vision: Hall 10, Booth B73

Image: Teledyne Flir

Two lenses in One for Thermal Imaging Cameras

The Flex View DFOV camera lens saves time and increases the inspection accuracy of the Flir Axxx and Txxx series thermal imaging cameras.The shape is 6 mm longer than the standard single lenses. This allows the performance of two otherwise separate lenses in one, without adding weight. With radiometric accuracy, the temperature of each pixel can be measured and recorded. Inspection times can be reduced with two lenses and there is no longer a risk of lens or camera damage when changing lenses. The wider 24-degree field of view function of the Flexview lens allows for wide-area scanning to detect potential anomalies, while the narrower 14-degree field of view function provides higher resolution due to the larger optical zoom with 2.8 times as many pixels from the target object.

www.flir.com
Vision: Hall 8, Booth B10

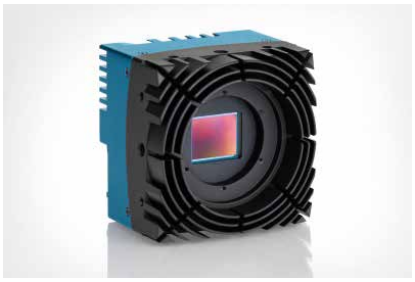


Image: Mikrotron

High-Speed CoaXPress Camera for Industrial Machine Vision

The company has developed the Eosens 21CXP2 to complement its high-speed CoaXPress camera series.

Based on the Gsprint 4521 CMOS sensor from GPixel with global shutter, the Eosens 21CXP2 combines a resolution of 21 megapixels with a pixel size of 4.5 µm, enabling up to 230 fps when using all 5,120 x 4,096 pixels. By reducing the sensor area read out, a frame rate of 5,543 fps can be achieved for images with 5,120 x 128 pixels. The integrated interface CoaXPress 2.0 with 4x 12.5 Gbit/s can handle the large amounts of data without latency.

The global shutter sensor used enables detailed imaging even of moving objects. It can be used in many industrial applications for the detection of defects in test parts.

www.mikrotron.de
Vision: Hall 10, Booth F30

Image: Allied Vision

Embedded Vision and Machine Learning Combined

Allied Vision enables the realisation of GenICam-based image processing applications with CSI-2 cameras.Existing GenICam-based applications configured with a USB camera can be migrated to CSI-2 cameras. All SFNC (Standard Features Naming Convention) features available with Alvium USB3 cameras can now also be used with CSI-2 cameras. A USB camera can thus be employed for prototyping and can easily be replaced by a CSI-2 camera after the application has been developed. The cameras can be controlled with Allied Vision's Vimba 6.0 software development kit or any other third-party GenICam-compatible software. The convolution filter with a 5x5 matrix includes an adaptive noise reduction mode that reduces noise in the image while preserving the corners and edges.

www.alliedvision.com
Vision: Hall 10, Booth F30

Images: Ienso

System-on-Chips (SoCs)-Based Camera Modules

The company has developed two embedded vision camera modules based on Ambarella's CV series system-on-chips (SoCs) that support resolutions from 1080p up to 8K, integrated CNN/DNN processing and multi-sensor inputs.

The iVS-CV28P camera module is suitable for applications where there are stringent size, power consumption and cost requirements, such as IoT, consumer or small business surveillance, precision agriculture and home appliances.

The iVS-CV22, on the other hand, is designed for applications that require high computing power, such as commercial surveillance, drones, industrial OEMs and automotive aftermarket applications.

www.ienso.com

Image: Solectrix

Digital Machine Vision Systems at Embedded World 2022

At Embedded World 2022, Solectrix showed Hive, a development environment for entry-level real-time modelling in image data processing, a digital 3D upgrade for stereo microscopes and features for the Proframe frame grabber system.

Hive is a platform-independent image processing tool for imaging prototyping based on the Halide framework. With the Hive Soft ISP (Image Signal Pipeline), the solution for real-time capable video processing offers a Halide-based video engine that supports image sources as well as various types of graphics acceleration and algorithm selection.

With the Sinascope 3D digital microscopy platform, all optical, eyepiece-based stereo microscopes can be expanded into a digital microscope with two 4K cameras and a 3D monitor.

www.solectrix.de

Vision: Hall 10, Booth C16

Image: Leuze

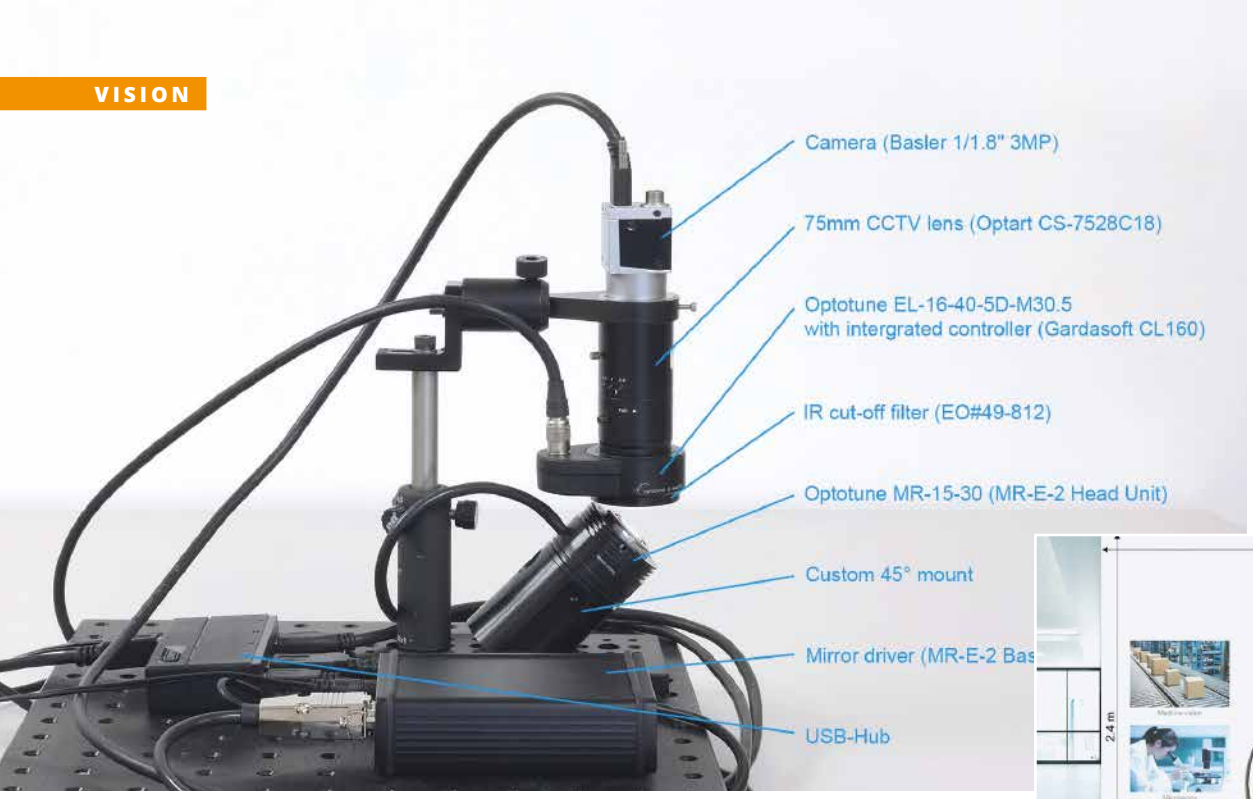
IP Camera Tracks Back Disturbances

The LCAM 308 IP camera monitors hidden areas on stacker cranes and conveyor lines. Operators of logistics centres can trace back events and rectify faults.

The LCAM 308 IP camera records 60 seconds before a malfunction in full HD. Events are thus traceable. The camera can be used flexibly: It is suitable for visual monitoring of areas that cannot be seen on storage and retrieval machines or on conveyor lines.

If necessary, a live stream in HD resolution can be started. In addition, the snapshot mode allows the recording of individual images. Standard browsers or standard streaming tools are sufficient for transmitting the 60-second recording or the live stream. No additional software is required.

www.leuze.com



Demo setup for FOV Expansion using Optotune's EL-16-40 and MR-15-30

Expanding FOV limits

Innovative Components and Setups Extend Previous Limits

Combining a regular industrial camera and lens with a 2D fast steering mirror and a liquid lens enables an extreme expansion of the Field-Of-View (FOV) and the Depth-Of-Focus (DOF).

Machine vision systems have fundamental limitations with respect to resolution, Field-Of-View, and Depth-Of-Focus. Angular resolution and FOV are conflicting specifications, limited by the size and resolution of the image sensor.

Expanding the FOV while maintaining high resolution is crucial for a variety of applications. For example, in the field of public surveillance at train stations or airports, a large scene needs to be imaged with a resolution that is high enough to manage detailed object detection or face recognition. Another example is traffic sign detection in autonomous driving, which benefits from FOV expansion by enabling to read signs at a larger distance. Other applications where good resolution and a large FOV are beneficial are barcode scanning and iris recognition. To maintain high resolution, the barcode or the human eye to be identified need to be accurately positioned to be within the camera's FOV. This limits the ease-of-use of such imaging systems or may make it necessary to use multiple devices to cover the necessary FOV.

Although high-end devices are available on the market that are capable of producing wide-angle gigapixel pictures and even videos, these devices are not practical for most applications. They rely on an expensive brute-force approach to use an array of image sensors and to provide the extreme computational and signal processing power to cope with the high data rate.

Commercially available single-device multi-camera systems provide a larger FOV by combining a few standard image sensors. However, these cameras are still relatively wide angle and have small aperture, hence the benefit in resolution is limited.

2D Mirror and Tunable Lens Combined

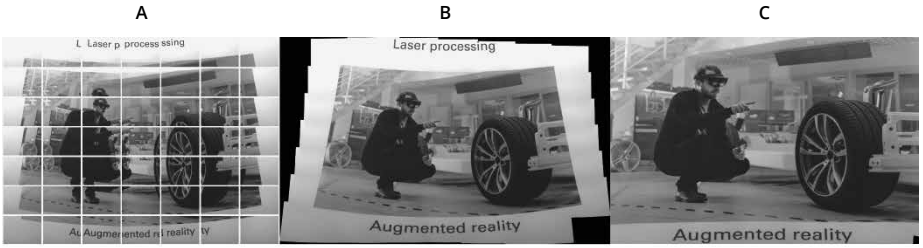
The core competence of the Swiss company Optotune lies in the optoelectromechanical design of dynamic light controlling components, in the understanding of the materials in use and in the control of efficient and clean manufacturing processes. Due to its specialization in this area, the company has used its competence to develop an option to extend previous FOV limits and thus enable efficient image processing systems that can cover much larger areas based on an innovative idea.

The company's approach is to equip an industrial camera and objective with a 2D fast steering mirror and a liquid lens. The mirror is used to increase the FOV of the imaging system while the liquid lens allows to acquire all images in perfect focus.

As bright illumination is the key to high quality images, a large mirror size is a precondition for the system. Common 2D-MEMS mirrors have a very limited angular travel range and are generally too small. On the other hand, a simple serial combination of two single axis scan mirrors is also not an ideal solution, because the second mirror needs to be considerably bigger than the first one, which leads to pretty bulky systems.

Optotune's solution consist of the company's 2D mirror product MR-15-30 with a 15 mm aperture and large ±25° scan angles, in combination with a tunable lens called EL-16-40, also developed by manufacturer, with its unrivalled 16 mm aperture. Used in a combined way, both products are ideally suited for FOV expansion, allowing for a compact and flexible system.

»The resulting stitched and distortion corrected overall image impresses with an exceptional quality.«



Workflow from the acquired raw images (A) to stitched (B) and distortion corrected (C) images

Stitched Image with Corrected Distortion

In order to investigate the functionality of the setup, a test system that combines the two Optotune products, the tunable lens EL-16-40 and the 2D beam steering mirror MR-15-30, with a 3 Megapixel monochrome camera and a 75 mm CCTV lens was realized. The EL-16-40 is used in a front-lens configuration, and the MR-15-30 is mounted at a 45° angle. This demo setup was placed centered in front of a 2.4 m x 2.4 m square exhibition wall at a distance of only 1.7 m.

While the camera's regular FOV only covers a small area of 5.2° by 3.9°, the 2D-mirror's ±25° tilt angles extend this FOV by factor 500. This means that despite the moderate 3 Megapixel sensor, high resolution images with more than a gigapixel can be obtained by stitching individual images captured by the system.

Figure 3 shows the resulting Field-Of-View and the distortion introduced by the 45° mirror arrangement. As a consequence, the resulting FOV of 70° in the horizontal direction is noticeably smaller than in the vertical axis that reaches 100°, despite the equal 50° travel range of the two mirror axes. For reference, the silhouette of the wall is shown in green.

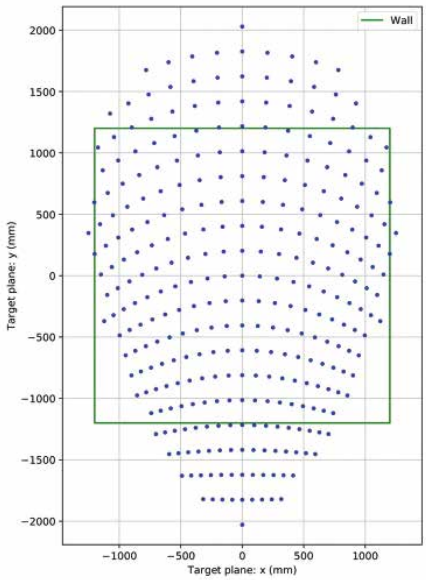


Figure 3: Total FOV provided by the mirror in relation to the wall size. The distorted grid is a result of the 45° projection.

All images: Optotune

The lens on the other hand is used to change its focus as the image is scanned. In this demo setup the EL-16-40 with its -2 dpt to 3 dpt tuning range allows to focus on objects placed at distances of 30 cm to infinity.

From the Individual Images Acquired in this Way, a Combined Overall Image is Created in the Next Steps

First of all, a set of pictures is collected by scanning the mirror over one of the images on the wall. Optotune's recommendation is that those images should have about 30 percent overlap to facilitate the following stitching process. The Swiss engineers used the demo version of the fully automated AutoStitch tool, available to license from the University of British Columbia that uses a spherical projection to render the stitched image. For the final distortion removing step, the open-source image manipulation program GIMP 5 was used.

Impressive Results

The resulting stitched and distortion corrected overall image calculated as described impresses with an exceptional quality. In order to demonstrate the high level of detail that can be achieved with that setup, a 10-mil barcode was attached to the wall. The smallest feature size of a 10-mil barcode is 0.254 mm which corresponds to 8.6 mdeg when looking from a distance of 1.7 m. This is smaller than the resolution limit of the human eye of about 15 mdeg. However, the setup described is able to resolve the barcode with an impressive quality, thanks to 2048 pixels along the small 5.2° horizontal FOV, which yields 2.5 mdeg/pixel.

Conclusion and Outlook

Combining Optotune's 2D mirror MR-15-30 and the EL-16-40 tunable lens with a standard camera and lens plus suitable stitching and image manipulation software tools enables the development of compact and flexible image acquisition systems that can enormously extend the Field-Of-View of those systems without the need to move the camera. Areas of application for that kind of system can be found in logistics, autonomous driving and many other fields where scanning of large areas with high resolution is required.

Optotune's recently introduced FOV development kit.

To help users get started with the system's capabilities, the company recently introduced a FOV development kit that features two imaging systems with a wide-angle objective for overview and a narrow-angle objective (50 mm or 75 mm) for high resolution in the area of interest. This development kit is accompanied by a powerful software to demonstrate its suitability for surveillance and inspection applications, incorporating options for face recognition, autofocus, and an area of interest selection. ■

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Enabling the Future of Lithium-Ion Batteries

Lithium-ion Batteries in Electric Vehicles and Solar Power Systems will be Behind the Growth of the Green Revolution.

To master the main challenges of electrode inspection tasks, namely the speed of the process and the need to identify ever smaller defects, cameras must be able to keep up with the production speed of the machines. This requires a high line rate while providing enough sensitivity to allow the use of short exposure times, and sufficient pixels to cover as wide a field of view as possible.

The quintessential electric vehicle, the Tesla Model S, uses more than 7,600 lithium-ion battery cells. In the near future, we may look at that kind of battery usage not as quintessential, but quaint. The transition to green energy in the coming decades will require a commensurate increase in battery production and innovation. lithium-ion batteries will be the workhorse of a green energy revolution in the near to medium future, storing power for nearly everything, from electric vehicles and eventually airplanes, to homes and commercial buildings.

Lithium-ion batteries come in three shapes: cylindrical, pouch and prismatic (also called a battery can). Your smartphone probably has a pouch battery while most household appliances will have cylindrical batteries.

Battery production is ramping up across the world. Tesla finished building its infamous first so-called gigafactory for battery cell production in aptly-named Sparks, Nevada in 2015. Another Tesla gigafactory, working mostly on solar power storage opened in 2017 in Buffalo, New York. The company has plans to open two more factories in coming years, in Berlin, and Austin, Texas. European battery company Northvolt has already started production at their gigafactory in Sweden in 2021.

The transition to green energy provides a long runway for a new sector of the global economy. Manufacturing will benefit as the demand for solar cells and batteries ramps up, and with any new technological development, an industry ecosystem will develop to support its growth and production. The lithium-ion battery is at the forefront of an ecological and economic revolution.

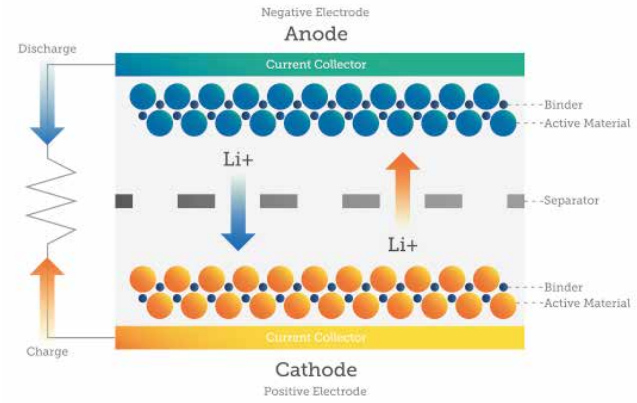
How lithium-ion batteries are built

For all their importance, lithium-ion batteries are conceptually simple devices. Alternating cathode (positive charge) and anode (negative charge) electrode sheets are stacked on top of each other, with a separator sheet between each layer. A liquid or solid electrolyte is mixed in to facilitate energy transfer between the cathode and anode sheets.

Cathodes sheets are typically made from aluminum foil, while anode sheets are made from copper foil. From there, each sheet is coated with specific materials to promote conductivity, efficiency, and binding. Active materials determine the capacity, voltage and characteristics of a specific lithium-ion battery. For cathodes, active materials often include lithium cobalt oxide, lithium manganate oxide or lithium iron phosphate. Anodes are typically coated with some kind of carbon material, such as black lead or lithium titanite. Binders are used to adhere the mixed materials to the foil sheet, and solvents promote the mixing of materials in the slurry until they are ready to coat the appropriate sheets. In addition, a cathode will include a conductive element to reduce internal resistance and increase conductivity within the cell.

The separator sheets that go between the electrodes are manufactured from porous

Teledyne Dalsa's Linea 8K and 16K line scan cameras with Camera Link interface are a popular choice in lithium-ion battery manufacturing.



The structure of a lithium-ion battery. Compared to metallic alternatives, lithium-ion is more stable during operation and charging. They're typically twice as energy-dense as Nickel-Cadmium batteries but can tend to be heavier than other options.

polyolefin film material that are applied with an aramid coating fluid and then cut to size. Once the layered electrode sheets are ready, they are placed in the battery casing in one of the three major formats, cylindrical, pouch or prismatic. Depending on the form and specifics of the battery, the casing will include external positive and negative terminals to connect to the device being powered, an insulation layer between the case and the electrode stacks, a gasket, a degassing hole and other elements.

Quality Assurance for Lithium-ion Battery Production

While lithium-ion battery production may be conceptually simple with coated electrode stacked sheets and an electrolyte solvent, the actual process is fairly complicated and sensitive. The thickness of the coatings on the electrodes can have a significant effect on a battery's performance or even its stability.

Line scan cameras powered with machine learning algorithms can help automate and streamline the quality assurance stage of lithium-ion battery manufacturing. A line scan camera is a camera that can be mounted on a factory production line to monitor the production of materials as they are moved through the manufacturing process. Line scan cameras are well-suited to inspection of electrode sheets, since the sheets are run at high speeds from big spools through the coating and stacking process.

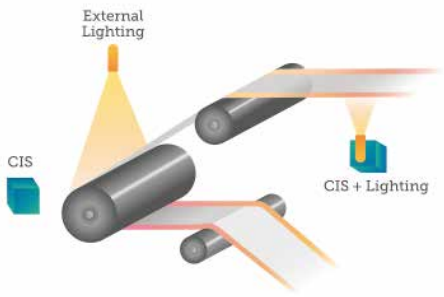
Laser profiling from inspection cameras can cover the whole manufacturing process of lithium-ion batteries. The cameras can measure the thickness of the electrode sheets and coating, look for surface defects on the sheets such as dents, scratches or bent edges, measure the dimensions of the battery casing for cylindrical or pouch batteries, and monitor the quality of the weld of the external terminal on the batteries.

Machine Vision Solutions for Effective Inspection Processes

Teledyne Dalsa is a part of Teledyne's Vision Solutions group and a leader in the design, manufacture, and deployment of digital imaging components for machine vision. The company's image sensors, line scan and area scan cameras, smart cameras, frame grabbers, software, and vision solutions are at the heart of thousands of inspection systems around the world and across multiple industries, including inspection processes in the production of lithium-ion batteries. "We are providing our products to high-volume secondary battery manufacturers in the North American and European markets, but there is a concentration of customers in the Asian market – primarily in China and South Korea", says Inder Kohli, Senior Product Manager at Teledyne Dalsa. "In Europe a lot of new companies have emerged and are still working to become significant players in that field. We are only at the beginning of what we hope will become a significant business area for Pan European automotive car companies."

The main challenges in many of the electrode inspection tasks is the speed of the process and the need to identify ever smaller defects. The camera must be able to keep up with the production speed of the machines and therefore have a high line rate while providing enough sensitivity to allow the use of short exposure times and have enough pixels to cover as wide a field of view (FOV) as possible. "This is why our Linea 8K and 16K line scan cameras with Camera Link interface are a popular choice in that industry. For slower lines and processes our Linea GigE cameras dominate, but also Linea 4K and Genie Nano 2MP area scan cameras are used for various inspection tasks during the production of lithium-ion batteries", Kohli says.

One of the first mass-produced lithium battery types. Cylindrical cells are made up of sheets of anodes, separators, and cathodes that are sandwiched and rolled up. These cells are well-suited for automated manufacturing, and the shape allows the cell to tolerate a higher level of internal pressure without deformation. Cylindrical cells are commonly found in medical instruments, laptops, e-bikes, power tools, and combined in the massive packs in Tesla vehicles.



Line scan cameras, contact image sensors, and 3D laser profiles can all be used for inspecting electrode sheets.

In addition to the various inspection tasks associated with the electrode manufacturing process, such as post-coating, post-calendaring and post-slitting and -separation inspection, other machine vision solutions can contribute to economic processes, e. g. laminating, winding, housing insertion and welding, sealing, grading and finally packaging processes. With a broad portfolio of machine vision components including the necessary frame grabbers, interfaces and software solutions, Teledyne Dalsa is well equipped to enable powerful inspection solutions for lithium-ion battery production.

"Combining our high-sensitivity line scan sensor technology in a compact and industry-proven housing with our frame grabbers, in the case of Camera Link, and our Sapera Software Suite, gives our customers a high-accuracy, robust and dependable imaging system built for 24/7 use in this harsh environment", says Kohli. "Combining this hardware and software at a very economical price point, means our customers achieve a very quick return on investment when choosing Teledyne Dalsa for their battery inspection."

The Growth Potential for Lithium-ion Batteries

The demarcation line for the growth rate of lithium-ion batteries is often projected in terms of how many electric vehicles are being sold compared to internal combustion engine vehicles. Electric vehicles are expected to hit 10 percent of vehicle sales by 2025 and then accelerate to 28 percent by 2030 and 58 percent by 2040. For instance, California – the most populous state in the U.S. and one of the biggest economies in the world on its own – aims for all new cars and passenger trucks sold in the state to be zero-emission vehicles by 2035. ■

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All images: Teledyne Dalsa

With the Opto NCDT 1900 laser triangulation sensors with Ethercat or EtherNet/IP, Micro-Epsilon offers a solution for use in factory and plant automation.

Fast and Accurate Laser Triangulation Sensors with Ethercat/Ethernet

Laser Sensors for High-precision Distance Measurement

For exact distance measurements, laser triangulation sensors are the means of choice. For direct integration into the manufacturing environment, one manufacturer now presents laser sensors with Ethercat and Ethernet/IP interfaces. This combines precision and integrability in a very compact sensor.

Measuring sensors used in factory and plant automation must meet numerous requirements. In addition to accuracy, high measurement and processing speeds, as well as measurement results that are as reproducible as possible, are required. There is an increasing demand for modern interfaces that allow easy integration into existing control environments. The cost-effective laser sensors enable accurate displacement, distance and position measurements in a wide range of measurement tasks.

Precision and Flexibility for Line Applications

With the introduction of the new Opto NCDT 1900 laser triangulation sensor with Ethercat, Micro-Epsilon offers a powerful solution for use in factory and plant automation.

The latest models are now equipped with an integrated Ethernet/IP interface enabling easy integration of Micro-Epsilon sensors into Industrial Ethernet control systems. This offers advantages especially in high-speed processes and in the networking of several devices and machines. Integration via Ethercat or Ethernet/IP facilitates communication, especially in modern plants. Thanks to direct data output, the measured values are available in real time. An oversampling function also contributes to fast acquisition of measurement values.

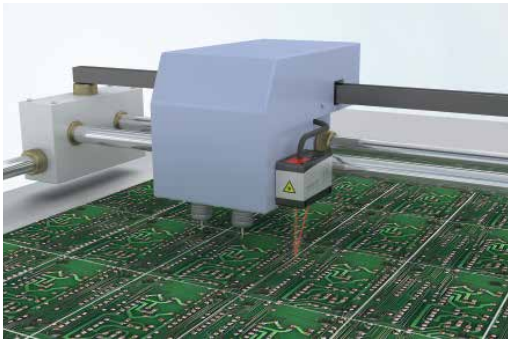
Highest Signal Stability for Dynamic Measurements

For the first time, the Opto NCDT 1900 sensors offer a two-step measurement value averaging feature to optimize the signal. The averaging enables a smooth signal at edges and steps while avoiding signal overshoots. This is particularly favorable for fast measurements of moving parts, as a precise signal curve is ensured.

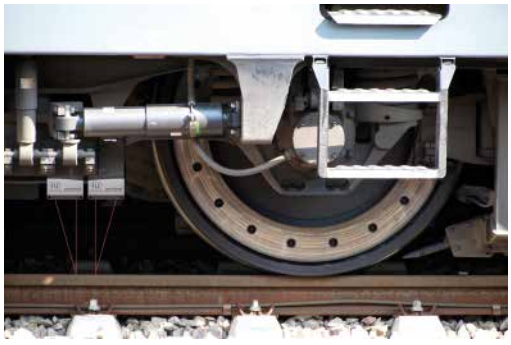
Intelligent Control for Changing Surfaces

The Opto NCDT 1900 sensors are also equipped with intelligent surface control. The Advanced Surface Compensation feature operates with new algorithms and enables stable measurement results even on demanding surfaces. For example, if the target surfaces change from matt black to glossy or from light to dark, the smart technology ensures that the exposure time adapts to the conditions presented by the respective measuring object.

In order to determine the measured values, the laser sensor projects the red laser point with a wavelength of 670 nm onto the target. The laser light is reflected in a certain reflection angle and hits an optical system on the CMOS line in the sensor. With quickly changing objects from bright to dark, only a small amount of light would reach the receiv-



The Opto NCDT series laser triangulation sensors enable fine positioning of the print head in printing, soldering and PCB assembly processes.



Special measuring cars are used to inspect high-speed train tracks. Laser displacement sensors of the Opto NCDT 1900LL series are integrated in these, which detect the distance to the track at a high measuring rate.

ing matrix without intelligent surface control. In contrast, the intensity would be too high when quickly changing from dark surfaces to shiny objects. In both cases, the result would be inaccurate or even useless. Therefore, the Advanced Surface Compensation regulates the exposure time, and also the intensity of the light emitted during the measurement task in such a way that the reflection on the CMOS line is in the perfect range. Then the sensor calculates the distance values with micron accuracy via the three-point relationship between the laser diode, the measuring position on the object and the depiction on the CCD line. The values determined can be fed into the plant and machine control system as analog or digital output signals via the fieldbus interfaces. The sensor is also extremely resistant to ambient light and can be used in highly illuminated environments.

Simple Mounting and Initial Operation

For reproducible mounting, the Opto NCDT 1900 is based on a patented mounting concept. Mounting is achieved via fitting sleeves that automatically align the sensor to the correct position. This enables both easy sensor replacement and even more accurate laser alignment. This is a decisive advantage, particularly when replacing sensors. No external control unit is required to operate the sensor, as the controller is completely integrated in the compact sensor housing. Due to its small dimensions, the laser sensor can also be integrated in confined spaces.

Application Diversity in Factory and Plant Automation

The innovative laser triangulation sensors are used wherever high demands are made on precision and ease of integration. The sensors are used, for example, in sophisticated factory automation, automotive manufacturing, 3D printing and measuring machines.

High-resolution Fine Positioning when Printing PCBs

In printing, soldering and assembly processes of printed circuit boards, the exact height positioning of the print head is crucial for a flawless process. Opto NCDT laser sensors enable precise positioning of the print head. Regardless of surface reflections, these sensors provide precise measurement results which are used to adjust the height and to detect the edges.

Positioning Gauge Heads in Measuring Machines

Coordinate measuring machines are often used to measure components. Opto NCDT laser triangulation sensors are used to position sensor heads quickly. Thanks to their advanced technology, the laser sensors enable fast and accurate positioning of the sensor head.

Measuring the Wear of High-speed Railway Lines

For the inspection of high-speed railway lines, special measurement wagons are used. They are equipped with Opto NCDT 1900LL laser displacement sensors, which detect the distance to the track at a high measuring rate. Their small laser line compensates for irregularities to generate smoothed measurement value curves. This is particularly suitable for determining the longitudinal trend of the rails. These robust sensors are insensitive to fluctuating reflections and ambient light.

Position Detection of the Car Body

For automated processing of car bodies, an exact determination of the car body position relative to the machining tool is necessary for e. g. drilling, punching or mounting of assemblies. For high precision distance measurement onto metallic or painted surfaces, laser triangulation sensors are used. Here, their insensitivity to ambient light and their high measurement accuracy in particular are decisive advantages.

Conclusion

The Opto NCDT 1900 laser triangulation sensors with Ethercat or Ethernet/IP offer maximum surface diversity with the highest signal stability. The combination of high measuring rate, extremely compact size with integrated electronics and extremely high measurement accuracy allows numerous fields of application. Predefined and individual presets in the web interface as well as fitting sleeves for mounting, allow a quick and easy commissioning with correct alignment of the sensor. For flexible connection to controllers, the Opto NCDT 1900 sensors also have an integrated Ethercat or Ethernet/IP interface. They are used, among other things, in automation technology, automotive manufacturing, 3D printing, coordinate measuring machines, injection molding, packaging and CNC machines, the battery industry, smartphone production, robot applications, and wood processing. ■

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All images: Micro-Epsilon

Revolutionary Movement

Integrative Motion Control with Customizable Software

Image: Aerotech

Positioning movements in the nanometer range require high-precision control. A new software platform integrates the entire periphery offering more than just motion control.

Aerotech has specialized in motion control and positioning systems for over 50 years. The in-house software developers in Pittsburgh bring concentrated know-how in programming software solutions for motion control: The latest result is the Automation1 control platform, which comes with several new features in the current release 2.2.

Whether in mechanical applications, automation solutions, or additive manufacturing processes, drive technology and motion are everywhere. Day in, day out, many design engineers think about how certain components, tools, workpieces, and much more can be moved in their applications in a targeted and precise manner. The positioning solutions that have established themselves on the market are as broad as the areas of application. They range from simple single-axis systems to complex multi-axis systems. Such complex systems are, for example, hexapods that want to move relatively freely in six degrees of freedom. High-precision positioning in the nanometer range is often required, especially in microscopy, metrology or even in the electronics industry, and medical technology.

Exact is Still Far from Precise

The positioning accuracy can be controlled via three parameters: the drive, the guides and the motion control used. "When it comes to positioning down to nanometers, drives and guides can be as precise as you like, but it's the control software that makes the difference," says Simon Smith, the European director of Aerotech, who looks back on decades of experience. "We can certainly achieve quite a lot with an extremely high constructive and costly effort, but ultimately the software must be able to precisely control and position the system."

One for All

The software developers at Aerotech have therefore developed Automation1, a motion control platform that can also integrate the entire periphery. It is intended to replace the previous Aerotech control platforms A3200, Ensemble and Soloist. "We only deliver new positioning systems with Automation1 as the control platform," emphasizes Simon Smith. "The easy-to-learn and easy-to-use architecture alone makes it much easier for users with Automation1."

So that the Drive is Right

While the new release builds on previous versions, it impresses with unique features. For example, the previous CNC user interface is replaced by the new Machine Apps HMI development tool. With this fully customizable tool, Aerotech is setting new standards in user interfaces for drive systems.

Seamless integration of PLC-based systems is also provided with EtherCAT compatibility. With this, Aerotech has extended the options for high-precision motion processes to PLC systems when they are embedded in a conventional system with lower precision. "With the new release 2.2 of Automation1, it now functions as a complete machine control system with all components and thus offers much more than a mere "motion control", concludes Simon Smith.

Important Features of the Automation1 Release 2.2

- Machine Apps HMI development tool instead of previous CNC user interface,
- etherCAT compatibility for connecting PLC-based systems,
- improved interfaces with additional Labview VIs and a Python API,
- enhancement of the Dynamic Controls Toolbox (a popular feature from the A3200 controls), which combines Aerotech's Harmonic Cancellation, Command Shaping and Cross-axis Feedforward functions,
- stepper motor control with closed loop,
- asset-wide backup and restore functionality using Aerotech's advanced API functionality. ■

Aerotech

Headquartered in Pittsburgh, USA, Aerotech Inc. is a mid-sized, employee-owned company. Founded in 1970 by Stephen J. Botos, Aerotech develops and manufactures the world's most powerful motion control and positioning systems for customers in industry, science and research. In the spirit of a family business, the owners continue to place the utmost importance on open and trusting dealings with customers, business partners and employees. In Germany, the medium-sized company is represented by its own subsidiary, Aerotech GmbH, based in Fürth, Franconia. In addition to sales and service activities, the customised assembly of positioning systems for the European market takes place in Fürth.

https://uk.aerotech.com

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Image: Göpel Electronic

3D Camera Module for Optimised Defect Detection

Two further developments have been made to the Inline-3D-AOI Vario Line 3D inspection system from Göpel Electronic, which on the one hand reduce pseudo defects and on the other minimise handling times.

With the 3D camera module, the Vario Line 3D receives a component that increases defect detection while ensuring fewer pseudo defects. This is made possible by intelligent software modules that adjust the inspection parameters according to the respective situation on the assembly. Due to the 3D technologies used, it is possible to measure components up to a height of 35 mm as well as to inspect optically critical surfaces with a large dynamic range.

www.goepel.com

Image: Creaform

Advanced Collaborative Robot Compatibility

To simplify the transition to automation, Creaform, a business unit of Ametek, introduces the version of the VX Scan-R software modules

VX Scan-R software is an integral part of the R-Series offering and is the automated 3D scanning solution for production-integrated applications, customisable layouts or turnkey solutions. VX Scan-R provides a digital twin environment that can be used for programme preparation or scan simulation and execution. The Metrascan 3D-RTM, a robotic optical 3D scanner, features high performance optics, blue laser technology and 360° target coverage, providing measurement accuracy, speed, versatility and ease of use for any quality control task.

www.ametek.de

Image: LMI Technologies

High-Resolution Laser Profile Sensors Detect Microscopic Features

LMI Technologies (LMI) announces the official launch of the Gocator 2600 series of 3D line profile sensors with 4K resolution. The combination of high resolution and large field of view makes it particularly suitable for measuring microscopic features.

The factory-calibrated sensors feature custom optics and 9-megapixel imagers and provide 4,200 data points per profile line for high-resolution 3D scanning and inspection with large fields of view up to 2m (at 0.55 mm X-resolution). They are used in battery inspection, food processing inspections, for example of bakery products, or in the automotive industry (e.g. air suspension and radar control).

www.lmi3d.com
Vision: Hall 10, Booth F30

Meanwhile, a future is foreseeable in which no one enters or moves around a factory, as robots take over all processes.

Quality Assurance Systems in Transition

Demands Placed on Inspection Systems by AI-assisted Design and Production

Despite artificial intelligence, automation and additive manufacturing, inspection systems remain essential to industrial production. What is changing above all are the components. Quality assurance must therefore transform, for example in the direction of robot-assisted automatic 3D measurement systems.

The factory of the future is one step away. A step away from the just-in-time principle common today to optimization methods that are not limited to parts production but start with mold design – conceived by computers with computational methods that surpass the human mind. This would enable part geometries that have not existed before, and that could be produced by means far more advanced than traditional methods. The only constant that would remain from our current manufacturing processes is the need for quality control, which as final result would be fully automated inspection.

Three elements are essential to the factory of the future: Robotics, Additive Manufacturing and Artificial Intelligence. In this article, we will try to outline the impact, consequences and, most importantly, the benefits that such a future may have on company growth and sales.

Robots Prevail in Factories of the Future

It is possible to foresee a future in which no one enters or circulates through factories, as machines perform all operations, transforming raw materials into final goods in the fastest and safest way possible. Consequently, the plant essentially becomes a space where robots unfold an electromechanical ballet, choreographed to the millisecond and performed relentlessly in a peaceful yet roaring environment.

In the absence of humans, safety standards can be reimagined, protocols can be reviewed, operating speeds can be accelerated, and full shift can be optimized because the health and safety of workers are no longer a concern. The lights can even be turned off since all actions are guided by optical and motion sensors.

While today's factories are designed to enable material handlers to move around safely, it is quite different for the factory of the future. In fully automated plants, tireless robots move effectively beside each other across vast floors, making turns tightly adjacent to one another. They perform their tasks dutifully and only pause for quality control.

Amazon and Boston Dynamics Push Robotics Deployment

Amazon's warehouses, with their inventory of goods and retrieval systems that use a series of robots to move the merchandise from makers to users, already offer a glimpse of the factory of the future. And the progress should not stop there, as Amazon is also developing drones and self-driving vehicles to speed up deliveries and complete their goods' robotic journeys in style.

Boston Dynamics has also contributed to the robotics boom by developing mobile and versatile humanoid robots for handling cases in different warehouse operations. These smart robots accelerate our progress toward the factory of the future by automating case handling anywhere in the warehouse with advanced mobility and state-of-the-art vision systems, eliminating the need for new, fixed infrastructures.

Additive Manufacturing is Shaping the Future

Some industries have already taken a step into the future by leveraging the power of the most advanced manufacturing technologies. From accelerated prototyping and improved agility in customizing designs to significant reductions in surplus part inventory, additive manufacturing is a disruptive technology that has the potential to revolutionize manufacturing from both cost and efficiency perspectives.

Medical devices, unmanned aerial vehicles, and jet engines can now be made with industrial-grade 3D printers. Not surprisingly, the range of printable materials continues to expand. In addition to basic plastics and photosensitive resins, they now include ceramics, cement, glass, numerous metals and alloys, and new thermoplastic composites infused with carbon nanotubes, and fibers.

Among the pioneers of metal 3D printing is Lincoln Electric Additive Solutions, manufacturer of large-scale prototype, production, and replacement parts and tooling

made of steel and stainless steel, Invar, and nickel alloys.

Because of the size and complexity of the metal parts that Lincoln Electric 3D prints, an accurate assessment of the dimensions is fundamental to avoid quality consistency issues. Nevertheless, conducting quality control on very large and heavy parts that are still too hot to touch is a challenge that, thus far, can only be achieved with non-contact, portable, and accurate 3D scanning technologies. Therefore, having access to modern quality control to spot defects and deviations directly in production remains essential to the future advancement of additive solutions.

Artificial Intelligence Reimagines Design

The next step is to incorporate artificial intelligence into part design and, thus, discover avenues that have not yet been explored. Since human intelligence approaches design in a very pragmatic way, the correlation between part geometry and its mechanical functions is usually quite direct. Now, however, with the rise of artificial intelligence and its millions of calculations per second, we will be able to create shapes never seen before, with a level of complexity that could not have been imagined by a human alone.

Starting with the attachment points and the various engineering constraints (thermal, stress, or strength) to which the part will be subjected in its environment, artificial intelligence can then simulate the entire network of constraints and obtain, iteratively, an optimized design that minimizes material use and production waste while maintaining performance standards and meeting design goals.

This form of artificial intelligence that leverages the power of machine learning to optimize the entire design-to-make process is called generative design. Increasingly popular with designers, it accelerates the whole design process, enabling companies to get to market faster with designs now perfectly adapted to their applications.

The Future of Making

With this new design know-how, manufacturers are now able to optimize their product durability, eliminate areas of weakness, and select more sustainable materials. They can also explore new design solutions that enable multiple components to be consolidated into solid parts, reducing assembly costs and simplifying the assembly chain. In short, artificial intelligence supplies the power to propel innovation to the front with better quality products designed and built in less time.

Quality Control Follows the Trend and Remains Effective

Although this technological progress is imminent, inspection and counter-validation are realities that will remain on manufacturing companies' agenda. Of course, the machine assumes that it is performing the right task, that it is 3D-printing the part correctly. However, only a fail-proof inspection system can verify the dimensions of 3D-printed parts and confirm their manufacturing quality.

Thus, even if humans gradually transfer some responsibilities to machines, their role in part design and manufacturing is still indispensable to control quality, as they must validate that 3D-printed parts comply with the CAD files. Therefore, even if human error is eliminated, the fact remains that the machine is not perfect. The dimensions and quality of 3D-printed parts must still be controlled rigorously with accurate 3D measuring systems.

For this purpose, Lincoln Electric Additive Solutions turned to Creaform's 3D measurement technology, the MetraSCAN 3D, to generate complete 3D surface models of their 3D-printed metal parts and compare them to the original CAD. This way, the inspection team can quickly verify that each feature adheres to both the original design intent and the expected tolerances.

Automation is also Revolutionizing Manufacturing Quality Control

Automation is also disruptive to quality control. Production floors, where handheld 3D scanning solutions were commonly seen, are now making room for automated quality inspection systems. Made of powerful robot-mounted optical 3D scanners, these robotic cells improve quality in a number of ways: they eliminate human error, improve repeatability and accuracy, enable the creation of more complex parts, and identify errors along the way.

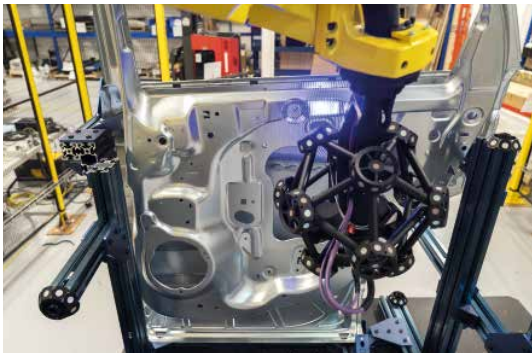
Thus, automation makes part inspection faster and product quality more accurate and repeatable, ensuring that products are produced at the highest quality levels and are able to get to market more efficiently.

Design and Manufacturing are Moving Forward

Robots performing all operations from handling to quality control, algorithms creating the best geometries according to engineering constraints, industrial-grade 3D printers producing all types of parts regardless of their size, complexity, and materials – all of the blocks are already there for companies to build their factory of the future. The challenges imposed by Covid-19 and its impact on the workforce are additional incentives to make this technological and innovative shift. One way or another, the more that companies take the lead, the more their gains in productivity and competitiveness will be worth the investment.

Although machines perform more efficiently compared to human beings and artificial intelligence is capable of learning over time with pre-fed data and past experiences, they cannot learn to think outside the box and, thus, cannot be creative in their approach. Therefore, human genius, creativity, emotional intelligence, and sense of ethics will remain essential components of the factory of the future.

All in all, manufacturing methods will continue to evolve at the same pace that new design means are developed. As long as quality remains imperative, this synergy will unleash possibilities for the creation and production of an infinite number of new parts as yet unseen and unimagined. ■



A robot-mounted optical CMM scanner during quality control of a car door

Lincoln Electric Additive Solutions chose 3D measurement technology from Creaform – more specifically, the Metrascan 3D – to create 3D surface models of its 3D-printed metal parts and compare them to the original CAD.

Robot-guided optical CMM scanner during quality control of a chassis.

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All images: Creaform

With the Wafer Handling Solution, Kuka has developed a mobile robot for transporting wafers between the individual workstations.

Image Processing Secures Wafer Transportation

Mobile Robot using Image Processing Transports Highly Sensitive Wafers in Semiconductor Manufacturing

Until recently, robotics had been used in the individual production steps. Kuka has created a mobile robot that is also responsible for transporting the highly sensitive wafers from station to station. On board the robot is an image processing system from Cognex that is high-performing yet compact in size.

Semiconductors' performance dictates the pace of innovation. This applies just as much to industrial automation as to digital communication via cell phones, laptops, smart building technology, and the automobile industry. And the market is continuing to grow. In 2018, the international semiconductor industry achieved 481 billion dollars in sales revenue and this figure is set to reach 525 billion dollars as early as 2022 according to a study by PwC.

The robotics industry is also taking advantage of this trend, as, for example, the latest generation of controls and controllers offer additional functions. Conversely, however, the innovative capacity of robot manufacturers is also accelerating the efficiency and productivity of microprocessor manufacturers.

For example: Kuka offers a wide range of extremely flexible robots that can also be quickly tailored to a whole variety of handling requirements, as the life cycle of semiconductors is short and the market correspondingly volatile.

Mobile Handling System for Cleanrooms

Using robotics, individual production steps can be automated very well and to a high-quality standard. However, up until now, robots have not been used to transporting semiconductor substrates (wafers) from one workstation to the next. Ideally, semi-conductor manufacturers would prefer end-to-end automation, because pristine cleanroom conditions can be much better achieved with "un-manned production." Until now, however, this aspect of the process was untenable due to the lack of precision with which mobile robots move and grasp.

Kuka has now developed the world's first single-source solution for the automated transport and handling of semiconductor cassettes: the Semi Mobility Solution. In this instance, a lightweight robot from the LBR iiwa series is mounted on a KMR 200 CR autonomous automated guided vehicle (AGV). The AGV can manoeuvre in the smallest of spaces, and the company's engineers have developed a sophisticated gripper system for the handling.

Cognex In-Sight 2000 image processing is responsible for the referencing and millimeter-accurate positioning of the gripper. An integrated LED lighting ensures uniform illumination even in changing ambient conditions.

The sensors combine the performance of image processing systems with the ease and low cost of an industrial sensor.«

System Solution: AGV Plus Robot Arm Plus Gripper

The Semi Mobility Solution goes to a handover point where wafer transport boxes are located. When the AGV has reached its destination, the robot arm is in place to precisely determine its position with the help of an integrated image processing sensor and performs a fine calibration.

This moves the robot into the position to grasp the transport box with a high degree of accuracy and deposit the sensitive wafers without any vibrations in a storage space on the AGV platform. Using this approach, the robot can pick up and transport two different sizes of boxes for wafers with a diameter of 200 or 300 mm. Once it has reached its destination, the robot puts down the transport boxes on the respective processing line.

The Semi Mobility Solution moves around the room on the basis of stored destinations but chooses the route there itself. The navigational capacity of the LBR iiwa platform enables it to move autonomously in a safe and sensitive way. Environment tracking is supported by laser scanners. They perceive the environment in real time, thus preventing collisions.

The safety-oriented environment recognition also creates the preconditions for being able to use the platform as a cobot (collaborative robot) without a safety fence near the operators. The gripping process itself is guided by image processing. Extremely high precision and reliability are essential in this process, because the wafers are sensitive. Vibrations must be avoided.

Image Processing: High-performance in a Compact Space

When selecting the image processing system to guide the robot, the manufacturer's developers chose Cognex's In-Sight 2000 sensors. These sensors combine the performance of image processing systems with the ease and low cost of an industrial sensor. They also offer maximum flexibility when mounting in space-constrained environments. This attribute was highly desired in this application because the IP sensor travels on the robot arm. Minimizing wiring requirements was also a key criterion and the In-Sight 2000 provided easy integration via Ethernet and PoE connections, which was another factor behind the decision.

In addition, Kuka's engineers appreciate the fact that with In-Sight 2000 the logic circuit is integrated into the device and the image processing quite simply lets itself be taught. Ralf Ziegler, Business Development Manager Electronics at Kuka: "The extensive communication possibilities that the sensor offers, its 'built-in' intelligence and the good programmability are also advantageous."

Another advantage for the In-Sight 2000: The In-Sight 2000's patent-pending integrated LED lighting provides uniform illumination over the whole image, regardless of the prevailing lighting conditions. This is particularly important in mobile applications because there is not the same lighting everywhere and even the time of day or the season can affect the image quality.

The gripping process itself is guided by image processing.

In Practice: IP-controlled Fine Positioning over the Last Few Centimeters

In practice, the Semi Mobility Solution first drives the robot gripper up to the transport box. At this point, the image processing is activated. It recognizes the offset from the destination point stored in the control system and on this basis references the position of the gripper, which can subsequently grasp the respective transport box with the required high degree of millimetric precision. An integrated calibration function guarantees consistently accurate positioning.

Kuka has already delivered the first Semi Mobility Solutions to international semiconductor manufacturers. The mobile robots work under cleanroom conditions and are certified in accordance with ISO Class 3 (IPA), UL 1740 and UL 1998. They can also be used in a fleet and, using Cognex's state-of-the-art image processing, grasp the boxes with the highly sensitive wafers both reliably and accurately. This innovative solution marks an important automation step in the microprocessor production chain.

Tried-and-tested Cooperation between Kuka and Cognex

Cognex supported Kuka during the development of the Semi Mobility Solution through the choice of the sensor, as well as providing global end user support. Supplying the In-Sight 2000 for the Semi Mobility Solution is not the first collaboration between the two companies. Cognex's sensor and camera systems are also used in the high-performance "Kuka.VisionTech" solutions for image processing algorithms. For example, they enable reliable quality or completeness checks to be made on components even in unstructured environments.

The robot manufacturer appreciates working with the supplier of industrial vision solutions not only for the high-performance products and solutions but also because of their straightforward collaboration and global presence. Ralf Ziegler: "With our partner Cognex, we can offer our clients and integrators good solutions and comprehensive support all around the world. If spare parts are needed, they can supply our clients and integrators within a very short space of time." ■

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All images: Cognex

Image: Aerotech

Release 2.2 of the Control Platform Automation1

The software developers at Aerotech have realised Automation1, a motion control platform that can integrate the entire periphery. It is intended to gradually replace the previous Aerotech control platforms A3200, Ensemble and Soloist. In Release 2.2, the previous CNC user interface is replaced by the "Machine Apps HMI development tool". The tool can be adapted to the user interfaces for drive systems. PLC-based systems can be integrated with Ether CAT compatibility. For example, Aerotech has extended the options for precise motion processes to PLC systems when they are embedded in a conventional system with lower precision.

"With the release 2.2 of Automation1, it now functions as a complete machine control system", concludes Norbert Ludwig, Managing Director of Aerotech

de.aerotech.com

Image: Automation Technology

3D Sensor Allrounder for the Inspection of Beverage Containers

Automation Technology offers its C5-2040CS 3D compact sensor for the inspection of beverage containers, a sensor that can be used as an all-rounder for bottle and can inspection.

The AT sensor has a resolution of 2,048 measuring points per profile. In this way, a 3D point cloud is determined that detects deviations from the norm. With a speed of 25,000 profiles per second at a viewing width of 100 mm, the sensor can react flexibly to the position of the beverage container on the conveyor belt.

Thanks to the standard interfaces GigE Vision and Geni Cam, the C5-2040CS 3D compact sensor can be integrated into any machine vision system just like all other 3D compact sensors from AT.

www.automationtechnology.de
Vision: Hall 10, Booth F54

Image: Polytec

Weld Seam Inspection with System

Polytec adds the weld seam control systems of the Canadian manufacturer Xiris Automation to its portfolio.

The turnkey systems for pipes and profiles are based on laser triangulation and feature high resolution as well as fast detection and analysis. Welding defects as small as 15 micrometres can thus be detected in real time.

In addition to these control systems, Polytec also offers Xiris cameras for weld monitoring, which allow a clear view of bright welding arcs while simultaneously imaging darker background areas such as the weld pool and weld seam. The HDR cameras were developed for weld monitoring in the visible light and infrared range. High-contrast images in the welding arc and the visualisation of temperatures in the weld pool enable analyses in different welding processes.

www.polytec.de

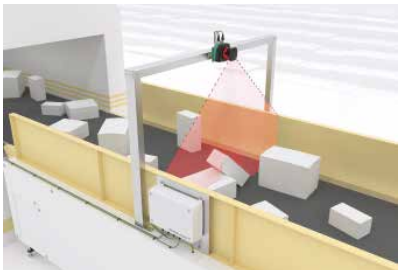


Image: Pepperl+Fuchs

Sensor System Detects Contours and Corrects Shadows

The Contour2D sensor system enables the detection of conveyor belt utilisation with the R2000 Lidar sensor.

In order to evenly distribute parcels on a conveyor belt to downstream stations, the occupancy of the conveyor belt must be recorded. The R2000 Lidar sensor is mounted in the centre of the conveyor belt. Due to the central sensor position, shadows from parcels fall on the conveyor belt, which would falsify the measurement results of the system. However, the interaction between the high angular resolution of the R2000 2D lidar sensor and an intelligent algorithm enables the correction of these shadows. The algorithm as well as the further processing of the raw data of the lidar sensor takes place on the Multi Scan Evaluation Unit (MSEU) of the sensor system.

www.pepperl-fuchs.com

Image: Kitov

CAD-supported Tool for the Automatic Planning of Inspections

Israeli intelligent visual inspection company Kitov.ai has simplified the setup of robotic vision inspection systems with CAD2SCAN, a CAD-based tool for automatic inspection planning.

CAD2SCAN is a CAD-based tool for automated inspection planning and a new feature of Kitov Smart Planner. By combining CAD2SCAN with Kitov's Smart Visual Inspection and Review Station, users can automate inspection solutions that are too difficult and time-consuming to programme and deploy manually. The semantic information extracted from the CAD is passed to Kitov's semantic detectors. Automated CAD-based inspection planning is suitable for industries that manufacture complex parts and products, such as inspecting parts made from a single material with complex 3D geometric shapes, or CNC parts.

www.kitov.ai

Image: Contrinex

Photoelectric Sensors for Hygiene-critical Applications

Contrinex is expanding its range of photoelectric sensors with M12M and M18M devices in metal housings. The sensors are equipped with ASIC technology and an IO-Link interface. Due to their robustness, they are particularly suitable for hygiene-critical applications.

Due to Ecolab approval, process engineers in the food and beverage sector use the M18P Optos. The M12M and M18M devices offer the same sensing ranges and resistance to washdown and process fluids, and also bring additional robustness to environments where mechanical shock and excessive vibration occur.With chrome-plated brass housings (M12M) and stainless steel housings (M18M), each with shatterproof PMMA optics, the sensors are suitable for the harshest environments.

www.contrinex.de

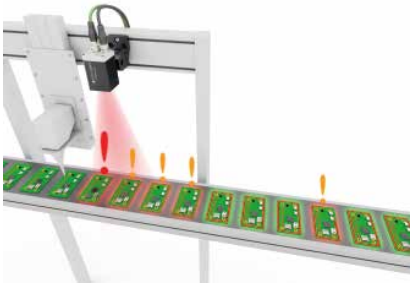


Image: Sensopart

Software Update for Testing Sensors

The sensors of the Visor series enable complex linking of detection results. The extended possibilities of result processing are part of a software upgrade.

The new "Result Processing" detector allows links to results of previous executions or other jobs. This makes it possible to detect changes and trends over a longer period of time.

The ability to save results as "static variables" and use them for follow-up processes and statistical evaluations expands the range of applications for vision sensors. The Visor can now detect subsequent faults and transmit a signal to the control system after a defined number of faults. In addition, the PLC programming effort can be reduced in many applications, as the evaluations can be carried out directly on the sensor.

www.sensopart.de

Image: Viscom

Automatic Inline X-ray Inspection Systems for Printed Circuit Boards

Viscom presents several systems for quality assurance. Among them the inspection series iX7059 systems for fully automatic inline X-ray inspection.

The iX7059 inspection series includes fully automated inline X-ray inspection systems. The 3D-AXI system iX7059 PCB Inspection XL inspects long PCBs. The D-AXI/3D-AOI combination system X7056-II and the 3D-MXI system X8011-III have various automation and documentation options as a deployable offline team player. Finally, the S3088 ultra gold system is characterised by 3D solder paste inspection with its possibilities of most precise measurement and closed-loop communication.

www.viscom.de

Image: Atecare

Expanded Portfolio of X-ray Inspection Systems

As a sales partner of the Korean machine manufacturer SEC, Atecare has new generations of further 2D, 2.5 D and 3D (CT) X-ray inspection systems in its range. In the field of quality monitoring of vehicle batteries, the systems from SEC also offer a wide range of X-ray inspection options.

The X-ray inspection systems of the SEC-X-eye series offered as offline and inline systems are equipped with different detectors and tubes. They have movable X, Y and Z axes and are offered with different table sizes and transport systems. Furthermore, different CT technologies can be used for analyses. The X-ray inspection systems inspect SMT, PCB, PKG, LED, sensors, BGA and QFN or, as NANO-Focus systems, can also handle IC structures.

www.atecare.de
Vision: Hall 10, Booth B87

Image: Bicker Elektronik

Complete Solution for Industrial Applications

Bicker Elektronik offers coordinated Power+ Board bundles consisting of power supply, mainboard and accessories in industrial quality.

The Kontron K3841-Q µATX mainboard for the 12th generation Intel Core processors ("Alder Lake") can be used in combination with the Bicker BEA-550K industrial PC power supply and suitable system components to create industrial PC systems. The fields of application are industrial automation, robotics, vision, inspection and surface analysis.

The high-end IPC power supply unit BEA-550K complies with the 80PLUS Platinum specification. The 500W switched-mode power supply is used wherever industrial PC systems have to operate in 24/7 continuous operation, even under interference conditions.

www.bicker.de

Image: Instrument Systems

Inspection of IR Emitters in the Far-field Range

The VTC 2400 from Instrument Systems is a high-resolution infrared camera designed for 2-D far-field analysis of the radiant intensity distribution of VCSELs and IR emitters.

The system consists of a translucent, diffusely scattering screen and a monochrome camera specialised in near-infrared measurements. Visualising the radiation characteristics of the radiation source on an additional screen makes the setup flexible. The traceable calibration of the VTC 2400 also guarantees a minimal error budget. Basic measurement parameters such as the distance to the DUT, the angular field of view or the angular resolution can be adjusted for your own application. This enables reconstruction of the beam intensity distribution and identification of the intensity maximum (hot spot), as required for laser safety evaluation, for example.

www.instrumentsystems.com

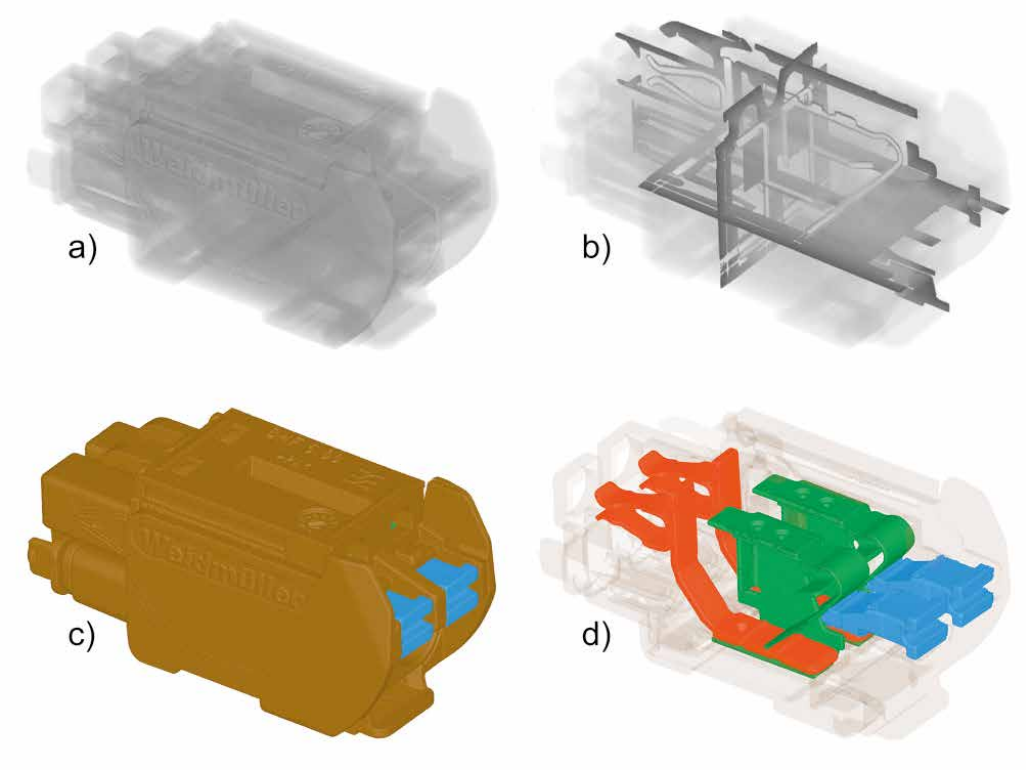
Image: IBS Quality

Mobile Cobot Inspection System

With the PAM system (Portable Automated Measurement System) IBS Quality presents a transportable scanning, measuring and inspection solution.

PAM's bundle includes all hardware, including fixtures for attaching sensors to the robot, software, installation, service and support. In addition to Verisurf software, 11 Dynamics robotics automation and a choice of 3D laser scanner brands or other scanner technologies are used. Cobots (collaborative robots) use PAM to complete repetitive user routines. The entire solution is housed in a specially designed inspection cart. The PAM system is used especially for first article and series inspection as well as reverse engineering and prototyping. The integrated Verisurf, 3D scanning and inspection application is based on a CAD platform and anchored in model-based definition (MBD).

www.ibs-quality.de



Volume of a connector a), volume sections b), point cloud of the plastic enclosure c) and point clouds for the different metal components d)

At the Push of a Button

Separate Point Clouds for Multi-material Workpieces Made Easy

Winwerth Multimaterialscan enables the automatic, sub-voxel accurate calculation of separate STL point clouds per material. A typical application is, for example, workpieces with plastic and metal components.

Conventional algorithms allow an automatic and sufficiently accurate determination of surface points without prior information about the workpiece (for example CAD model or STL point cloud of a master part) only for measuring objects made of one material. With the new Winwerth Multimaterialscan from Werth Messtechnik, a separate measurement point cloud is now automatically calculated for each material, even for measurement objects consisting of several materials that attenuate very differently. Typical applications include plastic-molded assemblies such as connectors or pump heads with corresponding integrated metallic components.

The materials to be considered by the algorithm can be defined by the operator by simply setting measurement windows in the volume section. The gray values contained in the measurement windows are automatically assigned to the respective material. This assignment can be checked and, if necessary, adjusted using a preview with colored marking of the materials.

Result of Comprehensive Experience

From capture of radiographic images, to workpiece surface capture with subvoxel precision, to output of the dimensions in a report, traceability of the results is guaranteed with Winwerth measuring software. Optical distance sensors, conventional styluses in single-point or scanning mode, the Werth Fiber Probe, X-ray computed tomography or machines with a combination of several sensors are all supported by the uniform concept. Measurement results in the form of measurement points, 2D images or volume data can also be conveniently evaluated with regard to geometrical characteristics or with nominal-actual comparison. In order to meet the most diverse requirements, the software has a modular structure. Different machines can be operated, from simple measuring projectors to complex multi-axis coordinate measuring machines with multi-sensor systems or even with X-ray tomography sensors.

Modern coordinate measuring machines cover a wide range of differently complex tasks. The qualifications of the machine operators range from employees with little training, who only occasionally determine a few Sizes, to specialists who, exploiting all technically feasible options, also handle very difficult measuring tasks. The very different working methods are optimally supported by the structure of the Winwerth software for machine operation. For example, there are several access levels that are adapted to the different qualification levels of the operators. Interfaces to CAD systems for target data import and to CAQ systems for statistical evaluation enable the adapted integration of the coordinate measuring machines into software structures of companies.

Integrated into the Production Process

For users untrained in the operation of measuring machines, WinWerth offers the possibility of simply selecting the part number and starting an automatic program sequence with it. Alternatively, this can be done by scanning a barcode on the production order. An automatic fault handling function helps, for example, if the parts are not inserted correctly.

Alternatively, a workpiece changing system (utility model) can be integrated into the housing of the Tomoscope coordinate measuring machines without further precautions for radiation protection. With several ready-loaded pallets, measurements are possible overnight and at weekends. Automatic feeding by means of feeding devices can also be integrated. ■

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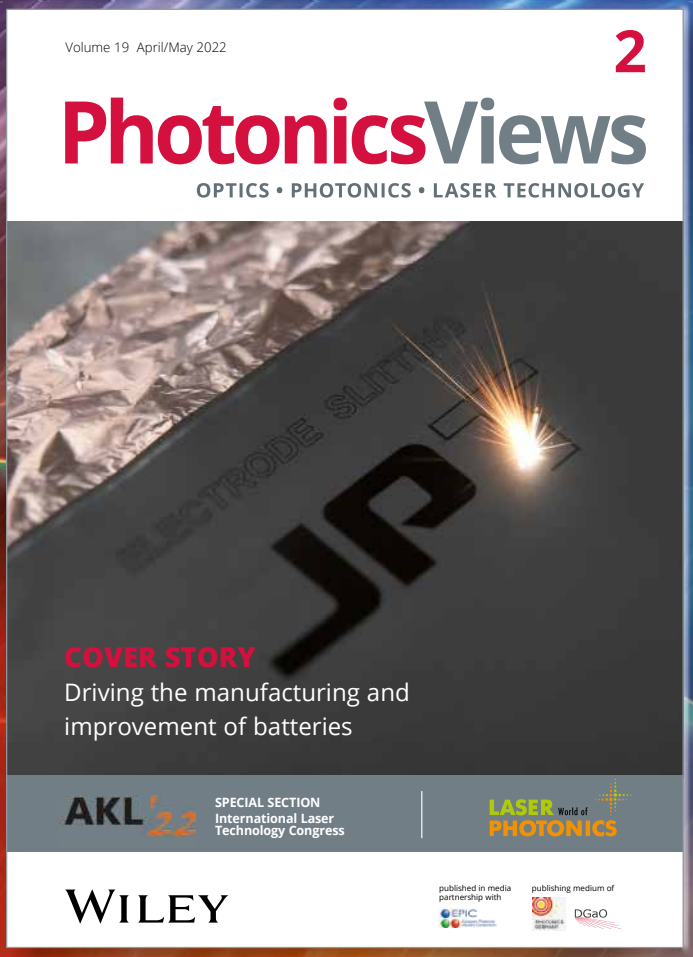
Image: Werth Messtechnik

Light at Work: PhotonicsViews



The European industry magazine for optics, photonics, and laser technology

- 6 issues a year
- reports on optical systems and components
- research and development
- application reports and business news

Daily industry, research news, and magazine information at
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WILEY

PhotonicsViews.com

Image: Ametek

High-performance Scanner with Blue Laser Technology

Creaform, a business unit of Ametek, expands the Handyscan Scan 3D Silver series with two more high-performance scanners, Handyscan Scan 307 Elite and Handyscan Scan 700 Elite.

The handheld scanners with blue laser technology have high data capture on parts with complex and shiny surfaces and a resolution and accuracy of up to 0.030 mm. In addition, they have been improved by VX-elements software algorithms. 3D measurements on parts of varying complexity and size have also been revised. All Silver Series 3D scanners are designed and manufactured in North America.

www.ametek.de

Image: Lucid Vision

Arenaview with Jupyterlab support

Lucid adds Jupyterlab development environment to Arenaview for testing, validating and prototyping camera features and system performance

Jupyterlab is the web-based, interactive development environment for notebooks, code and data. Its interface allows users to configure and arrange workflows in data science, scientific computing, computational journalism and machine learning.

Jupyterlab in Arenaview provides an integrated and pre-configured interactive development environment that can be used to test and validate a camera's features and performance. This allows application developers to accelerate their product qualification workflow without having to set up a custom development environment.

www.thinklucid.com
Vision: Hall 10, Booth D41

Image: Micro-Epsilon

Fibre Optic Sensors for Automated Production Processes

The optoelectronic fibre optic sensors Optocontrol CLS1000 are used for position controls as well as for position and presence detection.

Due to the high luminous intensity and resolution, values of up to 2000 mm are achieved for the scanning range. Five different controller versions with many output and trigger functions are available, allowing the measuring system to be adapted to the respective measuring task.

The Optocontrol CLS1000 series offers fibre optic sensors in combination with a powerful CLS1000 controller. This enables precise presence checks as well as position and attitude determination. Commissioning is carried out via the controller's OLED display and teach-in modes.

www.micro-epsilon.de
Vision: Hall 10, Booth C30

Image: Polytec

Vibrometer To Go

The Vibro Go is a vibration measuring device specially developed for mobile use.

Vibration data can be recorded for several hours and can be evaluated directly on the device with the on-board data analysis. The system allows non-contact measurement of dynamics and acoustics based on vibration displacements, velocities and accelerations of any object in the frequency range up to 320 kHz at distances up to 30 m and velocities up to 6 m/s. Vibro Go also has a 5-inch colour touch screen with menu navigation. Furthermore, Vibro Go has a 5-inch colour touch screen with menu guidance.The spectrum of applications ranges from condition monitoring of technical systems to insect research or structural analysis of spider webs.

www.polytec.de

Image: Gefra

Modular System for Optical Quality Assurance

The manufacturer and developer of the Optisort testing and sorting machines produces individual solutions based on its own machine construction kit.

Several machines have been produced based on this platform. They are identical to each other so that test plans and machine data can be copied between them.

The basis is the construction of the glass plate machine, equipped with various camera stations. One top and one side camera each with backlight for dimensional inspection, one borehole camera each from above and from below and one brightfield incident light camera each from above and below.

Gefra offers two machine base types: Optisort ST and Optisort W. The former is designed with a steel ring plate and is suitable for inspecting fasteners, screws, blind rivets and long rod-shaped parts.

www.gefragmbh.de

Image: Flir

Software Speeds up Inspections and Reporting in Thermal Imaging

Inspection specialist PFE Limited uses Flir Thermal Studio thermal imaging software to inspect industrial processes. PFE Limited uses thermal imaging for mechanical and electrical inspections and testing of industrial processes. For furnace inspections, the company uses a handheld camera from the Flir Exx series.

The Flir Route Creator plug-in allows preplanned routes for inspections to be created in Flir Thermal Studio. The routes can be downloaded to any Flir thermal imaging camera equipped with the Flir Inspection Route software and are executed directly on the camera. This ensures that no assets or inspection areas are missed. For reporting and analysis, the Route Creator generates a file in which the images are already automatically assigned to the respective object.

www.flir.com
Vision: Hall 8, Booth B10

Image: Zeiss

More Efficient Quality Control Through Measurement Software

Users now have access to the universal measuring software Zeiss Calypso 2022 with a focus on ruled geometry

With the product information (PMI) integrated in the CAD data, measurement programmes can be created automatically. With the revised release, separate or combined tolerance zones are recognised and the corresponding evaluation is created automatically. If defective geometry elements are attached to a PMI in the CAD model, the revised release automatically creates the inspection characteristic without measuring element and generates an inspection plan. The user can then analyse possible indications in the work log.

www.zeiss.de

Image: Hikmicro

Thermal Imaging Camera in a Compact Mobile Phone Format

The compact and powerful Pocket2 thermal imaging camera from Hikmicro is just as suitable for electrical inspections as for the construction, HVAC and HVAC sectors. It features a high-resolution 256x192 pixel fixed-focus vox detector (field of view/FOV 50° × 37.2°, HxV). In addition to this infrared detector, the Pocket2 is equipped with an 8 megapixel optical camera and an LED light. With the 3.5 inch touch screen and the intuitive menu, users can work quickly and efficiently. The measurement accuracy is +/- 2 percent or 2°C over the entire temperature range from -20 to 400°C with a good NETD < 40 mK (at 25 °C).

www.hikmicrotech.com

Image: EBE

Non-contact Level Measurement of Solids

EBE sensors + motion has so far covered the detection of liquids with a wide variety of consistencies. EBE is now expanding the product portfolio with sensors based on 2D ToF technology and thus also offers contactless level monitoring of solids. This technology can be used to monitor and measure a wide variety of media with a wide variety of surface shapes. Whether it is bulk goods or solids, the sensor technology reliably detects the media and delivers exact measured values of the level.

www.ebe.de

Image: Innovmetric

Open 3D Measurement Technology for Testing Multiple Parts

Innovmetric introduces the updated version of its smart digital ecosystem for 3D metrology, Polyworks 2022.

The 3D metrology platform now facilitates inspection of multiple parts when CAD data is not available and also introduces a universal data hub. Through the use of global metadata management strategies and alert programming, digital connectivity between data and people is improved as incorrect inspection dimensions are automatically detected and the right people are notified in real time. Mixed reality display technology improves collaboration between operators and their measurement hardware. Polyworks 2022 is an open solutions and releases an API to query data from its data management solution and integrate it with third-party software applications.

Metrology quality assurance

www.duwe-3d.de

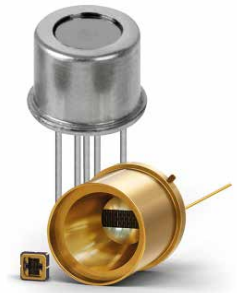

Image: Laser Components

Pyroelectric Detector and Emitter Matched to each other

With the 55+ series, Laser Components is opening up new areas of application for IR technology. The components are matched to one another in such a way that they deliver the best results at wavelengths between 5 and 10 µm. This part of the infrared spectrum is still little used for analytical purposes. The pyroelectric detectors in "Differential Mode" are based on a patented technology of the group of companies. As a result, they achieve a good signal-to-noise ratio and can play to their strengths particularly well in the wavelength range beyond 5 µm.

www.lasercomponents.com

Image: Telemeter

Record Temperature without Contact

An infrared sensor converts thermal radiation into a voltage signal. For this reason, IR sensors are used in numerous applications for non-contact temperature measurement. Telemeter has them on offer. In order to determine the optimal sensor for the customer, three parameters are essential: temperature range, field of view and filter. The temperature range determines the scaling, the field of view determines the area that is to be recorded and the filter reduces the irrelevant wavelengths in order to emphasize the actual measurement signal. Infrared sensors are available from Telemeter Elektronik in the digital or analog versions in the TO5 and TO18 designs. Their temperature range is between 0 and 100 °C.

www.telemeter.info

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