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Reset

While we do not know how far and for how long the Corona virus will have an impact on our everyday lives, research company IBIS World has undertaken studies of its effects on the industry in several countries such as the US, Canada, the UK, Australia, and Germany. What they found out sounds reasonable: Despite a large number of industries that – on top of a previously predicted recession – are expecting a decline in orders, like mechanical engineering, there are also opportunities for growth, for example for manufacturers of cleaning products and for pharmacies/drugstores.

Whether or not the virus may have a negative effect on the industry's economic development, in any case, machine vision has helped to conquer the pandemic quite a bit. In a confirmed study chest CT outperformed lab testing in the diagnosis of the disease. Recent research found that the sensitivity of CT for Covid-19 infection was 98 percent compared to blood testing, so-called RT-PCR with a sensitivity of 71 percent. Imaging clearly is a powerful tool, not only in the medical industry.

Let us hope that the inevitable recession will turn out to be milder than expected, and that things will be back to 'normal' soon. Meanwhile, one thing remains certain: machine vision will not stop to evolve, and the market players still have great news to share. For example, there is Basler who produce cameras for splash and product contact zones that help protect against steam and bacteria. CCS ensures that complex machine vision applications benefit from proper lighting, and Teledyne Photometrics offers array-based detectors such as the EMCCD and sCMOS cameras that ensure cells and bacteria can be seen properly.

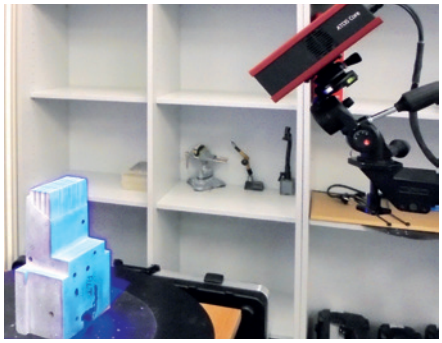
» **Machine vision will not stop to evolve, and the market players still have great news to share«**

Was it time for a reset? If so, the machine vision industry will definitely be back stronger than ever.

At inspect we are and will be here for you. Stay safe!

Yours,

Sonja Schleif



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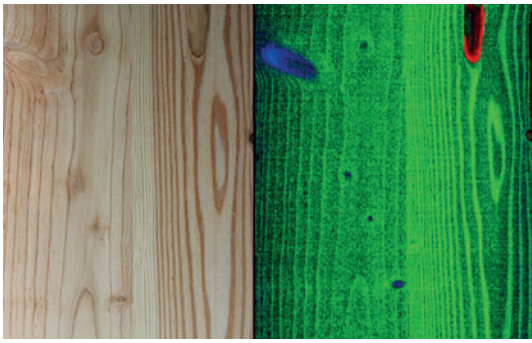

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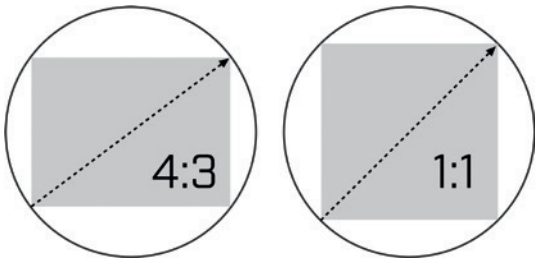
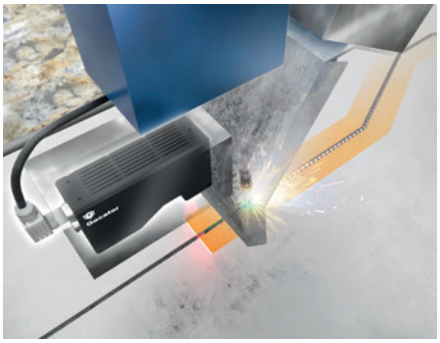




Future

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

News

Schneider-Kreuznach introduces new managing director

Dr.-Ing. Wolfgang Ullrich took over the management of Jos. Schneider Optische Werke GmbH. He succeeds Dr. Thomas Kessler, whose contract expired on December 31, 2019. In the meantime, the group of companies was managed by interim managing director Heiko Kober (CFO) as well as authorized officers Dirk Christian and Frank Jocham.

Dr.-Ing. Wolfgang Ullrich worked for a Jenoptik AG company from 1999 to 2008, initially as Head of R&D and later as Managing Director (CEO). In 2008 he moved to Grenzebach Algoscan as Managing Director (CEO). From 2013 he was Business Division Manager at Sturm Maschinen- & Anlagenbau.

www.schneiderkreuznach.com

Alysium-Tech Further Expands Sales Team

Daniel Kästner (picture above) and Pierre Seignol joined Alysium in the roles of Key Account Managers in January 2020, strengthening the sales team.

Kästners technical competence and experience in machine vision markets and Seignol´s experience in the automotive industry, supporting technically demanding projects, will expand the company´s abilities to provide the best customer support. This involves clearly understanding the requirements to ensure that the interconnect products continue to provide a competitive advantage to customers. Daniel Kästner will be supporting customers in Central Europe, Pierre Seignol will be supporting Key Accounts predominantly in Central Europe. **www.alysium.com**

Stemmer Imaging gains COO and loses CTO

The Supervisory Board of Stemmer Imaging appointed Uwe Kemm as Chief Operations Officer (COO) with effect from April 1, 2020. In this position he will be responsible for the implementation of the corporate strategy in addition to operational organizational units.
At the same time, Martin Kersting (CTO) resigned from the Management Board for personal reasons on March 31, 2020, leaving the company. However, he will continue to support Stemmer in an advisory capacity. The Management Board of Stemmer AG thus continues to consist of two members: In addition to new member Klemm, the CEO is Arne Dehn, who has held this position since March 2019.

www.stemmer-imaging.de

Basler announces financial figures for 2019: Sales and orders above 2018

Basler has presented the audited financial statements for 2019. In a declining market environment in 2019, consolidated sales continued to grow at a high level and amounted to 162.0 million Euro (previous year: 150.0 million Euro). At 166.5 million Euro, incoming orders also exceeded the previous year's figure of 154.0 million Euro. The pre-tax result fell to Euro 16.9 million (previous year: Euro 24.5 million, -31 %), in particular due to planned strategic investments in the form of personnel expansion. The return before taxes thus totaled 10.4 % (previous year: 16.3 %).

With these results Basler meets the forecast communicated to the capital market. Free cash flow as the sum of cash flow from operating activities and cash flow from investments reached a value of -9.7 million Euro (previous year: 1.3 million Euro). This was extraordinarily burdened by the acquisition of MVLZ Sanbao Xingye in 2019.

www.basler.com

Hannover Messe cancelled for 2020

The Hannover Messe was first postponed and is now cancelled for 2020. It is the first time in the 73-year history of the fair that the event is not being held. As a replacement, a digital offer is to replace the exhibition stands on site. The next Hannover Messe is then to take place in 2021 from 12 to 16 April 2021. **www.messe.de**

Automatica postponed to December

Due to the increasing worldwide spread of the corona virus (SARS-CoV-2) and on the basis of the recommendation of the Federal Government and the Bavarian State Government, Messe München has decided to postpone Automatica 2020. This step is carried out in coordination with the VDMA Robotics + Automation Association as the ideal sponsor and responsible for the health of exhibitors and visitors.

Automatica 2020 will now take place from December 8th to 11th, 2020.

Jenoptik grows in fiscal year 2019 despite difficult market situation

Following Jenoptik's publication of the preliminary figures for the 2019 fiscal year in February, the official figures are now being submitted: At 855.2 million euros sales were up 2.5 percent on the previous year. The momentum increased in the course of the year, with the fourth quarter, as expected, being the strongest in terms of sales at 259.5 million euros (plus 7.6 percent compared with the previous year). The greatest growth impetus came from the Light & Optics and Light & Production divisions. The solid business development was driven in particular by the high demand from the semiconductor industry and the good business development in the Automation & Integration segment. The companies acquired in 2018 - Prodomax and the Otto Group - contributed 66.4 million euros to revenue in the past financial year (previous year: 37.0 million euros).

Despite higher costs and expenses, EBITDA in 2019 rose by 5 percent to 134 million euros (5.1 percent more than in the previous year). This is mainly due to the contributions of the acquired companies and positive effects from the first-time application of the international accounting standard IFRS 16.

www.jenoptik.com

Allied Vision expands management

The german camera manufacturer Allied Vision, a member of the TKH Group, is adding a third position to the management team. In addition to Andreas Gerk and Peter Tix, the Chief Commercial Officer of SVS-Vistek, Henrik Ilsby, is now part of Allied Vision's top management team. SVS-Vistek has also been part of TKH since last fall, which is why Ilsby will keep his job there.

With this new addition, Allied Vision is reorganizing the responsibilities in the management: Andreas Gerk is responsible for the Product Portfolio, R&D, and Operations divisions. Peter Tix will be the new CEO and will be responsible for the Sales, Business and Finance divisions. Henrik Ilsby, as Chief Commercial Officer, will lead the worldwide internal and external sales force. Tix is also CEO of TKH Vision 2D Group.

www.alliedvision.com

Keyence Germany appoints new managing director

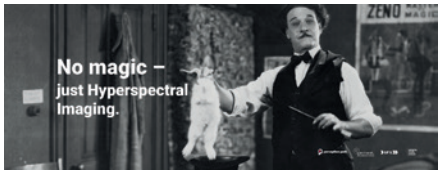
Keyence has appointed Andreas Wörz as Managing Director of its German subsidiary Keyence Deutschland with effect from 1 March 2020. Wörz was previously sales manager for the product groups machine vision and inline measurement technology.

www.keyence.de

Jenoptik takes over Japanese subsidiary completely

Jenoptik takes over the outstanding 33.42 percent of the shares in Jenoptik Japan Co. Ltd. from its joint venture partner Kantum Ushikata. Jenoptik Japan thus becomes a wholly owned subsidiary of the Group. The parties have agreed not to disclose the purchase price. Jenoptik regards Japan as a strategically important market and intends to invest in particular in local sales in the future. Jenoptik Japan, based in Yokohama, employs ten people and generates sales in the single-digit million euro range. The company was founded in 2005 as a joint venture between Kantum and Jenoptik. The portfolio includes photonic components, systems and equipment from Jenoptik. In addition to diode lasers, this includes laser systems, optics and industrial measurement technology.

www.jenoptik.com



Chii 2020 postponed to October

The postponement and cancellation of events due to the coronavirus continues. Now the organizers of the Conference on Hyperspectral Imaging in Industry (chii) in Graz, Austria, have decided to postpone the conference planned for this May to October, more precisely to 28 and 29 October, 2020.

www.chii2020.com

Control 2020 cancelled

The organizer P.E. Schall cancels Control for 2020. The reason for this is the corona crisis. Actually, the trade fair should have taken place from 5 to 8 May in the halls of the Stuttgart Exhibition Centre. Control 2021 begins on 4 May and ends on 7 in Stuttgart.

www.schall-messen.de

Vision Engineering opens Tech and Training Center in USA

Vision Engineering opened a new technology collaboration and training facility in Irvine, California, south of Los Angeles, LA. The new Vision Engineering Tech Center serves as a venue for supporting training and demonstration events, both online and offline.
The new facility will serve as a hub for collaboration with business partners from a range of high-tech organizations to develop products and assemblies for a range of technology markets. The facility will provide 2,700 square feet of collaboration and demonstration space equipped with Vision Engineering products and components. These include the new Deep Reality Viewer (DRV) microscope, the world's first ultra-high resolution microscope Spectacle-free 3D stereo viewing system. The Tech Center is equipped with 5G to allow Vision Engineering to view existing communication functions between sites in real time.

www.visioneng.de

Successors and predecessors at the top of the company: Daniel Scholz-Stein (left) and Norbert Stein (Source: Vitronic)

Vitronic: Generation change in the management

On the occasion of the 35th anniversary of his company Vitronic, the founder Norbert Stein takes the opportunity to carry out the generational change at the top of the company: Daniel Scholz-Stein will take over his position as CEO with immediate effect.

Scholz-Stein has been active in his previous professional career as manager and sales director and has experience in the automotive and image processing industry. He has special expertise in the areas of sales, market launch strategies, international business growth, marketing and building strategic partnerships.

In addition to the new addition of Scholz-Stein as CEO, the Vitronic management team includes Heiko Frohn, Chief Technology Officer; Matthias Pörner, Chief Financial Officer, as well as Norbert Stein, Gerhard Bär, and Reinhard Koy-Oberthür. **www.vitronic.de**

European Machine Vision Forum: Call for papers has begun

The European Machine Vision Association EMVA calls on researchers and developers to contribute to the 5th European Machine Vision Forum. All interested parties can submit their research results and product developments in the form of a summary to be presented as talk or poster at the event. This year's European Machine Vision Forum will take place on September 10th and 11th in Cork, Ireland. It was initiated by EMVA in 2016 and aims to bring together machine vision and academic research.
Those who wish to submit their abstract can do so until 8 May 2020 via the online tool of the European Machine Vision Forum. All submissions will be reviewed by the joint scientific and industrial advisory board of the Forum and all those who have submitted a paper.

www.emva.de

©Balluff

Frank Paul Nonnenmann (left) has been managing the company together with the previous managing directors Katrin Stegmaier-Hermle since 1 February 2020.

New managing director at Balluff

Frank Paul Nonnenmann has replaced Michael Unger as managing director at Balluff. After more than 28 years with the company and 20 years as managing director, Unger joins the advisory board of the Neuhaus-based family business. Like Unger, his successor is also responsible for setting up the global production and logistics network and the Machine & Plant Engineering (MPE) division. Unger's function as spokesperson of the management board is taken over by managing director Katrin Stegmaier-Hermle.

www.balluff.de

Cognex Names Paul Todgham as Chief Financial Officer

Cognex announced the appointment of Paul Todgham as Senior Vice President of Finance and Chief Financial Officer, effective March 9, 2020. In this role Todgham will lead Cognex's global finance and administration organization. He will be based in the company's Natick headquarters and will report to Cognex's President and CEO, Robert J. Willett. Most recently, Todgham spent six years at Levi Strauss & Company, where he served in a range of senior leadership positions, including leading finance for the company's Global Supply Chain, Distribution, Merchandising, Planning, Design and Marketing teams. Prior to his time at LS&Co., Mr. Todgham was Vice President of Finance for Ross Stores, where he led FP&A, Treasury and merchandise finance. Earlier in his career, he worked at Boston Consulting Group, advising clients in the technology and consumer sectors on issues of strategy, operations and organization. Mr. Todgham holds an MBA from Stanford University, an MPhil in Economics from the University of Cambridge, and a BA from Harvard University.

www.cognex.de

Machine vision business of Tattile merged with Chromasens

After the acquisition of Lakesight Technologies by TKH last year the investor now starts to merge the different companies. With effect from 1 March 2020 Machine Vision Business unit of Tattile will be part of Chromasens, which is part of Lakesight since 2017. Chromasens takes over business responsibilities of existing customers, portfolio and new products from Tattile MV and extends this to global range, keeping all the existing products family of Tattile MV and guaranteeing the new products roadmap. Tattile keeps focussing on Mobility business unit.

Due to importance of the Italian market and the fast growth in the Machine Vison Market Lakesight founds the subsidiary Lakesight Italy which will be located at the Tattile headquarters in Mairano, Italy.

www.chromasens.de

How Easy to Use Is Machine Vision Really?

During the trade show SPS 2019, five experts discussed the question of how simple machine vision really is in a panel discussion which was organized by VDMA Machine Vision.

Machine Vision has become an indispensable part of manufacturing. Constantly striving for quality, efficiency, and product safety, it has become the key technology in automation worldwide. However, the enormous potential of machine vision is far from being completely exploited. It must become even easier for the user to integrate and use the technology if its potential is to be fully exploited.

In numerous application fields, image processing technology has established itself as a powerful, economical method of checking the quality characteristics of products. In particular, the increasing efforts around Industry 4.0 have given a significant boost to the acceptance of this technology: Automation engineers have become fully aware of its potential, know about the advantages of "seeing machines" and want to exploit the promising possibilities of image processing more and more.

However, in the opinion of many experts, the use of machine vision is still not intuitive enough, as Rainer Schönhaar from the machine vision team at Balluff explains: "In the past, three people were needed to implement systems with machine vision components: one for system planning, another for the control technology and a third for machine vision. The communication between these 'worlds' must become easier in order to increase the user acceptance of image processing."

Andreas Waldl, Integrated Vision Product Manager at B&R, totally agrees with this statement: "Nobody is willing to invest a lot of time for communication between the automation and vision areas any longer. The integration of image processing in automation systems must be as easy as possible in order to provide economical solutions."

Standards as Key to Success

Klaus-Henning Noffz, Director for New Business Development at Basler, considers the communication standard OPC-UA (Open Platform Communication Unified Architecture) to be key to the continued success of machine vision in automation. There are already companion specifications for robotics and machine vision available, which define the communication between these two important sectors for automation. "The willingness of the industry to develop OPC-UA together and thus establish widely accepted standards for vision hardware and software was a very important step for the successful merging of automation and machine vision."

Peter Keppler, Director Corporate Sales at Stemmer Imaging, also confirms that OPC-UA makes the connection between these two areas much closer and increases acceptance by the user: "This standard definitely helps to create new possibilities, for example in the coupling of machine vision and robotics". As an example, Keppler cites the innovative sector of "Cobots", robots working losely with human co-workers. "Here, machine vision plays an important role in safely eliminating

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OPC-UA makes the connection between automation and machine vision much closer and increases acceptance by the user.«

Dr. Klaus-Henning Noffz, Director of New Business Development at Basler and Chairman of the VDMA Machine Vision Department: "The OPC-UA communication standard helps to bring automation and image processing together."

accidents or incidents between humans and machines. For absolutely reliable processes, it is necessary to acquire a large amount of image data, process it quickly and exchange the results between the systems involved without delay. OPC-UA offers the necessary tools for this and many other applications."

Christian Vollrath, head of Computer Vision at wenglor sensoric, also mentions the VDI/VDE/VDMA series of guidelines 2632 as a valuable tool for reducing communication difficulties between automation and machine vision systems: "You have to speak the same language and be able to name problems that occur in reality in the same way in order to find solutions. This international standard for image processing, available in several languages, defines the necessary terminology and simplifies the successful use of specifications."

Potential for Improvements

Standards are an important aspect to make it easier for automation engineers to use machine vision. However, the use of the technology will not become child's play in the foreseeable future, opines Peter Keppler: "A machine vision system consists of many components. From lighting, optics and camera to software – all elements must be optimally matched in order to reliably solve a specific task. Without a certain amount of expertise, it is therefore usually not easy to make the optimal selection. This applies equally to intelligent cameras and PC systems." Moreover, in Keppler's opinion, attempts have been made for years to find a standard, all-in-one solution that can solve any task, allows all communication options and offers the greatest possible flexibility, but is still easy to operate. "I think we will see a major change here towards special subsystems that can be used to solve specific tasks. As a side effect, this will lead to more intuition, because you no longer try to beat all possibilities with one system."

The industry is working hard on ways to make life easier for machine vision users. Many experts are hoping for considerable simplifications through the use of machine learning and deep learning methods. These innovative techniques should significantly accelerate the time-consuming learning of good and bad parts and thus relieve the user. However, the experts warn that they are not self-explanatory: On the one hand, the images required for teaching objects must be available or procured in sufficient number and quality, and on the other hand, the user must be clear exactly how and for what purpose he is applying such methods.

Control manufacturers are facilitating the use of image processing. For example, B&R offers its own vision system that is completely integrated into the control system. "This makes life easier for the user because he can use the operating environment that he is familiar with and now also finds options for image processing there," says Andreas Waldl. According to him, the willingness of users to test and use the image processing offered in this way has been increasing quickly for some time.

Intuitive user interfaces for the software are also important for the easier use of machine vision systems. According to the unanimous opinion of the discussion participants, there is still considerable potential for improvement here. "It is important for the user that he can quickly reach his goal in a simple way," says Rainer Schönhaar. "Which algorithms are used for this in detail is less important for him. The software must therefore be easy to use."

Increased Intuition

Christian Vollrath also sees great potential for making machine vision more intuitive during the image acquisition process: "If you want to detect scratches on a surface, for example, you need to know exactly what type of illumination is best suited for this purpose. Intelligent systems that suggest the most suitable lighting, optics and camera models to the user on the basis of the existing conditions are currently still utopian. Users are therefore well advised to expand their know-how, for example by attending suitable trainings."

"Machine vision has now established itself as an excellent tool for inspection tasks of all kinds. We have now reached a point where the aspect of how to make machine vision simpler is becoming more and more important," summarizes Klaus-Henning Noffz. "Machine vision has a certain level of complexity due to the multitude of possibilities, and it remains an important task for manufacturers to make its use as easy as possible for the end-users."

Participants of the panel discussion were Peter Keppler, Director Corporate Sales at Stemmer Imaging, Dr. Klaus-Henning Noffz, Director New Business Development at Basler, Rainer Schönhaar, Product Management Machine Vision at Balluff, Christian Vollrath, Head of Computer Vision at Wenglor Sensoric, and Andreas Waldl, Integrated Vision Product Manager at B&R. ■

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Machine Vision Industry Today and Tomorrow

Market Developments and Trends Relating to Vision 2020

The machine vision industry can look back on a phase of strong growth. The future also promises brilliant business. One reason for this is that more and more user industries are recognizing the benefits of machine vision for their processes – not least in connection with industry 4.0. This development will also be reflected in the Vision 2020 trade fair.

Machine vision is conquering an increasing number of application areas – through its constant use for quality, efficiency and product reliability – also outside factories. According to the latest figures from the German Engineering Federation (VDMA), the machine vision industry in Germany and Europe has been posting turnover and growth records for years. Turnover increased by an average of 13 per cent per annum between 2013 and 2017. Turnover in the machine vision industry doubled within a space of just ten years (2008 to 2017). In 2017 the German machine vision industry alone achieved a new record turnover of €2.6 billion, i.e. an increase of 18 per cent. The industry grew even further in 2018 and recorded an increase of 4 per cent.

Machine Vision Industry Is a Data Supplier

Machines and robots learn "how to see" with machine vision systems. Machine vision is therefore becoming a key technology of the future. Not only is it being used to a greater extent in the worldwide automation competition between traditional branches of industry, it is also increasingly conquering new industries outside factory automation. Improved quality, higher reliability, increased safety and cost-efficiency are properties which are required both in non-industrial application areas and in the smart factory of the future.

The global machine vision market is also characterised by enormous dynamism: pronounced merger and acquisition activities have been forecast for the industry for years and they increasingly seem to have started becoming reality in the last few weeks and months. Whereas image sensor manufacturers, in particular, were initially affected by changes, this now also increasingly applies to camera manufacturers. The industry is changing permanently and companies are being confronted by a continually changing competitive environment. A large number of companies are combining synergies and are merging in order to react to new market participants or jointly offer new system solutions over and beyond individual components.

Investor groups have also recognised the strategic importance of the industry and are investing more in machine vision companies. The new players include, for exam-

©Landesmesse Stuttgart

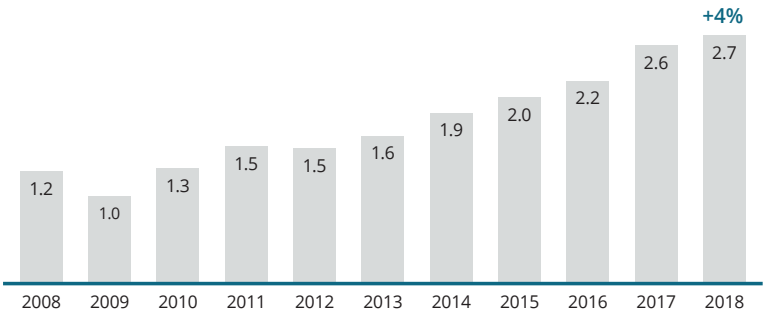
The organizer of Vision expects more visitors and exhibitors than in 2018.

ple, camera suppliers from Asia, but also automation companies which do not originally come from the machine vision sector. These companies have recognised the attractiveness and key role of the machine vision industry, for example as a data supplier in the context of Industry 4.0, and have the necessary company size or R&D resources. Small and medium-sized machine vision firms are faced here with great challenges which are also being intensified by the imminent generation change in many companies and the lack of company successors. In addition to current market tendencies, we are seeing new technological trend topics which are now promoting machine vision and with which entirely new players are also entering "the machine vision stage."

Vision Expects More Growth

These developments will also be reflected at the forthcoming Vision, the leading world trade fair for machine vision, which will be held in Stuttgart from 10 to 12 November 2020. Messe Stuttgart is currently assuming that the trade fair will experience additional growth in terms of the number of exhibitors and visitors. In 2018, when the Vision last took place, 10,000 visitors came to see the products and services of 472 exhibitors from 31 countries.

New strategic company alliances will be presented in Stuttgart along with first-time exhibitors from the smart factory sector who seamlessly integrate the topic of machine vision in automation and the area of machine control systems. Due to the trend towards embedded vision, new exhibitors involved in embedded systems will be able to show their portfolio and know-how at Vision 2020. The trade fair will focus on machine vision in the "non-visible area", i.e. short wave infrared (SWIR), hyperspectral imaging, polarisation cameras and thermography, as another trend topic. Visitors will also be able to experience even more start-ups and new companies from areas such as artificial intelligence and deep learning. Data security will be another exciting topic area. Last but not least, Vision 2020 will again feature all global key players from the area of machine vision components together with a large number of system integrators and solution providers who use the components to manufacture systems and implement them within the framework of application solutions in specific industries. ■



©VDMA

German machine vision industry: new record in 2018. Machine vision Germany total turnover 2008–2018

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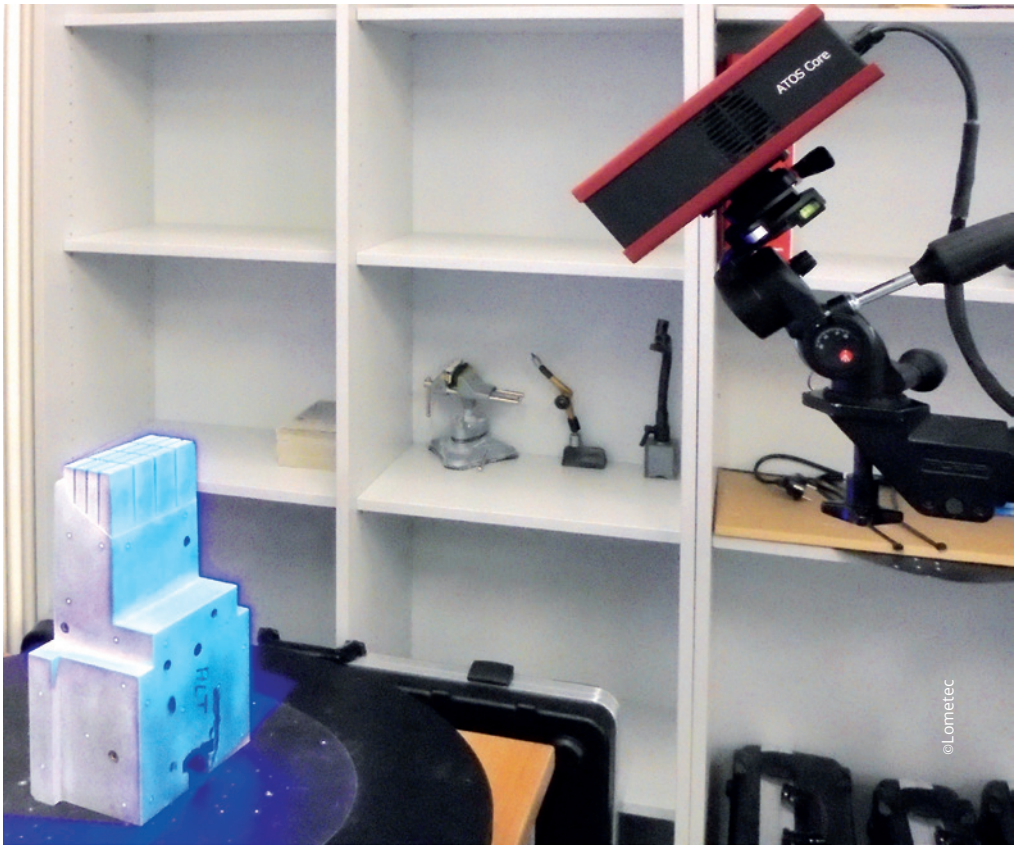
www.vision-fair.de

Truculent Tool

3D Scanning Prevents Production Downtimes

The digitization and measurement of failed mold inserts and sliders for plastics processing was used to rework imprecise system spare parts. 3D scanners using the triple scan principle ensured complete, flawless measuring data.



In the past, measurement service provider Lometec had 'merely' conducted some workpiece first-sampling for one of its customers, a well-known medium-sized plastics processor. But when an urgently needed, brand-new tool suddenly failed, the metrologists moved out on a special mission: Delivering overnight service, they digitalized the mold tools using GOM scanning systems so that precise, rapid reworking was possible. The impending default on delivery was averted.

Lometec's customer produces, among other things, thermoplastic weather-proof housings designed for use in extreme climates. When the quantities in demand began exceeding the existing tool's capacities, the company commissioned construction of a second, identical tool—and that's where the trouble began.

Tool Failure After Passing First Sampling

At first, everything was looking hunky-dory: The new tool was delivered and worked just fine, as verified by Lometec as part of first sampling of the housing. The 3D measurement service sampled 125 parts and recorded the results in the initial sample test report (ISTR). Process capability was validated and the plastics processor was able to produce with two tools at once, doubling output as desired.

But shortly after starting mass production with the second tool, it proved prone to faults: Sliders and inserts began seizing. The tool manufacturer responded promptly to the complaints and supplied spare parts–but these did not match precisely, making it impossible to simply exchange them, never mind swapping over the sliders and inserts between the two tools.

The Solution: Scan and Rework, ASAP

This gave the plastics processor the idea to have Lometec digitalize and measure the 14 affected mold inserts and sliders. The measuring data would then be used to rework the imprecise spare parts.

Lometec's managing director Jörg Werkmeister remembers: "Our job was to compare the old inserts with the new ones and return all of the inserts to the company again as quickly as possible, so they'd be able to keep on producing with one tool at least. Having both tools measured was naturally stopping production completely."

No sooner said than done: Themselves specialists for rapid optical 3D measurement, Lometec was confident they had what it took. The measurement service maintains two fully climatized measuring rooms and uses measuring equipment by renowned German manufacturers, including three GOM systems for full-field digitalization of technical mold halves. "We set up the 3D scanning lab completely from scratch in 2016, it's absolutely state-of-the-art," Jörg Werkmeister says. "Our trio of Atos Triple Scan, Core, and Scanport means we're excellently equipped for a diverse range of digitalization jobs." Investing in GOM technology had been very good decision, Werkmeister goes on to say. "The measuring data the systems supply is outstanding." To meet the demand for promptness, two metrologists tackled the plastics processor's job in tandem: One working with Atos Triple Scan, the other with Atos Core.

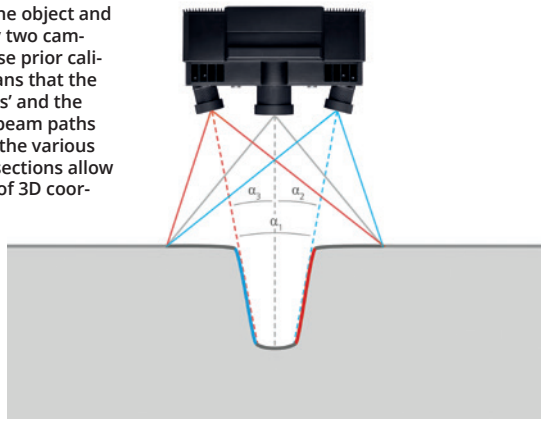
Before conducting the measurements, the metrologists cleaned the sliders and inserts, removing residues such as grease and the like. Next, they applied high-precision reference point markers. These ensure that the software joins the separate scanned images correctly. "For digitalization, we chose really small increments," Jörg Werkmeister tells us. This achieved high detail resolution.

New ATOS Q: The small outperformer

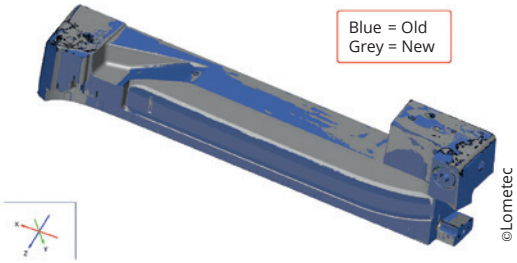
GOM's new ATOS Q is a high-performance 3D scanner for complex-inspection tasks. The lightweight and flexible system is equipped with interchangeable lenses for small to medium-sized parts and is powered by the latest GOM software.

www.gom.com

Triple Scan Principle: Precise fringe patterns are projected onto the surface of the object and captured by two cameras. Because prior calibration means that the two cameras' and the projector's beam paths are known, the various beam intersections allow calculation of 3D coordinates.



Actual-to-actual comparison of sliders and inserts highlights the differences between the two tools in clearly visible color.



Triple Scan Principle

Both of the GOM 3D scanners used work with the triple scan principle: Fringe patterns are projected onto the surface of the object and are captured by two cameras based on the stereo camera principle. As the beam paths of both cameras and the projector are calibrated in advance, 3D surface points from three different ray intersections can be calculated. The result is complete measuring data without holes or erratic points. The systems are mobile and can be employed easily even outside of the measuring room, e.g., on site at the customer's production facilities.

The Measurement Detects Differences

What did the measurements say? Werkmeister summarizes: "The GOM software used the measuring data from first tool's sliders and inserts to generate a 3D point cloud. We uploaded this to GOM Inspect Professional as a reference. We then took the second tool's 3D slider and insert data and compared the two sets actual-to-actual. The direct comparison highlighted the differences between the two tools really clearly." Using the supplied measurement logs and the corresponding STL data made it possible to modify the mold inserts and allow them to be exchanged.

Jörg Werkmeister is pleased with the successful project – and with his team's dedicated work: "Our rapid response allowed our customer to meet their delivery deadlines as planned." He winks as he adds: "I'll wager that the company will be looking more closely the next time they commission a new tool." ■

About GOM

GOM, a Zeiss Group company, specializes in industrial 3D coordinate measuring technology, 3D computed tomography and 3D testing. From product development to production and worldwide sales, GOM offers machines and systems for manual and automated 3D digitizing, evaluation software, training and professional support from a single source. More than 17,000 GOM system installations are in use worldwide in industries such as automotive, aerospace, energy and consumer goods. With over 60 locations and more than 1,200 metrology specialists, GOM guarantees sound advice and first-class service. GOM has been part of the Zeiss Group since mid-2019 and forms the Center of Excellence for optical metrology. Zeiss is a leading global technology company in the optical and optoelectronic industry with over 31,000 employees in 50 countries and annual sales of over 6.4 billion euros.

About Lometec

Lometec was founded in 2010. They are a DIN EN ISO/IEC 17025-accredited measurement lab contractor. The company supports parts suppliers in necessary approval processes by using high-speed digitalization technologies, tactile and optical video-based 3D coordinate measuring technology, and by creating gauges and production monitoring concepts.

View into Lometec's 3D scanning lab

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Flexible modular housing accessories for CX.I cameras are available from a single source at Baumer – offering complete, customized protection.

Outstanding Protection

Cameras for Splash and Product Contact Zones Help Protect Against Steam and Bacteria

Inspections in highly sensitive areas within the food, beverage, and pharmaceutical industries require robust components that are able to withstand aggressive cleaning agents. Sophisticated IP-protected cameras are the right choice for the job.

There are very few camera systems available that can be individually adjusted to specific applications. The CX.I cameras from Baumer have a solution to this problem – thanks to a patented flexible lens protection system and modular housing accessories that elevates the cameras to IP 65, IP 67 or IP 69K protection in no time at all. The manufacturer is able to provide this level of flexibility from a single source.

The pizza is supposed to contain five slices of salami – one at the center and four placed at equal distances around it. To make sure that customers are not disappointed when they slide the frozen product in the oven, the number and position of the slices must be precisely monitored during production. Manufacturers working in this kind of scenario often turn to image-based solutions using industrial cameras as a means of automatically detecting and separating faulty products. The applications of these solutions go beyond just food, however. In the pharmaceutical industry, cameras also deliver high-resolution images for purposes such as ensuring that blister packs contain exactly the 20 pills they are supposed to. Not every camera is suitable for inspection tasks like these because of the cleaning work that starts once production shifts in the pharmaceutical, food and beverage industries are complete. To remove any potential dirt and bacteria, cleaning teams make use of aggressive cleaning agents, steam, and pressure washers. Industrial cameras must be given special protection to resist this for years on end – and this is where the wheat is separated from the chaff. Some manufacturers sell only the camera and limit the housing to just the bare essentials or recommend third-party housings that are often inflexible and expensive. Baumer takes a different approach. With the CX.I cameras, the sensor specialist is expanding its product range for the production of safe foods and offering the most extensive camera accessory portfolio on the market. This enables customized options for protecting cameras in challenging environments – precisely matched to the design of the camera, and all from a single source.

Camera and Lens Protection

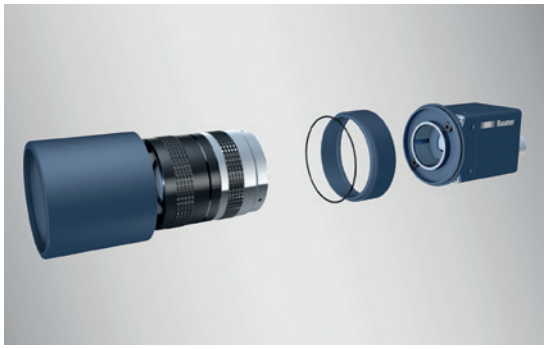
CX.I cameras, which feature sensors from 1.3 to 12 megapixel and high frame rates, generally have a hard-anodized surface finish that is able to stand up to even chemically aggressive cleaning agents. However, lenses also require the right kind of protection when cleaning agents of this nature need to be used. To provide this, Baumer has developed a patented, hard anodized type of lens protection: Available in two diameters and with M47 or M62 threads, it can be used directly on the majority of lenses. The lens protection is attached to the camera using an adapter plate and there are extension rings available for longer lenses. Installation requires just two screws, making the camera ready for use in the non-product zone within a matter of minutes. The lens protection is available with acrylic glass as well as laminated safety glass consisting of chemically strengthened alumino-silicate glass with high scratch, impact, and shattering resistance – enabling it to withstand daily mechanical cleaning processes too.

Modular System for IP 65/67 and IP 69K

With its modular IP 65/67 and IP 69K protective housings, Baumer is taking protection one step further. These solutions combine lens protection with a compact, customized housing for all CX.I cameras.

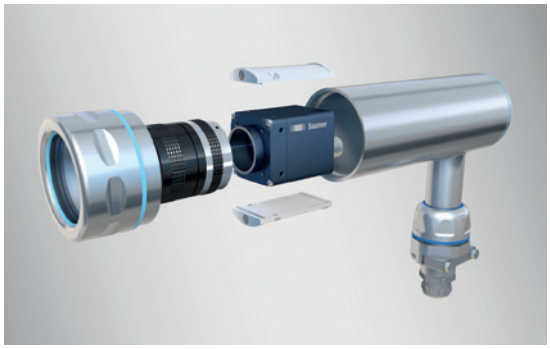
The round IP 65/67 housings have been developed in accordance with EHEDG guidelines. While dirt and pathogens are unable to attach to its smooth surface, cleaning liquid runs off it freely. Thanks to its hard-anodized surface, it can withstand cleaning cycles with highly aggressive chemicals – such as hydrogen peroxide being used to combat bacteria in the pharmaceutical industry. A seal ensures that the protection class is maintained at the bolted M12 connection and the power outputs for the illumination.

In addition, the company offers an EHEDG-compliant stainless-steel housing with a wash-down design for applications in the product contact and splash zone. It is sealed against dust and high-pressure water as well as steam jet cleaning, and complies with protection class IP 69K. Coupled



©Baumer

Thanks to the patented modular lens protection system, available with M47 or M62 threads, cameras and lenses of various lengths and diameters can be protected quickly and flexibly with a variable number of extension rings, ensuring compliance with protection classes IP 54, IP 65, and IP 67.



©Baumer

The IP 69K protective housing, with a hygienic design and stainless-steel materials, removes any possibility of product remnants adhering to the equipment.

with a surface roughness of less than 0.8 µm, an electropolished surface, and food-grade robust seals, it is especially suitable for applications in the food sector involving oil and grease.

The modular protective housings offer excellent external protection for the CX.I cameras. The manufacturer knows how important it is to provide protection on the inside, too, and for this reason he has ensured that CX.I cameras can withstand vibrations up to 10 g and shocks up to 100 g. The standard version of these cameras can handle a temperature range from 0°C to 65°C, which means that they are ideally suited to applications where refrigerated foods are being processed but can also be installed near an oven. The models with an extended temperature range from -40°C to +70°C are suitable for processing frozen food.

Everything from a Single Source

From the perspective of machine manufacturers or system integrators involved in applications for the food or pharmaceutical industries, there is one key advantage that CX.I cameras offer – all that is required is one camera, which can then be adapted quickly to suit any application using the accessories that are available. This delivers far better value for the money than expensive specialist cameras that are only optimized for a single purpose. What's more, the flexibility of the cameras and their accessories make it easy to integrate them into existing processes. If there is no room for the camera immediately next to the production line, all the user has to do is position it slightly further away and use a lens – with a matching lens protective cover, of course – that has a different focal length to compensate for the distance. This enables the fulfilment of a popular demand from customers – for a simple, comprehensive system from a single source.

Integrated Illumination Controller

The CX.I cameras benefit customers beyond simply the food, beverage, and pharmaceutical sectors. Companies working in mechanical engineering and automotive applications also use these cameras because they significantly cut down on the amount of installation work that is necessary. A special feature consists of four separately switchable power outputs for the direct control of illumination. These provide up to 120 W (max. 48 V / 2.5 A), delivering enough power for directly operating very bright sources of illumination whose luminosity can be controlled via pulse width modulation. Activating the four outputs in sequence creates results such as four images with different shadowing, which software can then use to derive information about the inclination, curvature, and texture of a surface. This procedure – known as "shape from shading" – can be used to detect tiny scratches in painted surfaces, for instance. Cameras from other manufacturers require a separate illumination controller that increases costs and requires added installation work. ■

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New Standard Initiatives Hosted by EMVA

Open Optics Camera Interface (OOCI) and emVision

Along with the two widely accepted standards GenICam and EMVA1288 the EMVA is currently hosting two new standard initiatives which are geared towards new industry requirements.

The first one is called emVision and aims at the lasting industry trend towards embedded vision. Cameras and PCs as the main components of machine vision systems tremendously miniaturized over the last years. The combination of a processing board with a powerful small camera, make it possible to design a very compact vision system which can be integrated into a larger system. Such systems are called embedded vision systems and are of high interest to the machine vision industry. However, adaptation is needed in order to enable industrial solutions to use embedded systems. Hosted by the EMVA, in August 2018 this new standard initiative formed to address these needs. With an impressive support from the machine vision industry, the standardization group currently develops a standard to achieve an easy integration and exchange of different embedded cameras within embedded vision applications. Already more than 40 companies are showing interest in this initiative and the working group of the standard includes delegates from Adimec, Allied Vision, Alysium, Avaldata, Basler, Baumer, Euresys, Flir, Framos, Matrix Vision, and Sony Semiconductor Solutions Corporation. The next steps of the standard initiative are to create a white paper with concepts and goals to be adopted by the Future Standards Forum (FSF) early in 2020, the year where also a first release candidate is targeted.

Open Optics Camera Interface (OOCI)

The second new standard initiative currently driven by the EMVA is the Open Optics Camera Interface (OOCI). As in machine vision the lens mount is still without any specification of how to control focus, aperture, etc. remotely the EMVA in 2017 has decided to start a new standardization group on an open lens camera communication standard to standardize the camera interface for optical components inside of, or attached to, machine vision cameras. Therefore, the focus of this standard is not so much the different mechanical existing as future lens mount, but a common communication protocol closely linked to the GenICam Standard. The standard is concentrated on the need to control lenses, filters, filter wheels, shutters, apertures, etc. with a common software interface. The basic idea is to reuse and apply existing technologies from the GenICam standard as much as possible and integrate the optics communication into GenTL and SFNC. GenTL will ensure compatibility with most vendor specific existing electrical interfaces such as Analog/OneWire/I2C/SPI. SFNC will make it easy to display and control the optics command interface from most existing end user applications. The OOCI working group believes that having this open standard will allow for the widest possible benefit to an industry that has to this date relied on de-facto standards, designed by single companies, for other markets. Already, major camera and optics manufactures have joined the working group and a white paper has been published as preparation for the global adoption of the standard. ■

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Protective Windows for Every Environment and Application

Midopt introduced Protective Windows, designed to shield lenses and enclosures from dirt, dust, liquids, impact, and harsh environments without sacrificing image quality. Protective Windows are useful for imaging in the ultraviolet (UV), visible (VIS) and near-infrared (NIR) spectrums. The company offers a variety of glass and acrylic Protective Windows, depending on the application and environment.

Glass Protective Windows offer superior durability, can withstand high operating temperatures and are a great solution for applications requiring exceptional surface quality. Acrylic Protective Windows are a cost-effective, lightweight solution for protecting the lens. Midopt Protective Windows are offered with anti-reflection (AR) and oleophobic (anti-smudge) coating options.

Protective Window types include: Fused Silica, Borofloat, Sapphire, Precision Windows, Industrial-Grade Glass and Acrylic.

www.midopt.com

Six cameras with Pregius

Baumer presents six LXT cameras with resolutions from 0.5 to 7.1 megapixels. They combine Sony Pregius CMOS sensors of the 3rd generation with 10 GigE and thus enable performance increases. With a pixel size of 4.5 or 9 µm, the cameras offer very high sensitivity. For example, Applications with short exposure times or with NIR illumination are better supported. The extraordinarily high image quality with an SNR (Signal to Noise Ratio) of 44 dB (pixel size 4.5 µm) simplifies stable image evaluation even under difficult conditions, e.g. in applications with very high light intensity, such as laser welding or in sports and movement analysis with fluctuating lighting conditions. Thanks to the very high frame rates,

extremely fast applications can also be reliably recorded, analyzed and controlled, e.g. for error analysis of machines and processes or for eye tracking applications.

www.baumer.com

Conquering the Industry

Hyperspectral-Based Imaging Is Establishing Itself in Ever New Industrial Fields of Application

With the help of hyperspectral imaging technology, spectroscopic analysis of objects can be carried out in order to determine organic or inorganic impurities – not only on the surface, but also partly inside the inspected materials.

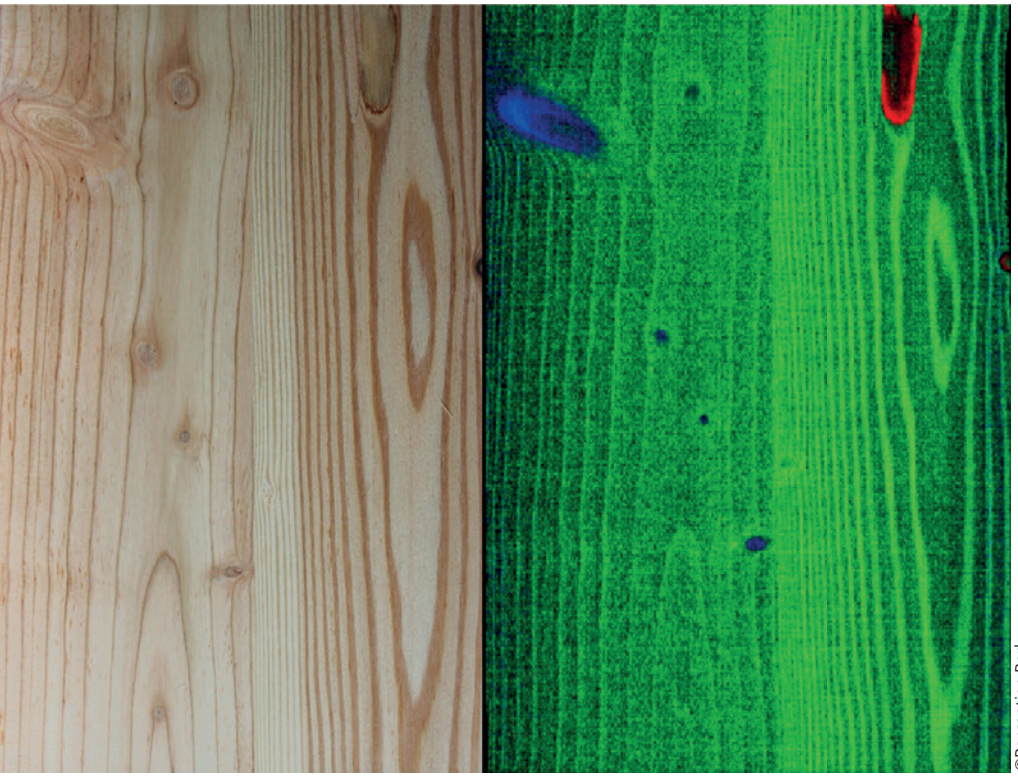
Conventional image processing systems have become established in automation in industrial applications in recent years. Machines that can "see" can do more than systems without image processing, and this knowledge has now become established among developers and designers. While conventional 2D and 3D vision systems check the quality of objects by recognizing certain error features on the surface, hyperspectral imaging (HSI) goes one step further.

Hyperspectral imaging systems usually utilize 100 or more different wavelengths and a spectrograph that splits the light reflected from the object into its spectrum and reproduce it on the camera sensor. An HSI system assembles the resulting images into a three-dimensional hyperspectral data cube that can contain very large amounts of data. The result is a chemical fingerprint of the object under consideration, which enables the analyzed material properties to be determined precisely. With the help of special evaluation software, each identified chemical component can then be flagged with its own color in the images taken in order to visualize the existing substances in a simple way for the user. This technology is called Chemical Color Imaging (CCI).

Diverse Applications

"Hyperspectral imaging can be used in a wide variety of industrial application areas and in certain cases offers solutions for tasks where conventional image processing systems fail," explains Markus Burgstaller, Managing Director of the Graz-based company Perception Park that specialized in that innovative technology a few years ago. As an application example, Burgstaller mentions the classification of substances that have no visual differences but are not chemically identical: "Plastics of various compositions can look very similar and can therefore hardly be classified by conventional image processing. On the other hand, HSI systems are able to analyze chemical properties and therefore recognize materials very reliably. With this technology, the concentration and distribution of ingredients can largely be recorded in real time."

A special feature of hyperspectral imaging systems makes them particularly attractive for certain applications: Some substances are not transparent to visible light but can be penetrated by infrared light. This gives the possibility to check the chemical composition of packaged content even through a suitably designed packaging. According to Burgstaller, applications in which this property comes into play are found primarily in the pharmaceutical and food industries, but also in numerous other industrial segments.

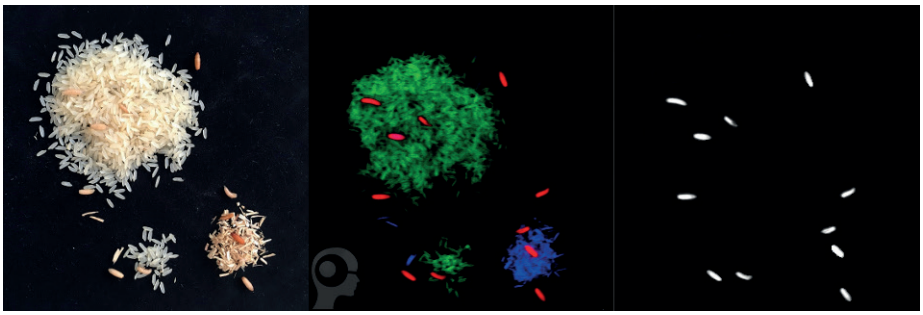


©Perception Park

Fault Detection in the Pharmaceutical Industry

As in many other areas, production speeds in the pharmaceutical industry are increasing rapidly worldwide. In order to reduce the risk of product recalls and to protect consumers from contaminated drugs, particularly strict safety regulations apply in this industry. Image processing systems have therefore been state-of-the-art in the manufacturing processes of pharmaceutical products for some time in order to evaluate products in real time according to criteria such as shape, size or weight. However, the use of hyperspectral imaging and CCI systems can further optimize the monitoring of pharmaceutical production processes: Pharmaceuticals can be 100 percent examined for their molecular properties.

A typical application of HSI systems in the pharmaceutical industry is the checking of retard tablets for correct coating. This form



An image processing solution based on hyperspectral imaging detects contamination such as maggots and pieces of wood between rice. The right partial image shows a segmentation image with recognized maggots.

of medication releases the active ingredient after its administration over a longer period of time or to a specific target in the body. The sustained release coating of the tablet is decisive for this controlled release of the active ingredient: if it is damaged or missing completely, the medication gets into the body faster than desired and fails to deliver its long-term effect.

With a combination of HSI and CCI technology, the quality of retard based medication can be reliably controlled, explains Markus Burgstaller: "With a hyperspectral camera working in the NIR area and the use of chemical color imaging technology with our software suite Perception Studio we were able to clearly demonstrate that previously artificially generated coating defects can be recognized with 100 percent certainty and also in real time in high-speed production. This quality check is possible even through blister packs, provided the blister material is not made of aluminum, which would reflect the NIR radiation."

According to Burgstaller, testing retard coatings is just one of many possible use cases for HSI technology in the pharmaceutical industry. It can also be used to reliably check whether the correct number of tablets are packed in blisters, whether they are undamaged and free from any contamination, whether the correct ingredients are contained in drug capsules or whether they are completely sealed. "Hyperspectral imaging offers numerous application options in the pharmaceutical sector and thus increases safety for patients and manufacturers."

More Security in Food Production

Similar guidelines as in the pharmaceutical industry apply in food production: In order to exclude health risks to consumers, no contamination must remain undetected in the products. The food must also contain exactly the ingredients that the manufacturer wants to and that are defined in the product descriptions for the consumer.

HSI and CCI also offer numerous application options for this industry. These techniques make it easier to find any contamination in food and identify unwanted objects such as stones or earth when sorting potatoes, carrots or other vegetables, as well as shell parts or other substances in the production of nuts, even in high-speed production lines. If food is stored for too long, maggots can also nest, or fresh fruit can start to rot, according to Burgstaller: "In food production, the task very often not only means to detect any contamination, but also to identify rotten, immature or pest or mold infected goods. These and many other quality defects can be safely ruled out by the use of hyperspectral imaging systems."

Industrially manufactured food such as sausage and cheese are usually offered for sale in a shrink-wrap form. Similar to the pharmaceutical industry, HSI systems also allow quality checks through the packaging in many cases. A special task here is the inspection of heat-sealed joints, which are supposed to guarantee absolutely tight packaging of the food. Even the smallest contamination or damage to these sealed joints can lead to leaky packaging and spoilage of the goods before the calculated best before date. Unsellable products or expensive product recalls would then be possible consequences for manufacturers in this area, which can be avoided in many cases by using hyperspectral imaging.

HSI Systems for Plastics Sorting

Even at the end of their lifespan, plastics are still too valuable to simply throw them away. If the full potential of the currently deposited plastic waste were used in an environmentally friendly way applying the best recycling and energy recovery methods and technologies, many millions of tons of plastic could be recycled. This would also make it possible to generate large amounts of heat and electricity.

Appropriate measures are required for such improvements in order to stop the disposal of plastics and to set up recovery-oriented collection systems. These must be reconciled with modern sorting infrastructure and improved recycling and recovery processes in order to exploit the full potential of this valuable resource. Recycled plastics can be reused in many everyday products, e.g. in clothing, in vehicle parts, in packaging products and for many other purposes. However, too little plastic is currently being recycled, although innovative technology such as Perception Park's Perception Studio would offer the needed potential.

»Hyperspectral imaging can be used in a wide variety of industrial application areas and in certain cases offers solutions for tasks where conventional image processing systems fail.«

"A distinction e.g. between polypropylene and polyethylene or other materials that look very similar at first glance, hyperspectral imaging makes it easy to do so. With our Perception Studio, appropriate systems can be developed even by people who have little or no experience with the subject of spectroscopy. The technical possibilities for a significant expansion of the recycling quotas for plastics are therefore already available and for environmental reasons should substantially be used," Burgstaller expresses his hopes for the future. ■

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Spinning Disk Confocal Microscopy

Improvements of Spinning Disk Confocal Microscopy on Standard Laser Scanning Confocal Microscopy and Conventional Fluorescence Microscopy

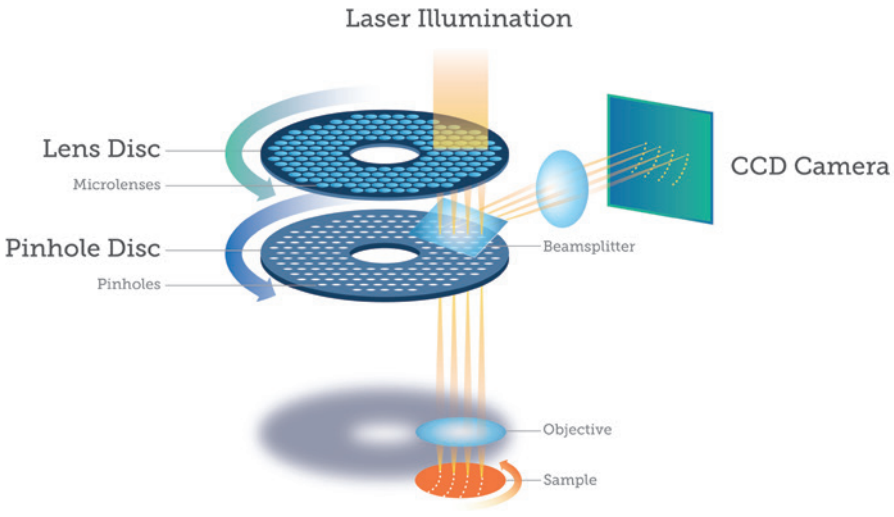
Spinning disk confocal microscopy allows for fast and efficient imaging of live samples, dynamic processes and optical sectioning of 3D samples in 2D slices. Customizable pinhole disks, secondary microlens disks and highly sensitive cameras help to overcome its limitations.

Everything we see is thanks to light which passes from objects into our eyes. By using a lens (such as a magnifying glass) we can bend and focus that light, which lets us see smaller objects. Conventional light microscopes are essentially a series of lenses that bend light from a light source, through a sample and into your eyes, or into a camera. This allows us to see ever-smaller objects such as cells and bacteria, which is hugely important for biological study.

However, cells and bacteria (and the smaller structures inside them) are mostly water and are therefore transparent. Imaging tiny see-through bags of water results in images that don't contain a lot of information, and in microscopy it is vital to have some sort of contrast or dye/stain that will give areas of the sample a color and make them far easier to see. In addition, what if you only want to image some of the smaller structures inside a cell, like the nucleus or the cell membrane? Coloring the entire cell would make it impossible to localize the areas you are interested in.

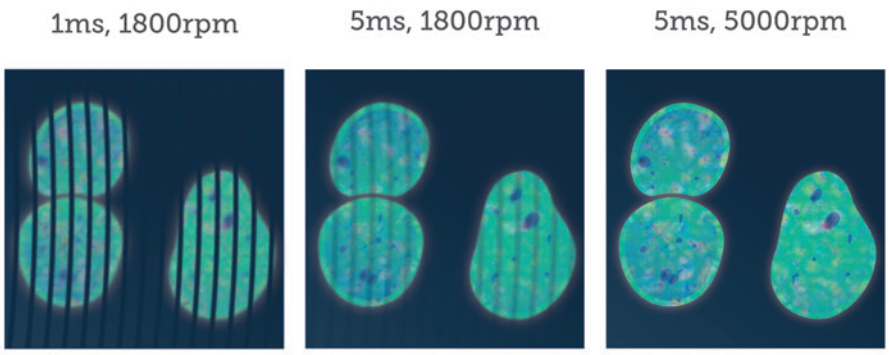
Fluorescence microscopy solves both these issues of contrast and localization. Fluorescence is where an object will emit light after absorbing light. Many different objects exhibit fluorescence, such as minerals (the word fluorescence coming from the mineral fluorite), deep sea fish (most famously the jellyfish Aequorea Victoria, from which green fluorescent protein (GFP) was discovered), plants, chemicals and many more.

Fluorescent chemicals (known as fluorophores) are used to label samples, and fluorophores are available that emit light in virtually any color. In a fluorescent microscope, a sample is labelled with a fluorophore, and then a bright light (excitation light) is used to illumi-



Springer/Gräf R., Rietdorf J., Zimmermann T. (2005)

Using a secondary micro-lens disk to improve light transmittance through the primary pinhole disk. Laser illumination is focused through the pinholes by the micro-lenses, with both disks spinning in sync over the sample.



Bildquelle: Elsevier/Stehbens S1, Pemble H, Murrow L, Wittmann T. (2012)

The effects of disk rotation speed and exposure time on the resultant image. From left to right, images show increasing exposure times and/or disk rotation speeds, which results in a cleaner image without streaks. Scale bar 10 µm.

nate the sample, which gives off fluorescence (emission light). In this manner, samples are highly contrasted to the black background as the fluorophore emits a bright colored light. By localizing these fluorophores to the area of interest a clear image of any part of a cell can be taken, making fluorescence microscopy a powerful tool for life sciences.

Drawbacks of Fluorescent Microscopy

In fluorescence microscopes the entire sample is illuminated by the excitation light, and the resulting fluorescence is detected by a camera which records the whole field of view. As the entire sample is flooded with light and all the emitted light is collected, this includes collection all of the out-of-focus light above and below the focal plane, causing blurriness and image degradation. This effect is exacerbated when imaging 3D elements such as cells, which contain fluorophores, areas of auto-fluorescence or liquid-filled areas that scatter light. When imaging such samples vital information can be lost.

Confocal Microscopy

Confocal microscopy improves on standard fluorescence microscopy, as a confocal microscope works by rejecting out-of-focus light from above or below the focal plane using a pinhole, which results in greater resolution, greater contrast and reduced noise. However, this pinhole only images a tiny area of a sample (approximately 100 nm) and consequently needs to be scanned across the whole specimen, which takes time and causes considerable photobleaching.

Rather than a single pinhole, a spinning disk confocal microscope (SDCM) has hundreds of pinholes arranged in spirals on an opaque disk, which rotates at high speeds. When spun, the pinholes scan across the specimen in rows, building up an image. Using a spinning disk vastly improves the speed of image acquisition (allowing for imaging of fast dynamic processes and live specimens), and considerably reduces photodamage and bleaching.

The pinholes in the disk are arranged so that every part of the image is scanned as the disk is turned. By altering the disk rotation speed, pinhole diameter and/or pinhole spacing, the image brightness, contrast and quality can be modified and optimized, making SDCMs highly customizable. However, while larger pinhole diameter results in improved light transmittance through the disk, it also reduces resolution, and while having big pinhole spacing eliminates any pinhole crosstalk, it also reduces light transmittance.

Having small pinholes with large spacing would result in higher axial resolution but the lowest transmittance of light. Light transmittance through the disk can be improved with the addition of a second disk which contains micrometer scale lenses in the place of pinholes. The micro-lens disk focuses light through each pinhole of the primary disk, with considerably improves light transmittance to the sample.

High Rotation Speed Guarantees High Quality

An important point to consider is that SDCMs excite and image multiple points at once, meaning that standard point detectors such as the photo-multiplier tubes (PMTs) used in standard confocal microscopes are insufficient to detect the emitted light. Instead, array based detectors are used such as the cutting-edge EMCCD and sCMOS cameras produced by Teledyne Photometrics. These cameras need to have short exposure times due to the speed of the spinning disk, with short exposure times or a slow disk rotation speed resulting in a streaky image. By using cameras that can match high rotation speeds, high-quality images are produced.

In conclusion, spinning disk confocal microscopy offers a clear improvement on standard laser scanning confocal microscopy and conventional fluorescence microscopy, allowing for fast and efficient imaging of live samples, dynamic processes and optical sectioning of 3D samples in 2D slices. Multichannel images can be taken at multiple wavelengths, resulting in high-quality images dense with information, and deconvolution methods exist to further improve contrast and image quality. The main disadvantage of SDCM is that only a small proportion of light is transmitted through the disk to the sample, but with customizable pinhole disks, secondary microlens disks and highly sensitive cameras these limitations can be easily overcome, while also improving imaging speed and field of view even further to produce high resolution images faster than ever. ■

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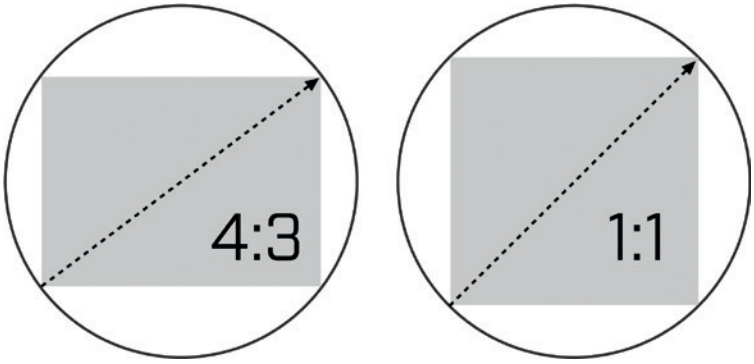
Sensor Review Mono Cameras

Part 2

In the last issue of inspect we already presented part 1 of the Flir camera sensor test of 100 + models. Part 2 now deals with the selection of the right sensor type.

To ensure you get the right camera for your application, FLIR designs and manufactures machine vision cameras with a wide range of sensors. Understanding the differences in optical format, readout, and pixel structure of these sensors, and how they impact different performance criteria can help you choose the camera that is best for you. For example, inspection of parts on a moving conveyor belt will benefit from global shutter readout, while traffic systems for detecting mobile phone use by drivers will find on-sensor polarizing filters useful for seeing through the glare of car windshields.



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Sensors can have different aspect ratios but share the same optical format.

Resolution, Pixel Size, and Optical Format

Resolution, pixel size and optical format are closely linked. The optical format of a sensor is a measurement of the physical size of the image sensor. It is measured diagonally across the sensor and represents the diameter of the image circle the lens must produce to completely illuminate the sensor. Sensors can have different aspect ratios but share the same optical format.

Increasing the resolution while maintaining the optical format results in a decrease in pixel size. Smaller pixels of the same pixel architecture will generally have a reduced quantum efficiency and saturation capacity. Reducing the pixel size while maintaining resolution results in a decrease in sensor size. Lenses for smaller sensors are generally more compact, lighter and less expensive than lenses designed for larger optical formats.

CMOS Compared to CCD

CMOS is the dominant technology for image sensors. Compared to the CCD sensors they have replaced, CMOS image sensors deliver superior imaging performance across a wide range of metrics including Quantum Efficiency, Absolute Sensitivity, Dynamic Range and Temporal Dark Noise. CMOS image sensors can read pixels much faster than CCDs, yielding large increases in speed for sensors of the same resolution.

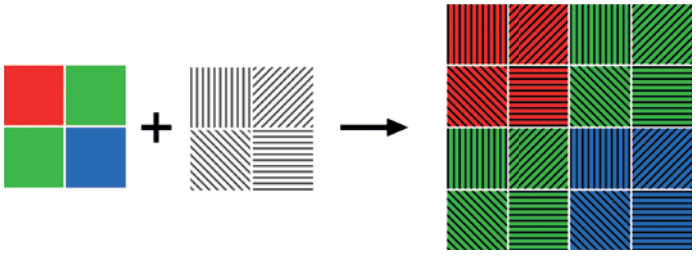
Global Shutter Compared to Rolling Shutter

While the practical differences between global and rolling shutter sensors are less of a factor with Sony's success with their Pregius global shutter CMOS technology, traditionally, global shutter was preferred for imaging fast moving objects whereas rolling shutter was preferred for its lower cost and success at low light imaging.

Global shutter sensors have read-out circuitry on each pixel. This enables them to read every pixel across the sensor plane simultaneously. Rolling shutter sensors read each row out sequentially. Global shutter sensors are preferable for imaging moving objects. By reading out all pixels at the same time, they can capture moving objects without any distortion. When rolling shutter sensors capture moving objects, the objects will continue to move as the line-by-line readout takes pace. This means that the object will be in a different position from one line to the next. Depending on the speed of the object being imaged, this can result in significant distortion.

Back-Side Illuminated (BSI) Sensors Compared to Front Illuminated Sensors

On most CMOS image sensors, the light sensitive photodiode is located on the back



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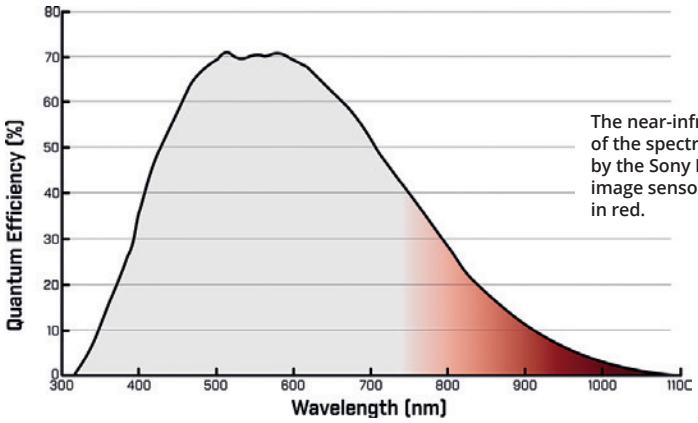
Red, green and blue pixels are rearranged into 2x2 "super-pixels." Each super-pixel has one polarizing filter of each orientation.



The near-infrared region of the spectrum detectable by the Sony IMX248 CMOS image sensor highlighted in red.

©Flir Systems

side of the sensor. It sits behind the readout circuitry, which is sandwiched between the photodiode and the microlenses used to direct light into the pixel. Back-side illuminated (BSI) sensors invert the layout of this typical pixel structure. By placing the photodiodes directly under the microlenses, photons can enter the photodiodes more easily, yielding a higher QE.

On-Sensor Polarizing Filters

On-sensor polarizing filters enable new applications by making it possible to detect not only the intensity of light hitting a given point on the image sensor, but also its polarization angle. Sony's IMX250MZR and IMX250MYR sensors are based on their popular five-megapixel IMX250 Pregius global shutter CMOS sensor with the addition polarizing filters below the microlens of each pixel. These filters are oriented to 0°, 45°, 90° and 135°.

Glare Elimination

Polarizing filters can eliminate unwanted glare on reflective and transparent parts. On-sensor polarization enables these systems to be installed quickly and adjusted dynamically. In addition to simplifying lighting requirements for industrial imaging systems, glare reduction is useful for managing the challenging lighting encountered in outdoor applications.

Degree of Linear Polarization

Degree of Linear Polarization (DoLP) is the proportion of light that is polarized at a given pixel. A perfectly polarized light source would have a DoLP of 100%, while unpolarized light would have a DoLP of 0 percent. DoLP can be useful for differentiating materials which would otherwise appear identical.

Angle of Linear Polarization

The Angle of Linear Polarization (AoLP) is the average polarization angle of the light at a given pixel. When used in conjunction with a polarized light source, AoLP can be used to greatly enhance the contrast of the fibers in composite materials.

Sony's newest additions to their Pregius family of global shutter CMOS sensors come equipped with a unique new selectable conversion gain feature. This provides users with control over the gain applied during the analog to digital conversion.«

Combining Polarization and Color

The IMX250MYR sensor adds a color filter array to the sensor below the polarizing filters. This sensor uses a unique quad-Bayer pattern which prioritizes spatial resolution of the polarization domain over spatial resolution of color information.

Selectable Conversion Gain

Sony's newest additions to their Pregius family of global shutter CMOS sensors come equipped with a unique new selectable conversion gain feature. This provides users with control over the gain applied during the analog to digital conversion.

By selecting between high and low conversion gain, the performance of the sensor can be optimized for high sensitivity or high saturation capacity. Enabling conversion gain is equivalent to adding an additional 7.23 dB of analog gain.

Near-Infrared Imaging Performance

The silicon used by CMOS image sensors to detect incoming photos, has a relatively low sensitivity to light of wavelengths greater than 900 nm. The average QE for Sony Pregius and Starvis sensors at 850 nm is 18 percent, while at 950 this falls to 7 percent.

For applications which benefit from sensitivity in the Near-Infrared (NIR) wavelengths, Pregius and Starvis sensors are generally recommended. While their QE at 950 nm may be lower than other sensors optimized for higher QE at this wavelength, the far lower Temporal Dark Noise (read noise) of Pregius sensors easily compensates for this. The low read noise results in Pregius and Starvis sensors having much better NIR Absolute Sensitivity Threshold. This allows higher gain to be applied, delivering a brighter, clearer image than sensors with higher NIR QE, but lower NIR AST.

Get the Review

If you would like to compare camera sensor performance for quantum efficiency, dynamic range, temporal dark noise (read noise), and more Flir's 2019 mono and color camera sensor review can be downloaded at:

www.flir.eu/globalassets/iis/guidebooks/2019-machine-vision-emva1288-sensor-review.pdf ■

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In the Right Light

Choosing the Best Lighting Configuration for an Application

Lighting is a hugely important consideration in machine vision, including the choice of form factor. While every little variation influences the outcome, every shape has an influence on the illumination effect, too.

Not only is sufficient intensity needed to receive images with low noise, but the direction, angle and wavelength of the illumination are also important. These, coupled with the nature of the particular work piece, the target information required, and the rest of the inspection environment determine the best choice for the particular application.

In this article we look at one of these essential lighting criteria: the choice of lighting form factor. There are many lighting configurations to choose from, and even within a particular form factor there are variations which can significantly influence the appearance of the output image. Each shape produces its own illumination effect which works for some applications but not others.

Ring Lights

Ring lights are used to illuminate the complete work piece from above, with the camera looking through the center of the ring. This is the most common technique for illuminating diffuse, non-reflective objects and is used in applications such as OCR, 2D code reading, general visual inspection including for damage or stains, inspecting parts on PCBs, etc. Ring lights can feature LEDs mounted on a flexible circuit board which can be adjusted to different angles in order to concentrate the light on the center of the work piece. This gives multipurpose bright field illumination which alleviates the influence of slight positional or inclination deviations in the work piece for stable imaging.

Low Angle Ring Lights

Low angle ring lights are also available. In this case the LEDs are mounted to a flexible circuit board within the ring in a steep angle. This allows the light to be mounted much closer to the work piece, illuminating it at a very low angle to give dark field illumination which highlights surface features since the camera only receives light that has been scattered by a defect on the surface. Typical applications include inspection for engraving, damage, or stains on metal surfaces, edge extraction, inspection for foreign material mixed on medical devices, inspection for damage to glass edges, visual inspection for O-rings, etc. It is also possible to have very thin low angle ring lights where the LEDs are mounted horizontally within the ring. Because they are so thin, these lights can be mounted very closely to the work piece, again giving dark field illumination. However, because the angle of illumination is so low, only the finest surface details are picked out. Figure 1 shows these different ring light geometries. One general characteristic of these types of ring light is that the intensity of illumination tends to be greater at the center of the work piece. For a more even illumination with reduced shadowing diffuse ring lights can be used.

Diffuse Ring Lights

Diffuse ring lights use surface-mounted LEDs with a diffuser plate, and there is little variation in the uniform illumination region even if the distance of the light from the work piece is changed. This means that they can be used for both high angle and low angle illumination. Figure 2 shows diffuse ring light configurations.

Bar Lights

Bar lights are versatile illumination systems which provide oblique lighting. They give flexible bright field/ dark field lighting depending on the number of lights used and the installation position and angle with respect to the workpiece. This flexibility allows the light to be positioned to get the optimal image. LEDs are arranged in straight lines to provide direct illumination and are available with a choice of

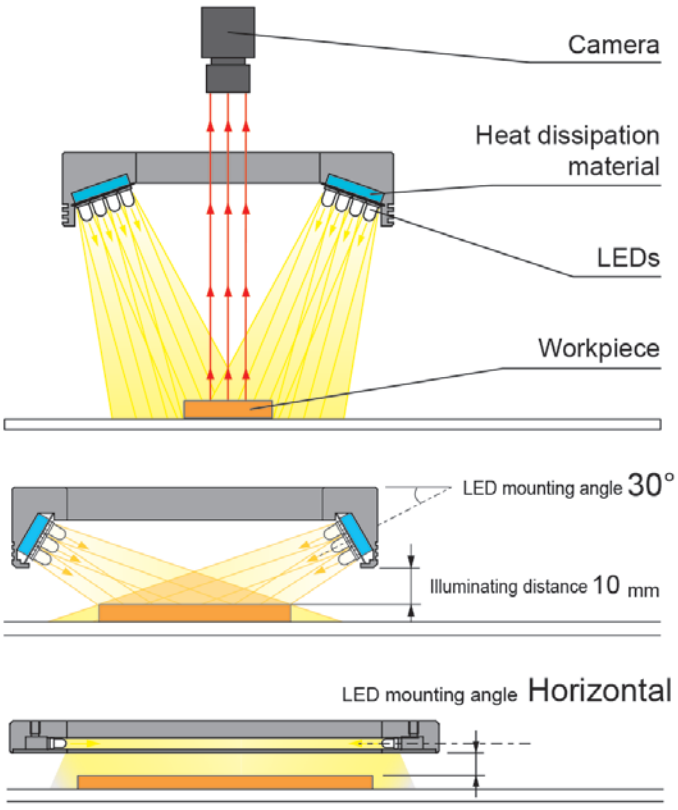

Fig. 1: Conventional ring light geometries

length and number of rows. By using lenses, it is possible to provide convergent illumination for narrow spaces or diffuse illumination for wide areas.

Dome Lights

Dome lights provide an even and homogeneous illumination of the work piece and can be used to illuminate complex reflective shapes. They can be used for visual, text, or color determination inspections on glossy surfaces, curved surfaces, or uneven surfaces; inspection for engraving, damage, or stains, inspection of metal with hairline features; inspection of parts on circuit boards, etc.

Light from surface-mounted LEDs is diffused by the dome-shaped reflective panel to give uniform illumination, with little change even if the distance to the work piece is changed. This type of lighting can be used in a wide range of industries. An alternative way of producing diffuse, uniform illumination is to use a flat dome. This recreates the effect of dome lights in a thin enclosure. The special light guiding plate used creates a bright clear view with no hole needed for the camera. A fine surface dot pattern on the surface of the plate virtually eliminates image irregularities and Moire effects in the image. Flat dome lights also eliminate the dark spot caused by the camera hole in traditional dome lights.

Since flat dome lights occupy less room than a dome light, they can be used for applications with limited space. Figure 3 compares the geometry of flat dome lights with dome lights. While flat dome lights give illumination equivalent to a dome light when positioned close to the work piece, they also provide coaxial illumination when they are used further away from the work piece.

Added Versatility

Figure 4 shows the diversity of illumination effects that can be achieved on different types of work pieces using the various form factors discussed. These were produced using white LEDs, but all of these form factors are available in a variety of sizes and with a choice of LED power and wavelengths adding even greater illumination options. In addition, the lights can be overdriven to produce higher light intensity in short pulses using external lighting controllers, or in some cases, built-in lighting controllers. Of course, these are only a selection of form factors available for machine vision applications. Others will offer different image details, so it is important for users to discuss their requirements with lighting specialists to get the optimum set-up for their application. ■

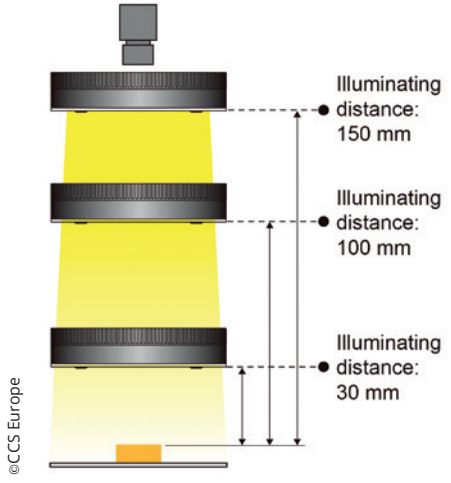

Fig. 2: Diffuse ring light geometry

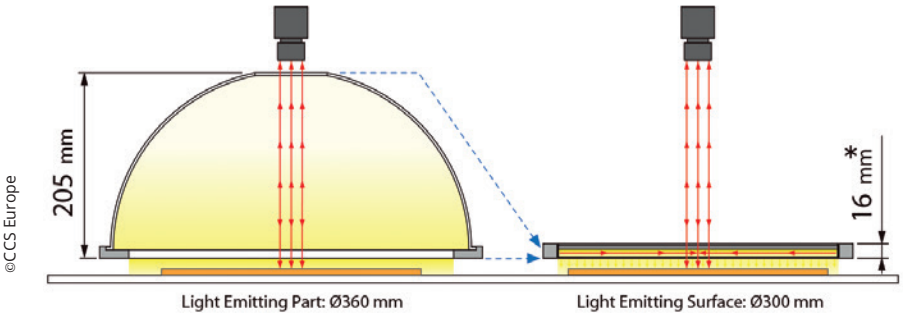

Fig. 3: Comparison of dome and flat dome form factors

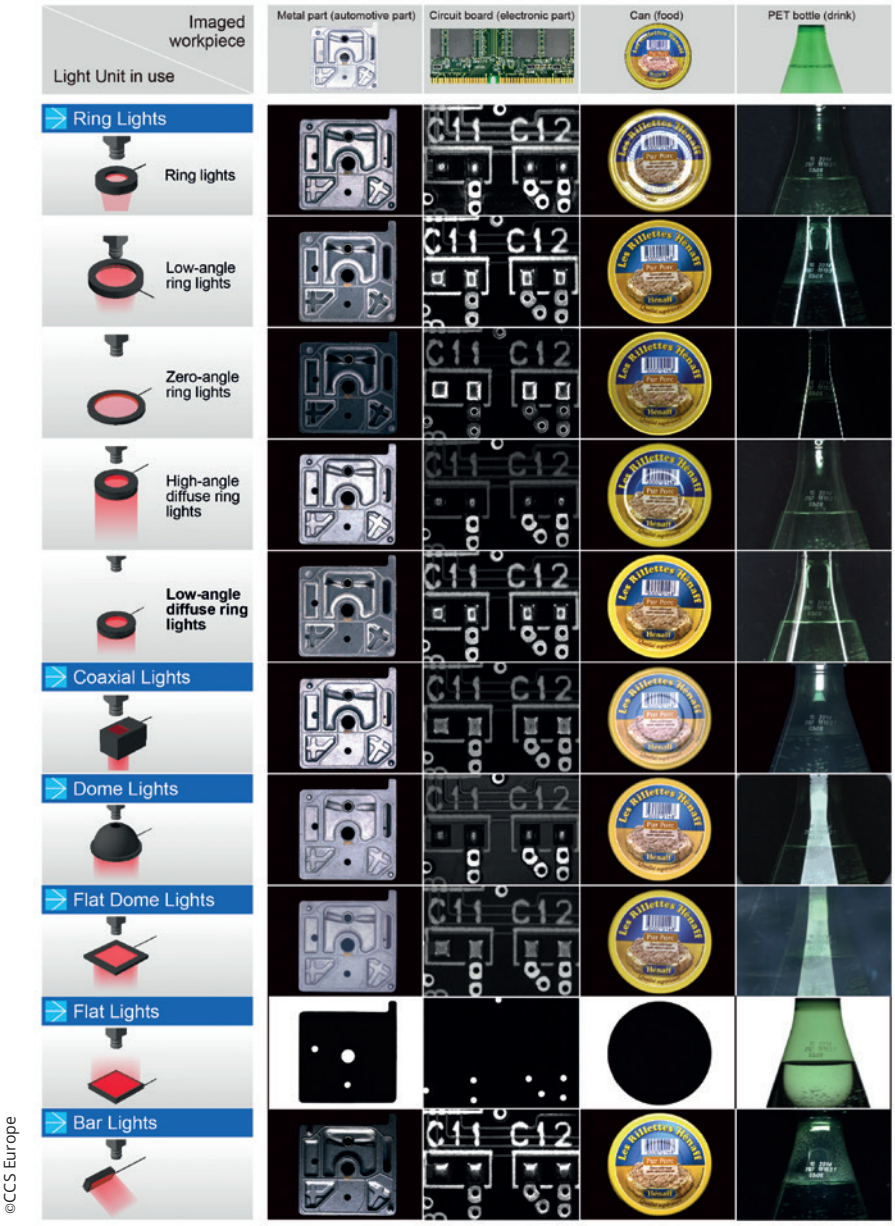

Fig. 4: Illumination examples on different work pieces with different form factors

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Latest GenICam Release 2019.11 Available

The latest GenICam release 2019.11 is available for download. Part of the current GenICam release is the new version 3.2 of the reference implementation (RI). The RI offers hardware and software vendors an efficient method to ensure compatibility of a camera with the standard in their image acquisition software. In addition to many minor improvements the new version of the GenICam reference implementation now includes support for GenDC ChunkData. Furthermore, the RI includes modular logging and bindings for Python and Java. The current release also includes the latest versions of the GenICam modules SFNC 2.5 and GenTL 1.6. Furthermore, the new module GenDC has been added to the GenICam release version 2019.11. The abbreviation stands for "Generic Data Container" and defines a transport media-independent data description that enables devices to transfer almost any form of image and metadata between camera and host system, using a uniform and standardized data description. GenDC thus completes the GenICam family of transport media independent modules that define the control and data exchange between imaging devices and the host.

www.emva.org

USB / HDMI interface card

Active Silicon expands its Harrier product line with a USB / HDMI camera interface card. This interface solution provides simultaneous HDMI and USB Video Class (UVC) V1.1 output for autofocus zoom cameras, including the Tamron MP1110M-VC, MP2030M-GS and Sony EV camera series. It serves both as a video output and as a UVC / USB control input and supports modes up to 1080p60.
USB video output is enabled when the card is connected to a SuperSpeed USB 3.x host. The HDMI output is activated by connecting an HDMI cable. When the interface card is switched on, the camera video mode can be selected using the DIP switch settings on the card. The video modes of the camera and other functions of the camera or the interface card can also be controlled by serial communication via RS-485 / RS-232 / TTL or by using UVC / USB commands via the USB connection. The USB interface serves both as a UVC video output and as a USB-based control input. For developers who are new to creating UVC-based applications, the Harrier USB Software Development Kit includes a sample UVC application and a software API.

www.activesilicon.com

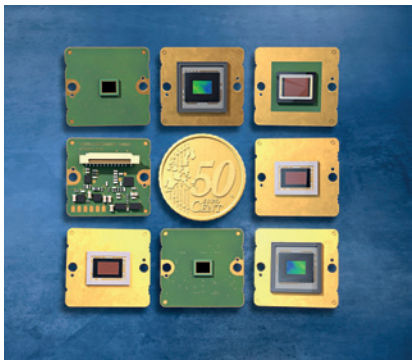
New Generation of Prism Cameras

JAI has launched a new generation of prism cameras for its Fusion series of multispectral imaging solutions. The new cameras with the designations FS-3200D-10GE and FS-1600D-10GE are equipped with two-channel dichroic prisms, which distribute the incident light on two precisely aligned CMOS area sensors. One channel captures the light from the visible spectrum (approx. 400 nm to 670 nm) and delivers it to a Bayer color sensor, while the second channel combines the light from the near infrared region of the spectrum (approx. 740 nm to 1000 nm) monochrome, NIR sensitive sensor conducts. The new model FS-3200D-10GE has Bayer and monochrome versions of the Sony Pregius IMX252 CMOS sensor with a resolution of 3.2 megapixels (2048 x 1536 pixels) and a maximum frame rate of 123 fps with 8-bit output. The FS-1600D-10GE has Bavarian and monochrome versions of the Sony Pregius IMX273 CMOS sensor with a resolution of 1.6 megapixels (1440 x 1080 pixels) and a maximum frame rate of 226 fps with 8-bit output.

www.jai.com

Camera Modules Qith MIPI-CSI-2 Interface

Vision Components presented its expanded range of high-quality camera modules with MIPI-CSI-2 interface at embedded world 2020. These advanced components enable compact, repeatable OEM designs and easy connection of image sensors to more than 20 single board computers, including NVIDIA Jetson, DragonBoard, all Raspberry Pi boards and all 96 boards. As a special feature, Vision Components also offers non-native MIPI sensors on a specially developed adapter board with MIPI interface, including IMX250 and IMX252 from the Sony Pregius series, which is characterized by high light sensitivity and very low readout noise. With now 10 different image sensors to choose from, with resolutions up to 13 MP, the German manufacturer is the world leader in the market for MIPI camera boards. Vision Components supplies MIPI boards in large quantities at consumer prices. The associated VC-MIPI cables support high data rates.



www.vision-components.com

Complete AI solution for industrial vision applications

With the market launch of IDS NXT Ocean, there is now a complete AI solution for industrial vision applications. Camera hardware, software, infrastructure, knowledge and support come from a single source at IDS. This makes precisely coordinated, user-friendly processes possible. Users only need sample images and knowledge to evaluate them (e.g. "good" / "bad") to create a neural network.

The generated network can then be run directly on the IDS NXT industrial cameras, making them inference cameras. An inference camera can apply its knowledge acquired through deep learning to new data. Since IDS NXT industrial cameras have a special AI core, neural networks are executed directly on the devices with hardware acceleration – this enables inference times of a few milliseconds. With features such as a C-mount, robust housing, GigE network connection with RJ45 or M12 connector, RS232 interface and REST web interface, they are also full industrial cameras. The models IDS NXT rio and rome are now available as series cameras with different sensors and protection classes.

www.ids-imaging.de

Composed Optics Simplify System Integration

Edmund Optics now offers plano-convex lenses (PCX) with MgF2 coating and C-mount long pass filters made of colored glass. Techspec's plano-convex lenses (PCX) with MgF2 coating consist of the plano-convex lenses (PCX) with MgF2 coating, mounted in C-mount housings for easier integration into optical systems. Each housing is engraved with the focal length and the article number for better identification. Mounted plano-convex lenses (PCX) with MgF2 coating have an MgF2 anti-reflective coating to reduce the reflection per surface to <1.75% at visible wavelengths.

C-mount long pass filters made of colored glass are framed versions of our long pass filters made of colored glass and thus enable easy integration into optical systems. Each socket has a C-mount thread and is engraved with the product number and filter number by SCHOTT or Hoya for better identification. C-mount long pass filters made of colored glass are available for the UV, visible or IR spectrum.

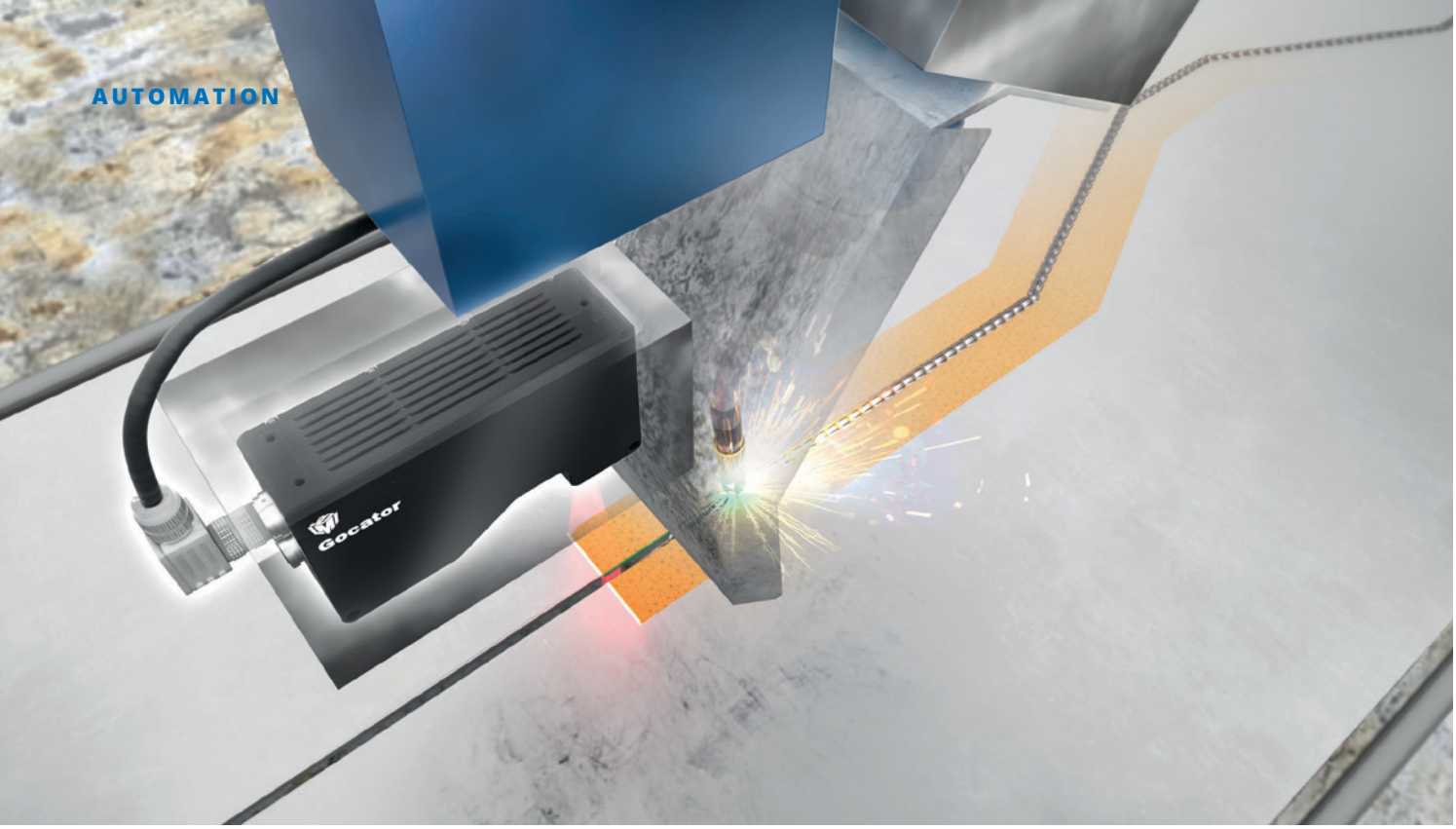
www.edmundoptics.eu

Zero Latency from Sensor to Operating Computer

The MX377 camera, the latest product from Ximea, features one of the largest sCMOS sensors available today. The Gpixel Gsense6060 with 37.7 million 10 µm pixels offers imaging performance on par with the best CCDs – finally – in a high-speed CMOS architecture.

The camera delivers scientific imaging capabilities with high dynamic range and low noise – at high speed. The MX camera line utilizes a multi-lane PCIe interface which is able to deliver data at the maximum rates the sensor is capable of. The camera was also designed with cooling for low light level applications. It can be provided with several versions of the Gsense6060 sensor, including frontside (FSI) or backside (BSI) illuminated models.

www.ximea.com



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Smart 3D Vision for Welding

Robot Vision Guidance for Automated Assembly Applications

Adding smart 3D machine vision to industrial robots significantly improves their precision in automated assembly applications.

Today's industrial robots require a pre-programmed motion plan. This is because without machine vision, parts must be exactly positioned in order for the robot to locate them in space. In many assembly applications, however, part tolerance stackups lead to levels of variation that make effective automated assembly with robots difficult to achieve.

Adding 3D Vision to Arc Welding Robots

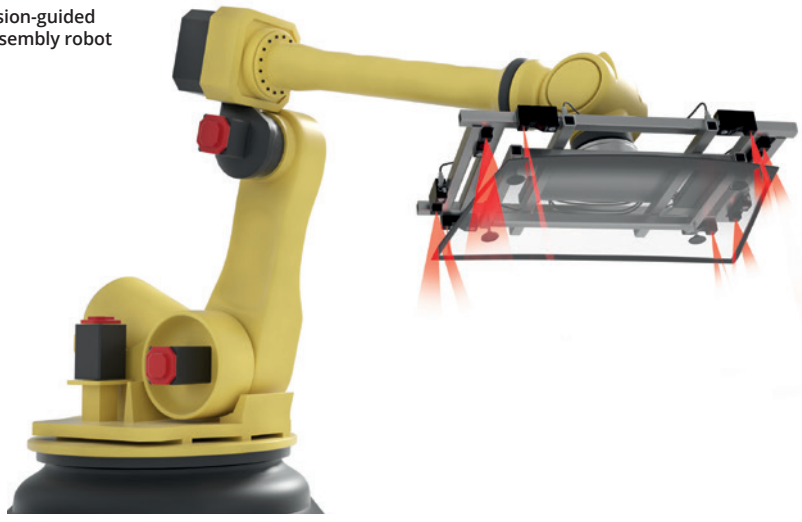
In automated arc welding applications, a robot is precision-programmed to follow a weld path where torch positions and torch angles are specified according to narrow mechanical tolerances on the workpiece setup. To achieve a high-quality weld, any mechanical deviations must be prevented on workpieces and fixtures, and all seam locations must be 100 percent correct. The main challenge in this approach has been meeting the tight tolerances required to produce high-quality welds over long periods of time.

The Smart 3D Solution

LMI's Gocator uses non-contact laser line profiling technology, within a compact design that allows it to fit into small work areas. The sensor's visible laser light makes it easy to precisely position the robot for initial system setup. The sensor head is easily integrated with a robot controller over Ethernet for maximum flexibility in order to provide vision guidance to the robot. This simplifies part fixturing issues and improves weld positioning for improved joint quality.

In addition, Gocator sensors have an embedded processor and onboard software to transform signals from the sensor head into calibrated digital data and determine the actual position of the weld seam. When it has located the seam position, the position is communicated directly to the robot controller. The robot then corrects the movement according to the actual position and executes a perfect weld every time. With this closed loop system capability, welding quality is substantially increased and costs for rework, trimming, and scrap are minimized.

This vision guided robotic system can handle seams such as fillets, butts, and edge/overlap joints. The robot is programmed



Vision-guided assembly robot

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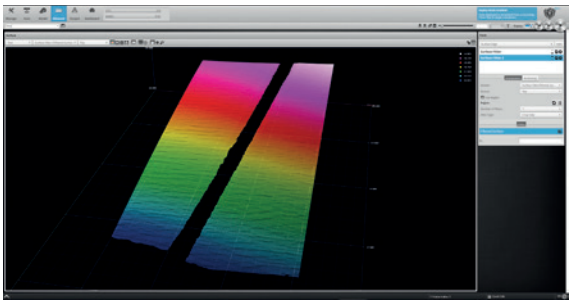
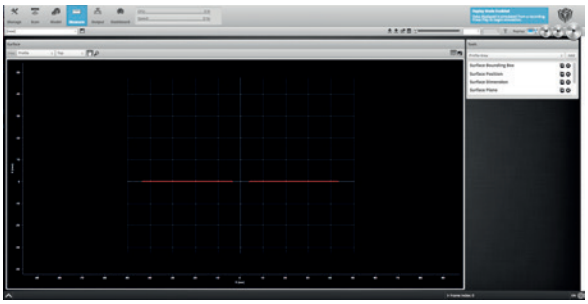




Sensor output showing the gap between two surfaces

with parameters such as joint type and plate thickness. During the search process, points along the joint are defined in two or three dimensions. Searches are accomplished without the arc being activated. Distance measurement can also be given for real-time Z height positioning.

Welding Environment

The arc welding environment is extremely hostile. Weld splatter, smoke, and dirt are generated by the weld operation. To protect the sensor during the actual weld, a pneumatic shutter over the sensor head provides mechanical protection. Standard cooling and air purge systems further enhance its use in harsh environments for optimum functionality and reliability. Furthermore, an IP67-rated aluminum housing ensures that the sensors are protected from moisture, dirt, and vibration.

Smart 3D in Action: Welding Car Door Hinges

Eight laser guidance systems are used to accurately locate the position of eight seam paths, which guide the spot-welding process in robotic arc welding of door hinges onto car bodies. Driven by Gocator 3D sensors, these systems are able to guide the robot to properly position the door hinge within search times of under 1 second. With 3D location data, the robot can position the welding tip at the exact spot with a search accuracy of ±0.1 mm. Quality welds are produced on every assembly, even when components and fixtures are not perfectly positioned.

Conclusion

Automating assembly operations such as arc welding requires the ability to determine the accurate locations of one or more features and feeding this information to the robot controller to correct the robot path to complete a quality assembly. The smart sensors provide a solution to this challenge by using built-in tools and communication protocols to offer vision guidance in these robotic assembly applications.

Case Study: Automated Rivet Hole Inspection in Aircraft Section Assembly

The Application

Aircraft production presents various technical challenges, such as large product dimensions, complex joining processes, and the need for proper organization of assembly tasks. Overcoming such challenges while enforcing tight tolerances and managing small batch sizes is often difficult to achieve with a high degree of cost efficiency.

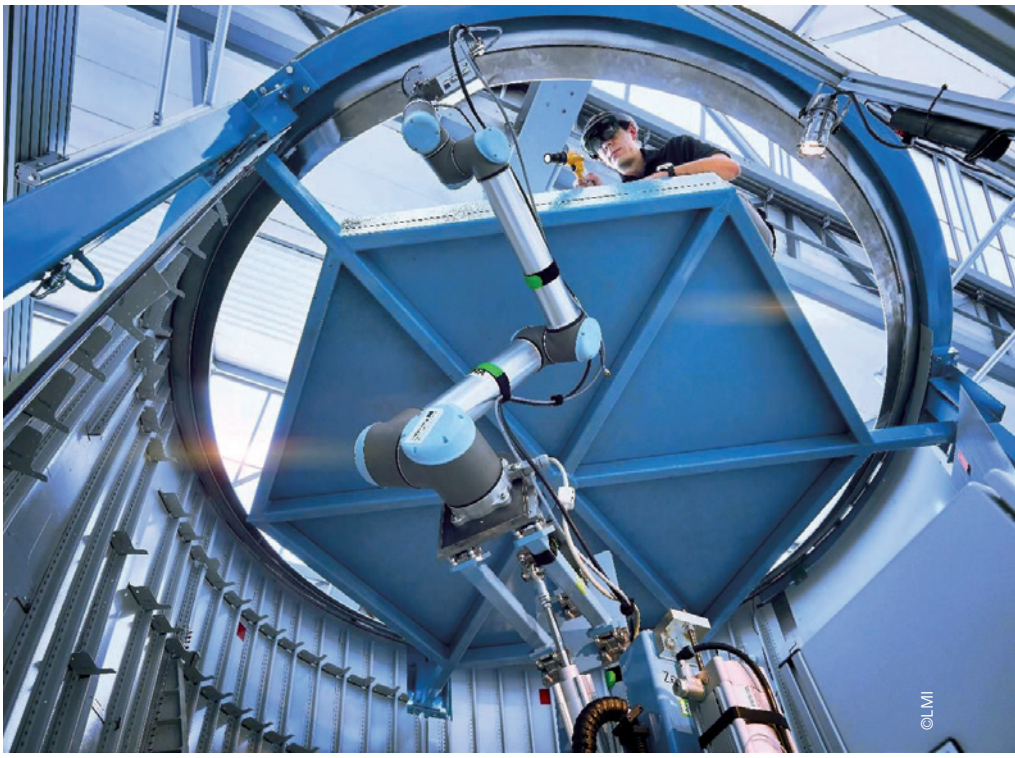
The Challenge

In the assembly of the aft section of the aircraft, the pressure bulkhead is mounted to the section barrel. Two operators must work collaboratively in uncomfortable, non-ergonomic positions, while having to maintain exacting assembly quality standards.

The Solution

Zema devised a semi-automated approach to optimize aircraft section assembly. This was achieved through an innovative riveting process for solid rivets, using Human-Robot-Collaboration in combination with an intuitive Human-Machine-Interaction operational paradigm. Zema's solution leverages col-

Arc welding environment



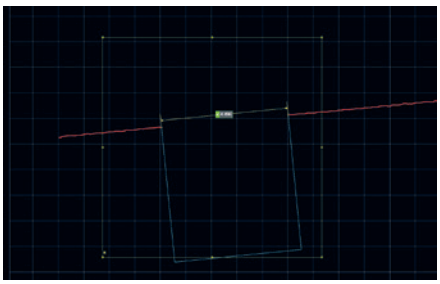
Robot and human collaborate during the assembly process

laboration between humans and robots in order to complete the task more efficiently. First, the solution involves placing a robot inside the section barrel. The robot's workspace is then expanded by mounting it on top of a lifting unit, which enables it to position the anvil properly in front of the bulkhead. At the same time, a human performs the more complex tasks of inserting the solid rivets and operating the riveting hammer from outside the sectional barrel.

To create the robotic system used in this application, a Gocator 3D laser line profile sensor is mounted and calibrated to the robot flange using built-in hand eye calibration. The sensor is then able to provide 3D coordinates of every measured point. With onboard data processing and built-in measurement tools, the sensor detects the holes in the frame or shell of the aircraft, enabling the riveting process to be completed with maximum accuracy and efficiency.

Tasks in the riveting process are divided between human and robot. The human detects the designated hole, inserts the rivets, positions the riveting hammer and starts the collaborative process by activating the hammer. In parallel, after ascertaining the position of the holes, the robot positions the anvil and bucks it against the rivet during execution of the process.

"We picked the LMI sensor because it can be integrated very quickly and flexibly into our robot applications and enables onboard data processing, which is a great advantage for the rapid implementation of research ideas and feasibility studies. In addition to onboard data processing, access to the sensors raw data is an important factor for us - and this is also made possible by LMI. All in all, we have the perfect scope for research and industrial applications with Gocator sensors," said Tobias Masiak, Research Assistant (Robotic & Human-Machine-Interaction) at Zema.



Detection and measurement of a rivet hole using Gocator

The Result

With the introduction of a Gocator laser triangulation sensor the distance between rivet and anvil no longer depends on human judgement, but on the measurement precision of the sensor, the robot positioning, and the calibration of the tool (e. g., anvil, additional production equipment). As a result of automating this complex process, assembly errors and deviations are greatly reduced.

Next Steps

Refinement of this solution is ongoing, including long-term stress testing of the developed process tools and the integrated robot system. Furthermore, the test series includes quality inspection using data fusion from Gocator, camera and force-torque data, as well as information gathered from operator experience. Combining the data with Artificial Intelligence algorithms will be introduced in future iterations. ■

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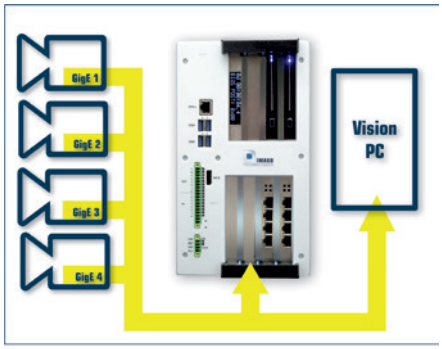
www.lmi3D.com

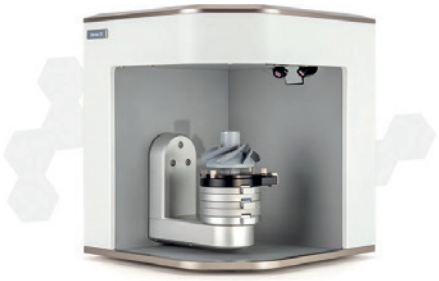


Connect And Run: The New Image Storage Box From IMAGO Technologies

Image Storage Box Presented

Imago has launched an image store box. It can save the data streams from up to 4 GigE cameras on two 1 TB removable hard drives. As a further convenience function, two digital inputs are assigned to each camera and allow filtering. Possible filters are, e.g., saving only the images for NOK decisions. The Image Storage Box is now available for order and delivery.

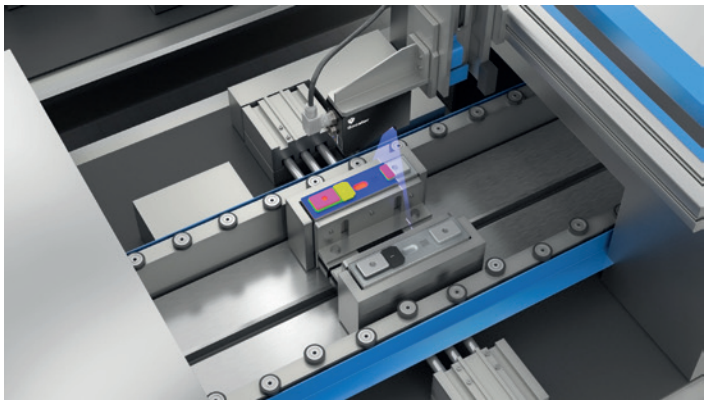
www.imago-technologies.com



3D Desktop Professional Scanner

Artec 3D has introduced the Micro, an automated 3D desktop scanner for industrial measurement technology. Equipped with a double camera, the Artec Micro works precisely. Thanks to its blue LED lights, which are matched to the two-axis rotation system, it creates perfect digital copies with a minimal number of single images. The fully automatic industrial scanner starts with a click of the mouse and generates high-resolution 3D color scans with an unsurpassed point accuracy of up to ten micrometers (0.4 Thou). This corresponds to one tenth the size of a grain of salt.

www.artec3d.de



3D Smart Sensors

LMI's Gocator 3D smart sensors now support optical character recognition and barcode reading. These essential image processing functions are suitable for a variety of inspection applications in which characters or symbols have to be decoded.
The Surface OCR tool recognizes and extracts strings from surfaces using either the scan data from the 3D height maps or the 2D intensity data. Surface OCR is a valuable tool for inspection applications in which flat or embossed symbols are to be decoded. This is particularly important for applications in the automotive sector (stamped parts), batteries and packaging (marking and tracking) as well as rubber and tires (DOT codes). With the Surface barcode tool, data encoded in 1D (linear) and 2D barcodes can be read from surface data (2D intensity or 3D height map) without the need for additional 2D cameras or special barcode readers.

www.lmi3d.com

©Katja Geisler/Mitutoyo

Unveiling Hidden Potential

Improving the Accuracy and Speed of Robot Arms with Vision System Measurements

The combination of the taglens with a robotic arm is a versatile, powerful tool for existing robotic vision systems that improves the efficiency of smart factories.

The premium dimensional measuring instruments manufacturer Mitutoyo raises the bar in quality assurance by developing a way to fit their tunable acoustic gradient index of refraction lens, better known as the taglens, to a robotic arm. Extraordinary on its own, the lens drastically improves demanding inspection tasks even when stationary, but combining it with the agility of a robotic arm is where the hidden potential lies. With its ability to produce images having up to 22 times an objective lens' normal depth of focus, its aptitude for applications using industrial robots is quite high. The possibilities to minimize movement of arms, improve inspections, or even simplify setup and programming for users make it very appealing to all industries.

Expanding the Reach of the Taglens

With an industrial robot system that has excellent repeatability, it makes sense that they are often used to observe particular sections of workpieces for various reasons. In this setup, the robot arm that the taglens is installed on has a repeatability of 20 µm. In typical robotic vision systems, this works well to provide the exact distance and positioning needed for autofocus adjustments before an image can be captured. However, when applying the ultra-fast varifocal taglens to imaging systems, the inspection efficiency skyrockets. What makes the lens special is its ability to always be in focus regardless of height difference, position tolerances, or curved surfaces; something very important when compared to systems using objective lenses without a taglens. This also removes the need for any moving parts along the optical axis, thus enhancing the inspection throughput.

When using vision systems with a limited depth of focus there is a chance that the images will not always be clear, thankfully when using the robotag this is nearly impossible because of its extended depth of field. Due to our edof software and being able to scan the focal length at a rapid rate, everything captured is in focus, guaranteeing a clear diffraction-limited image every time. When combined with a defect detection algorithm, the edof pairs beautifully with AI to make an automated defect detection system, appropriate for industrial inspection applications that demand a high throughput. This particular function isn't just a feature of the robotag alone but can be performed by fitting the taglens to any robotic system. Better suited to automated vision systems than traditional lenses, the taglens has no competition in improving existing applications throughout the industrial sector.

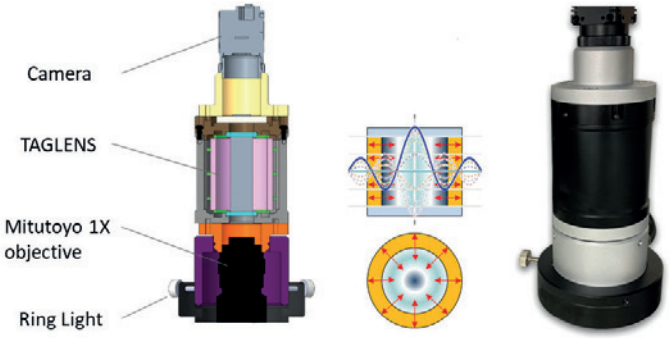
The Power Behind the Pair

The two main components in this pair definitely complement each other well, but what makes it so powerful is the lens itself. Its ability to improve image distance, working distance, and depth of focus is unparal-

leled when compared to conventional lens systems.

How it works is because of the taglens' physical design, using silicon-based fluid specifically chosen based on its thermal and viscous properties as well as how the incident light travels through it. This optically transparent fluid must have a density that differs in the center to bend the light rays as they pass through, just like in typical glass lenses. As the lens' element is liquid, the defined constant density change is not possible via compression and cannot be controlled accurately enough by temperature changes either. However, the density of a gaseous or liquid medium can be changed in wavefronts when a sonic wave travels through it since it propagates and oscillates in the same direction. The oscillating sonic frequency can be anywhere between 50 kHz and 500 kHz, forming wavefronts that travel through the liquid from opposite directions. This causes interference resulting in a standing wave, meaning that the waves being generated in both directions coincide at the middle where the amplitude amplification is much stronger than the outer areas. Using a piezo ring as the cavity where the liquid medium is enclosed, the vibrations are sent in its radial direction, creating a Bessel curve of density making it behave similarly to a parabolic lens.

As the basis for the technique used by Mitutoyo is now clarified, the reason why this product is so innovative makes sense. The taglens works like a perfect parabolic lens and thus refracts a parallel beam of light precisely into one focal point and by adjusting the amplitude, the strength of the curvature changes while the parabolic distribution of density does not. When shifting its perfect focal point between minimum to infinity at a rapid rate the lens becomes varifocal in nature. As the lens does this, the image produced will, in turn, appear to have everything in focus, regardless of distance or orientation. This is extremely beneficial for many applications that require large amounts of information from a single perspective, be it high-speed inspection, microscopy, automatic driving, etc. Capable of improving efficiency and reducing cost in many systems, the potential applications seem almost endless.



©Katja Geisler/Mitutoyo

The inner workings of the tunable acoustic gradient index of refraction lens (taglens)

Adding Pulsed Light at 70,000 Times per Second

Soon to be an add-on for the robotag, a broadband pulsed light source (PLS) was specifically designed to enable automatic focus control by matching the high frequencies of the taglens. Since the pulse signal output for the PLS from the controller is synchronized with the resonance frequency of taglens, the observation position can be changed by simply adjusting the phase. Because of this, when sequentially varying the phase by turning on the pulsed light source, it is possible to set desired focal positions. What this produces is the ability to not just have an image with everything in focus but also be capable of selectively probing planes along the height of the sample and reconstruct a 3D image. Each frame is captured using the external trigger mode, pulsing the light to corresponding drive amplitudes of the taglens. Perfect for sections of different heights this quite literally sheds new light on sloped or stepped work sections. Using Mitutoyo's most recent version of tagpak, we can observe these multiple images at a high frequency, providing defect detection software with multiple specific and sharp options. Another alternative is the compositing of multiple 2D images into a single in-focus one, also made possible thanks to the pulsed light source. This single image with several compounded focal lengths yields an even higher quality image than can be obtained when relying on the combination of the edof and a standard light source.

With this technology, it is even possible that Mitutoyo can perform accurate 3D-shape inspection thanks to the combined efforts of the taglens and PLS. As of right now though, the application of these two devices when utilizing the mobility and precision of the robot arm, drastically improves inline quality assurance and vision measurement and is expected to be released in the near future.

As we can see throughout the world right now, the inclination towards having a smart factory is evergrowing. As more and more companies adapt their facilities it makes sense that Mitutoyo has created a product so versatile in application to already existing robotic vision systems. Each coming with a Software Development Kit, the robotag or the taglens alone can be easily integrated into pre-existing systems. Extremely beneficial to inspection systems of any kind, as well as a multitude of other applications, the robotag improves overall efficiency no matter the task. ■

©Katja Geisler/Mitutoyo

Drastically improving visual inspection, Mitutoyo's new pulsed light source adds many new features to the already powerful taglens.

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Higher, Better, Faster

Ensure Product Quality, Improve Diagnostics, and Accelerate First Article Inspections

How can the automotive and aerospace industries ensure product quality without impacting productivity, improve diagnostics while limiting production downtime, and accelerate first article inspections in a context of limited resources and strict requirements for high accuracy and resolution?

Products built in the automotive and aerospace industries are made of hundreds of components manufactured by different suppliers who are based in diverse locations and use varied manufacturing processes. Once assembled, all of the components must fit together and align correctly to produce viable products free from defects that could distort their performance and ruin their efficiency.

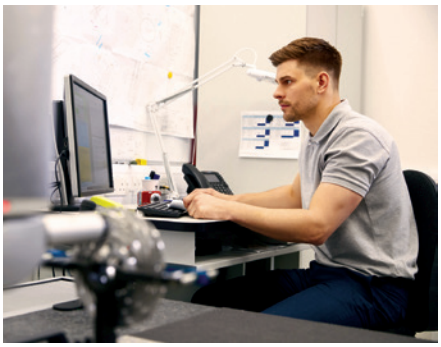
If irregular gaps between a door and car body or between the panels on an aircraft fuselage are reported by quality control, production is stopped, and quality assurance is called for inspection. Not only must they identify the root cause and fix quality problems accurately, but they must also deliver their diagnostic quickly, as production is waiting. Moreover, these inspections can occur on thousands of parts and products, all with different sizes, surface finishes, levels of complexity, and geometries.

This article aims to highlight how quality control and quality assurance specialists working in the automotive and aerospace industries can ensure product quality without impacting productivity, improve diagnostics while limiting production downtime, and accelerate first article inspections in a context of limited resources and strict requirements for high accuracy and resolution.

Automotive Industry

The volume of vehicles that the major automotive manufacturers produce every hour, every day, and every year is astonishing. A century after Henry Ford's eureka moment, technological progress made an exponential leap that has empowered an incredible collaboration between humans and machines, resulting in the creation of 115 cars per hour [1].

The quality control and quality assurance processes, however, must keep pace with this production capacity so that yield is not slowed (when samples are being inspected) and downtown is limited (when problems must be located on the line and fixed quickly).



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QC specialists working on a CMM in the lab

Quality Control (QC)

QC is essential to identify any inaccuracy that could compromise subsequent steps in the production line. In high volume production, sampling parts are brought to the CMM's queue for inspection.

Coordinate measuring machines (CMMs), which are very accurate but take time to operate, must be handled by trained and ex-

perienced employees - a rare find in today's job market. Since this metrology equipment is difficult to access and generally overloaded by all kinds of tests and controls, bottlenecks are common and often lead to productivity issues, even if the inspected parts comply with the requirements. In short, production waits for the validation of the parts, which wait for the availability of the CMM.

Is it possible to relocate certain inspections in order to offload the CMM?

Quality Assurance (QA)

When problems are raised by QC or production, QA specialists take action, performing the root cause analysis (often under pressure because production has been stopped) and implementing corrective actions quickly to limit downtime.

Through this process, they have to discover why, for example, there's an irregular gap between the car's door and the body, a headlight doesn't fit in a car's frame, or a closed hood has a bumpy shape.

As these inspections can occur on thousands of parts, all with different sizes, shapes, and surface finishes, is there a tool more suited for QA that could employ the benefits of 3D visualization and colormapping to quickly identify discrepancies?

First Article Inspection (FAI)

As its name suggests, a FAI requires the complete inspection of parts prior to the start of production. Since all features must be measured and verified, it takes time—a lot of time— especially if the complete FAI is performed on the CMM.

Is it possible to redirect less critical measurements to another metrology instrument and keep only the crucial dimensions for inspection on the CMM?

Aerospace Industry

From ribs and stringers to landing gears and engines, airplanes are made up of millions of components produced by thousands of companies located in many different countries around the world. As the aerospace industry relies on a myriad of suppliers and subcontractors that must build various complex parts, often with specialized finishes and treatments, quality must be ensured throughout the entire supply chain while maintaining the production lead times and keeping costs under control.

Because performance criteria and tolerances are even tighter in aerospace, critical features must be controlled at the CMM, which must be programmed and handled by specialized workers. As older employees move toward retirement, many companies worry that there are not enough resources with the right skills in the workforce. Lack of experience and insufficient training for operating CMMs challenge producers' ability to perform all of the inspections required by industry standards.

QC must be accurate since the impact of a failure is always greater for the aerospace industry. Even if the volume of production is smaller, the costs of potential damage are

higher. The Boeing 737 Max's saga illustrates these important consequences, as media have reported that grounding the aircraft will cost American and Southwest Airlines more than $1 billion in lost revenue and efficiency [2].

Therefore, accessibility to the CMM is important to guarantee the inspection of critical dimensions. If the CMM is unavailable due to bottlenecks generated by controls on less important features, it could impact the part quality, as well as the production lead time and manufacturing costs.

Thus, not only must the CMM be available for QC, but also it must be vacant to perform FAIs, particularly on critical dimensions of new parts that will be industrialized. The more new parts there are (as is often the case with new programs), the more FAIs there are to execute and the more CMM time—and human resources to operate the CMM—must be available, unless there is an alternative solution that is simpler to use and fairly accurate for less critical dimensions.

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Alternative solution to the CMM: MetraScan 3D inspecting an automotive part

Alternative Solution to the CMM

To ensure product quality, improve diagnostics, and accelerate FAIs, the automotive and aerospace industries need an alternative measuring solution—to support the CMM—that can provide QC and QA professionals with accuracy, speed, portability, versatility, and simplicity.

Accuracy: The measurement quality is essential to take on inspections previously assigned to the CMM. Additionally, the alternative solution must provide accurate, high-resolution, and repeatable results regardless of the measurement setup quality, the instabilities of the environment, and the user's experience level.

Speed: Since the CMM is slow to operate and takes time to program, the alternative solution must perform faster. It should also offer quick setup, real-time scans, and ready-to-use files, allowing QA and QC professionals to save precious acquisition and analysis time, which will accelerate QA analysis and FAIs while limiting production downtime.

Portability: As investigations often occur directly on the production line, QA specialists must be equipped with a device capable of operating in various environmental conditions without affecting performance or impacting accuracy. Unlike the CMM, which must be kept in a controlled environment, the alternative measuring instrument must have the flexibility to be brought wherever the part is.

Versatility: Moreover, the alternative solution must have the capacity to measure various part sizes and shapes—regularly seen in the automotive industry—and complex geometries and surface finishes, such as polished aluminum, which are common in the aerospace industry.

Simplicity: Finally, the alternative measuring instrument, in comparison with the CMM, must be easier to use and not require programming time to enable people with no special training, skills, or experience to operate it.

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Building an airplane; critical features must be controlled at the CMM

Conclusion

Accurate, fast, portable, versatile, and easy-to-use 3D scanning solutions, such as Creaform's MetraScan 3D line-up, are the prescribed alternative solution for QA and QC professionals in the automotive and aerospace industries who want to fix quality issues and deliver approved quality parts quickly and efficiently.

By adding a metrology-grade 3D scanner to the measuring instrument kit, delicate inspections of high-tolerance features can be assigned strictly to the CMM, while all remaining controls can be redirected to the MetraScan 3D. This action not only ensures product quality through the supply chain, but also improves diagnostics on reported quality issues and accelerates FAIs in a context of limited resources and strict requirements. ■

Source

[1] https://www.carmagazine.co.uk/features/car-culture/two-born-every-minute-inside-nissans-sunderland-factory-car-february-2016/

[2] https://www.cnn.com/2019/10/24/business/american-airlines-southwest-boeing-737-max-costs/index.html

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Device for phased array testing

Olympus has added a new model to its Omniscan test equipment that uses phased array ultrasound technology (PAUT). The Omniscan X3 test device raises the standard with innovations that improve the entire test process. Thanks to the quickly and efficiently configurable test settings and image capture using Full Matrix Capture (FMC) with subsequent image processing using the Total Focusing Method (TFM), decision-making has become even easier. After an exam is completed, trend-setting software functions simplify analysis and reporting.

An integrated, comprehensive planning aid ensures that you can get an idea of the test procedure before starting the test. This can reduce the risk of errors. The entire test plan, including the TFM area, can be drawn up in a simple process. In addition, improved calibration functions and the support of a simultaneous configuration of sensor and sound bundle group, the integrated creation via dual linear, matrix and dual matrix array sensor and the automatic checking of the leading wedge ensure faster device setup.

www.olympus.de

SWIR cameras for R&D and machine vision

With the cooled near-infrared cameras of the A6260 series, Flir has two special cameras in its range: The model Flir A6261 can be used as a fully equipped SWIR camera in a particularly flexible and versatile way, since users can set camera settings such as frame rate, integration time and window size completely according to their wishes and Can configure requirements. The A6261 has been specially optimized for the IR shortwave spectrum (SWIR) in the wavelength range of 0.9–1.7 µm and is therefore particularly suitable for applications such as laser profile detection and the inspection of silicon wafers. Your sensor enables a gain factor of up to 75x.

The Flir A6262 has special properties with its spectral range of 0.6–1.7 µm, which not only includes the infrared short-wave spectrum (SWIR), but has also been expanded into the visual range with 600 nm. The camera allows the view z. B. through glass, by applied layers of color, in the food sector through the top layer of fruit (skin) or in medical operations sometimes through blood directly onto the tissue.

www.flir.com

First-class pictures with 101 megapixel resolution

The new Shr461CX is the latest model from the SHR camera series from SVS-Vistek. The rolling shutter sensor IMX461 from Sony offers a resolution of 101 megapixels (11648 x 8742 pixels) and – as with the sister model shr411 – an outstanding image quality. The shr461 thus fulfills the high requirements that are becoming increasingly common in many industrial areas for automated image processing systems.

The Shr461 has a dynamic range of 82 dB. This is made possible by the sensor and the complex thermal construction of the camera, which guarantees the operation of the image sensor with low noise and thereby creates the conditions for the first-class image quality of the Shr461CX. This excellent thermal connection also enables the maximum operating temperature of 70 °C, which is significantly higher than the values of conventional industrial cameras in this resolution class. Due to this thermal robustness, the Shr461CX is also predestined for use in areas that are inaccessible to other cameras.

www.svs-vistek.com

Industrial test facility for lyophilisates

Antares Vision has introduced Lyo-Check, a fully automated industrial test facility for lyophilisates. It uses a technology that was developed to check freeze-dried products for contained or adhering foreign particles and also to check product containers for cosmetic and functional defects.

The patented solution has two inspection carousels: In the first carousel, thanks to the top grip technology, in addition to the inspection for deposits on the floor, the edges of the containers are also checked. The side inspection is then carried out to determine deformations and foreign particles. The most demanding and most difficult image analysis test is the upper inspection, here the lyophilisate cake is checked visually. In addition, the tightness of the containers can be checked with the head space gas analysis by examining the container volume above the lyophilisate for the presence of oxygen molecules. The machine can control up to 600 containers per minute and is based on the fail-safe system.

www.antaresvison.com

High-Tech in the Greenhouse

Modern, Efficient LED Lighting Systems Increase Greenhouse Profitability

The right lighting can create ideal greenhouse conditions. Considering possible savings in operation costs, the conversion of existing lighting systems to LED can be worthwhile.

Agricultural yield, and consequently the production of food for human consumption, have always been at the mercy of the weather. Moving production to the sheltered environment of greenhouses is one part of the solution. Exposing plants to artificial light around the clock and thereby accelerating biological processes is one step further. But such approaches require sophisticated lighting systems. The energy supply for the lighting accounts for a considerable proportion of the commercial realization of such technology.

Creating the Ideal Conditions for Growth

If lighting can be used to create optimum conditions, the ideal color temperature, and the perfect day and night cycle, the yield can be increased further still. Depending on the type of plant, it may even be possible to have more harvests in the same period than under traditional conditions. This not only allows the additional costs of the planting facilities to be recouped, but also means more customers can be supplied without multiplying the amount of land used. The discussion about advanced cultivation methods with higher yields revolves around such concepts as "urban farming," for example, which provides a way of supplying the population in conurbations with local produce without increasing transport costs exponentially.

Greater Efficiency with LED Lighting

For some time now, the high-pressure sodium and mercury lamps traditionally used in greenhouses have been replaced by cheaper LED lights. The latter are usually more expensive to buy but are always cheaper to operate than the old lights. Their greater efficiency alone saves the system operator money, not to mention the resulting lower heat loss. The simplest solution, and the action often taken in existing facilities, is to replace the entire light with an LED fixture installed in the same location and on the same mains supply. The LED light fixtures take up less space than bulky traditional lights and generate less heat, which means they can be placed closer to the plants – and that in turn enables new, highly productive approaches to gardening like vertical farming (with rows of plants arranged vertically one above the other) or container-based "farms" which require little space and can be set up and operated close to the consumer.

The way in which LEDs work is fundamentally different from conventional light fixtures. They require power supply units made to specification. If the LED light fixtures are simply fitted in exchange for the existing traditional lamps, it is not uncommon for each LED unit to be assigned its own power supply unit, which ensures that the current remains constant and controls the light intensity. Unlike most other lighting technologies, LEDs are powered by impressed current, so they require a constant current source to operate. And if each individual lamp is to be controlled (e.g. dimmed), each power supply unit will require additional wiring for a small signal control line.

Despite the considerable amount of work involved, it can be worthwhile converting an existing system because of the savings in operating costs. Additional advantages include the longer service life of the LED lamps and the lower maintenance requirements. In taking this approach, however, users are failing to exploit the full economic and technical potential associated with the use of LED lighting technology.

Opening up New Possibilities

It is therefore worthwhile, especially when developing new greenhouses and indoor farms, to adopt a completely different approach and to maximize profitability through optimum planning. The use of modern power supply systems opens the door to a number of possibilities:

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- Use of one central energy supply instead of many decentralized units;
- reduction in the amount of cabling work;
- separation of light and heat discharge and therefore avoidance of undesirable effects of direct heat on the plants. The amount spent on air conditioning can be reduced or may even be virtually zero.
- Control and monitoring of the entire system from one central location or remote monitoring over the internet or cloud;
- the option of programming lighting cycles to individual requirements depending on the type of plants;
- easier maintenance and repair.

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The iHP series offers advantages when it comes to supplying modern and efficient lighting systems.

Achieving these benefits is by no means more expensive than a conventional solution – if implemented correctly, it can even be cheaper. This applies both to the acquisition costs (CapEx) and the operating costs (OpEx). The iHP high-performance power supply system from Artesyn plays a key role in all this. Incidentally, iHP stands for intelligent High Power.

Flexible Combination, Interconnection and Operation

The iHP range consists of 19" rack modules for network connection and communication as well as plug-in modules for generating the required output voltages and output currents. The maximum capacity of the small version of the system with four plug-in units is 15 kW, while the large version with eight plug-in units delivers 30 kW. All the plug-in units are independent of each other and can supply a voltage of between 0 and 250 VDC. With a choice of connection in parallel or in series, it is possible to have any conceivable combination and to obtain up to 1,000 VDC or 1,600 A depending on the requirements. The system can be configured as a precision current or voltage source and is therefore also suitable for much more complex tasks than "just" lighting.

The modules in the iHP series can be interconnected – not only within a single plug-in unit, but also across racks. The option for larger installations like multi-level indoor farms for growing vegetables is to have 10, 20 or even 30 fully assembled iHP chassis interconnected to provide outputs of 300, 600 or 900 kW. The only upper limit in this case is the capacity of the grid connection.

Each power supply unit can be controlled down to slot level, with the capacity to address each individual plug-in module, through the updatable control software contained in the system and the large number of interfaces. The control can be both analogue and digital, but the digital operating mode offers considerably more options and scope. Users can read out the settings or change the configuration, for example. Reports and graphs showing voltage, current, temperature and power levels can be generated automatically. Operators can compile their own software or build their own dashboard with the GUI toolkit supplied by Artesyn, thereby making operation more intuitive.

Clear Advantages for Greenhouses

Back to the topic of lighting control: what do these features mean for our greenhouse?

The system provides an abundance of power for the central supply of lighting installations, including relatively large-scale systems. Moreover, because the iHP installation is separate from the lamps in a custom-built room with much better climate control (no dew, no fog and no dirt), there is less outlay on the air-cooled cabinets tested and proven in industrial environments. If the power supply systems were installed near the LED lights in the traditional way, the conditions in the greenhouses would make greater demands on the design, with the increased temperature and humidity raising the safety specification (IP67) – and of course the price as well.

With some clever wiring of lamps, e.g. five lamps connected in series, the iHP power supply unit can supply 250 VDC. The current levels are still low enough in such a configuration to mean that the only costs incurred for installation are for the cable (15 A instead of 100 A cable).

The same applies to the control system. Each power supply output can be controlled individually, so each lighting panel can be set at a different brightness or a different day/night cycle than the adjacent panel. That means the user has far more options than simply switching the lights on and off.

The centralized design means that the system is much more energy-efficient and, apart from the localized heat generated inside the LED lamps, there is no further rise in temperature due to hot power supply units. This makes it easier to cost and manage the temperature control of the plants.

Finally, the remote monitoring facility for the iHP series allows a number of oversight and inspection scenarios for unattended operation. Critical parameters can be monitored, and warning messages can be sent if necessary. There is a technical support service for users who need some help if it is necessary to replace a module which has failed or to make changes to the software. The monitoring of parameters allows servicing work to be planned and prepared in advance.

All in all, the iHP series offers clear advantages when it comes to supplying modern and efficient lighting systems. The horticulture market is booming, and advances are being made at such a rapid pace that this is helping to identify new applications all the time and to develop the variety of products on offer.

With a complex product like the iHP series, it is of course essential to provide extensive support. The strengths of the users in the market in the above scenarios will probably lie less in electrical engineering and more in biology. They will also be looking for a solution to a problem rather than a power supply. This is where Emtron electronic comes in as an authorized distributor and configuration center for the iHP series. Demonstration devices can be supplied ready configured to individual specifications and the application team will help with any questions. ■

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PCB Quality Control

Smart Laser Sensors Inspect Finest Details in Electronics Production

When manufacturing PCBs, extremely high precision and high production speeds are required. Advanced displacement sensors are used in pick-and-place machines to perform reliable quality monitoring in the micrometer range.

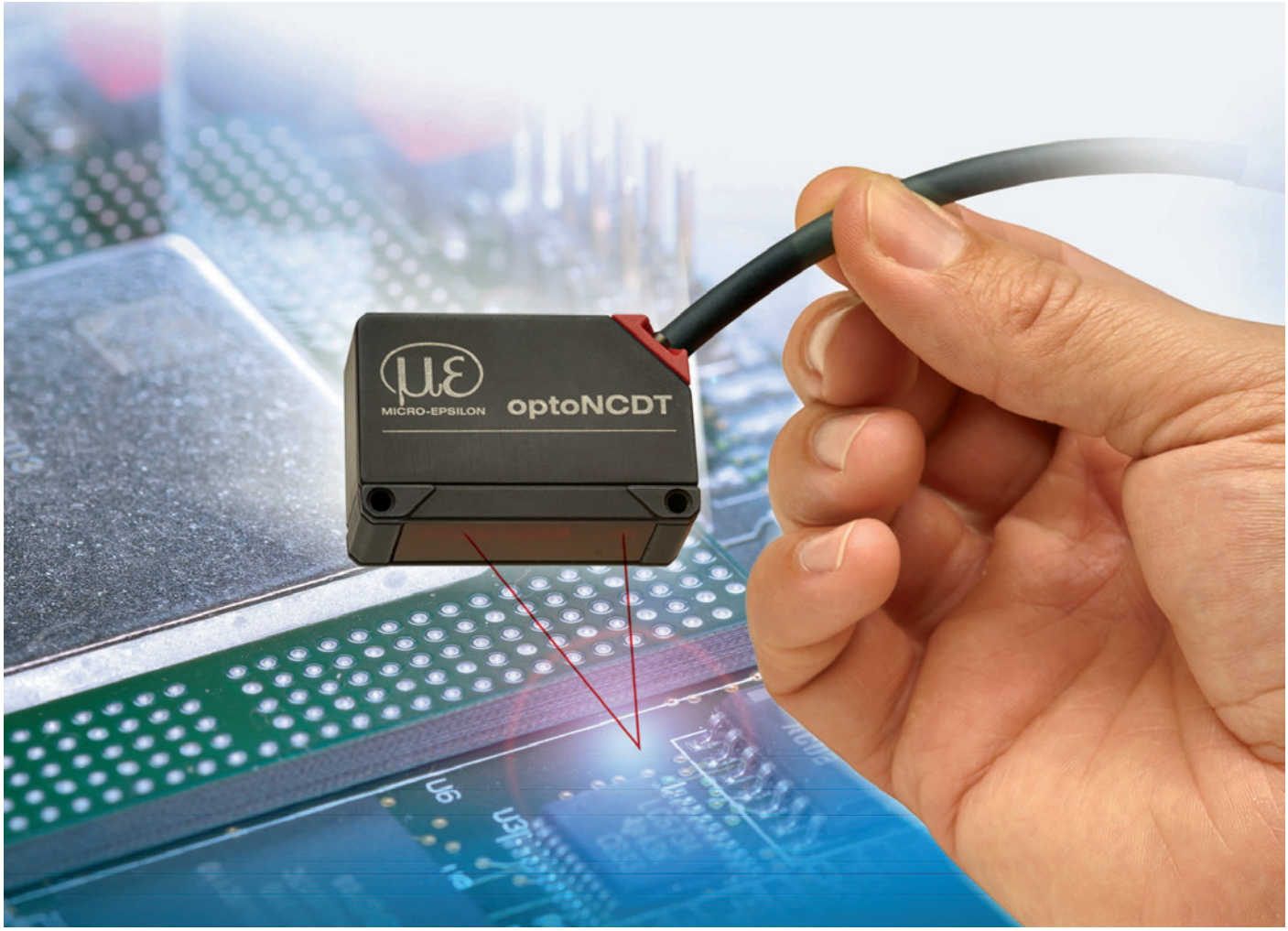
In PCB production, smart OptoNCDT displacement sensors from Micro-Epsilon inspect, among other things, the position of integrated components and measure the scribe lines of PCB panels. The most important characteristics of innovative laser triangulation sensors are high performance, extremely compact design and reliable signal adjustment with changing surfaces which ensures high precision results.

PCBs Require Precision

Whether it is smartphones, medical devices or machine tools – almost all electrical devices have a PCB. However, these devices are getting smaller, more efficient and faster whereas the development cycles are becoming increasingly shorter. This also means that the boards have to become significantly more powerful by using highly integrated components. Miniaturization of switches and individual components as well as ever increasing packing density are essential elements to fulfill the required performance. In order to ensure that current in the form of electrical energy signals or as information signals easily flows through the components, exact positioning of electronic components is crucial. With PCB manufacturing, these must not only be in the right place but also on the right level in order to properly connect them. For smooth function, the components must not be tilted.

High Requirements for the Measuring System

Sensors inspecting the position of highly-integrated components in the line must overcome a series of challenges. Primarily, these are high speed because of the highly dynamic production process, a small diameter of the focus due to extremely small components, and high spatial resolution due to minimal displacement changes that have to be detected. The smart OptoNCDT 1420 laser triangulation sensors from Micro-Epsilon are designed for high-tech applications. These laser sensors measure without contact and do not affect the PCB or the highly-sensitive components. The non-contact measuring procedure enables the laser sensors to



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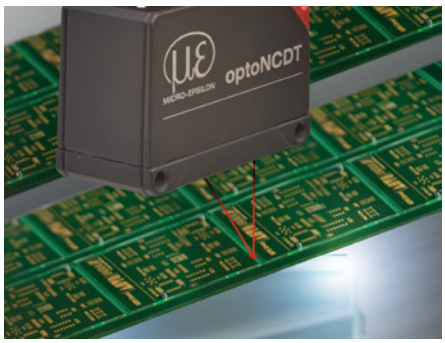

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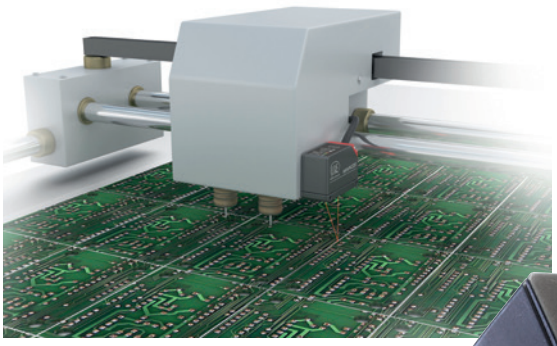

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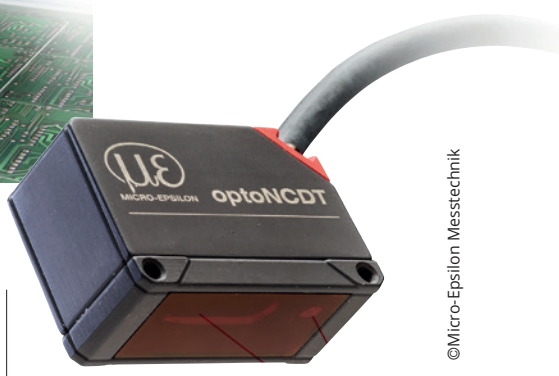
Also the scribe lines of the PCB panels must be measured precisely. Here, the OptoNCDT 1420 laser sensor is used which is suited to this application due to its combination of speed and precision with a compact design.



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Using sensors such as the OptoNCDT 1420 laser triangulation sensors from Micro-Epsilon improves the quality, reduces waste and consequently costs. The smart laser sensor measures displacement, distance and position with a repeatability from 0.5 µm.

acquire and process the measurement values very quickly.

Quality Control in Electronics Production

In quality control of PCB production, the sensors are placed in such a way that they measure the PCB from above. A traversing system guides them over the PCBs and its highly-integrated components. With a measuring rate up to 4 kHz, they detect dynamic processes directly in the production line. The sensor's compactness at just 46 x 30 mm and its integrated controller allow it to be integrated in restricted installation spaces. The smallest possible diameter of the light spot is just 45 x 40 µm, which enables high precision measurements on fine pins as the light spot can be sharply projected onto them.

Another essential prerequisite for reliable measurements on PCBs is a measuring procedure that can measure different materials, from plastics to metals, which is why the laser triangulation principle is the right choice. Therefore, laser sensors from Micro-Epsilon provide the innovative Auto Target Compensation (short: ATC) feature. Particularly with a PCB, the sensor measures on permanently changing surfaces from matt black to shiny and reflecting targets, as well as from bright to dark. The ATC ensures that the exposure time adapts to the conditions presented by the respective measurement object. To determine the measurement values, the laser sensor projects a red laser point at a wavelength of 670 nm onto the target. The laser light is back-scattered in a certain reflection angle to hit the optical system of a CMOS line. With quickly changing objects from bright to dark, only a small amount of light would reach the receiving matrix without Auto Target Compensation. 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 Micro-Epsilon sensor regulates the exposure time via the Auto Target Compensation 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 in as analog or digital output signal into the plant and machinery control system.

Measuring Scribe Lines on PCB Panels

Another application in PCB manufacture is the scribing of pre-determined breaking points into the panels for depaneling. A PCB consists of several panels or smaller PCBs which go through the production as one large PCB. This kind of bundling is necessary for production reasons since it simplifies board assembly. The scribe lines are usually produced by two opposing saw blades that cut a V-groove into the board which should allow for the small PCBs to be easily and cleanly depaneled, i.e. separated from one another, by the end of the production processes. The scribe lines are about 400 µm wide.

The scribe lines of PCB panels must be measured exactly. Here, the OptoNCDT 1420 laser sensor is also used due its unique combination of speed and precision combined with an extremely compact design for this application. The sensor detects inline whether the keyway was exactly milled into the panels. If the scribe line is too thin, the panels will break during the production process which consumes resources and may cause damage to the machines. If the grooves are not milled deeply enough, the panels would fray during depaneling and break irregularly, which means that they do not fulfil the quality requirements any longer and a lot of waste is produced.

Conclusion

Using modern sensors such as the OptoNCDT 1420 laser triangulation sensor from Micro-Epsilon ensures quality improvements while reducing waste and saving money. The smart laser sensor reliably measures displacement, distance and position with a repeatability from 0.5 µm. Its extremely small measurement spot detects even the smallest of components such as pins on PCBs with high accuracy. With more than 4,000 measurement values per second, this sensor is designed for highly dynamic processes such as those found in the electronics industry or in additive manufacturing. Its small design and the integrated controller enable easy integration into machines and systems even when installation space is low. The intelligent surface control balances the fluctuating intensity of the light reflected during the measurement process when color or brightness change rapidly. Particularly with PCBs where matt and shiny as well as bright and dark objects are side by side, this is a major advantage in order to achieve stable and micrometer-precise results. The intuitive web interface allows the user to operate the sensor. It offers predefined set ups for different measurement tasks. Furthermore, up to eight user-specific settings can be stored and exported. The video signal display, signal peak selection and a freely adjustable signal averaging enable the optimization of measurement tasks. The ROI function (region of interest) allows, e. g., for interfering signals to be filtered out. Fast commissioning is also possible. With easy measurement tasks, the user can use the multifunction button on the sensor.The characteristics that the OptoNCDT 1420 combines is as unique as its design, which received the Red Dot Design Award. ■

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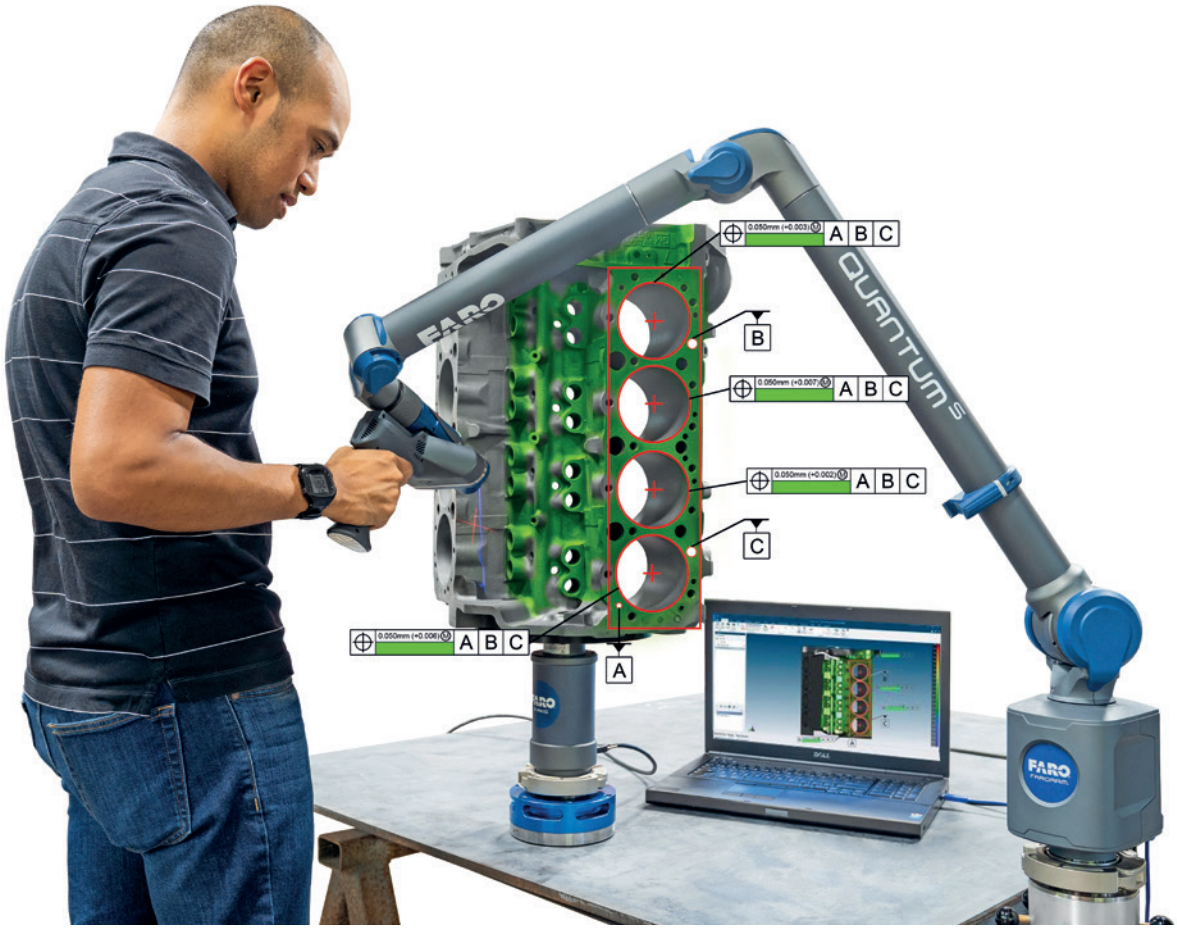


Carefree Integration for Probing and Scanning

Easy to Use and Powerful Software Platform Package

A versatile software that provides scalability, high performance, and ease of use makes the measurement experience seamless and easy for users.

Tested by the National Institute of Standards (NIST) and German Physikalisch-Technische Bundesanstalt (PTB), CAM2 has been specifically designed to enable users of Faro metrology hardware products to realize the highest level of measurement performance across a variety of manufacturing industries including, but not limited to Automotive, Aerospace, Mechanical Engineering, Machine Tools and Metal Fabrication.

Typical areas of applications include Dimensional Control, First Article Inspection, Part & Assembly Inspection, CAD-to-Part Comparison, Component Alignment & Assembly, Verification of Tools, Jigs and Fixtures, Repeat Part Management and Reverse Engineering.

Regardless of the choice of Faro hardware, be it for tactile (probing) or non-contact applications (scanning), CAM2 ensures a complete and carefree integration with the company´s metrology equipment. Moreover, users can easily connect several of the measurement devices to one running software instance. This provides the scalability that reduces inspection time by parallelizing the data capture process during any measurement job.

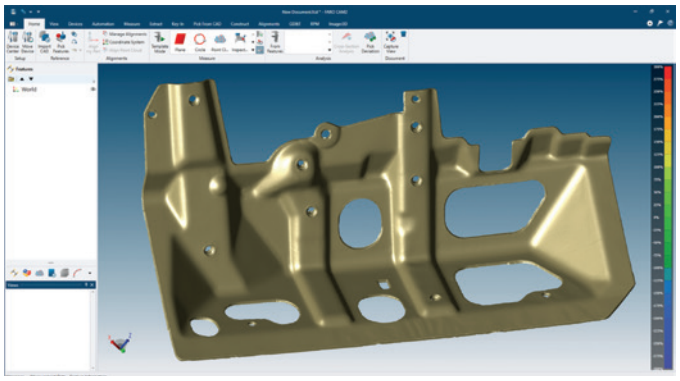
The new software has been developed to allow a seamless and easy measurement experience, without the need for extensive training or expertise, ensuring that any operators can quickly and easily accomplish their measurement tasks. This is possible thanks to features such as easy access to relevant commands, direct measurement and analysis of parts, an intuitive graphical user interface (GUI) for quick set-up management and oversight of inspection routines, image-guided, automated measurement workflows, live graphical feedback of measurement results, Quicktools, and Shortcuts that enable users to aggregate a complex measurement into single commands.

Enhanced Usability and Smart Guidance

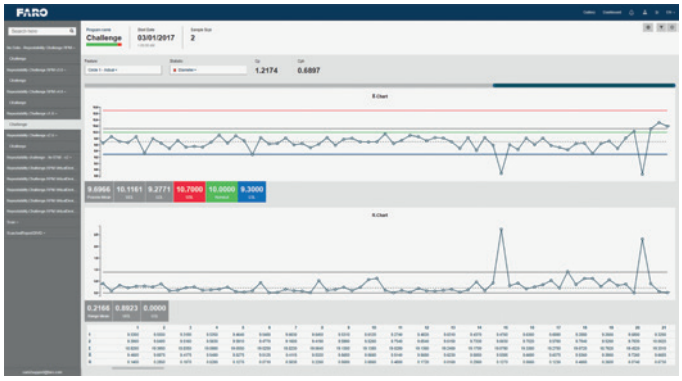
In addition to the tight integration with proprietary metrology products, CAM2 2019 extends the narrative for high value interactivity and usability.

With built-in universal CAD translators, all major CAD file formats can be directly imported into the software at no additional cost. The software supports the import of different CAD formats from various vendors: 3D Systems (ACIS, CATIA V4, CATIA V5, CATIA V6 and Solidworks); Autodesk (Inventor and AutoCAD 3D); PTC (Creo); Siemens (I-deas, JT, NX, Parasolid and Solid Edge); Rhinoceros (Rhino3D). Open formats include IGES, PRC, STEP, STL, and VDA-FS.

The ability to directly load the native CAD file also improves the fidelity of the result-



The software's mesh generation capabilities produce visually-appealing and metrology-grade STL files that can be trusted when measuring to a golden part.



The Repeat Part Management (RPM) Control Center addresses the increasing needs for SPC (Statistical Process Control).

ing CAD that is used in CAM2 as it eliminates a common double translation to and from open CAD formats.

The software offers new features which guide the user through specific operations, visually and audibly. The idea is to lower the bar for the technical expertise required to use Faro 3D measurement solutions, shorten the workflows and allow users to direct their primary focus on the measurement results themselves. For example, it provides users with scanning profiles to assist them in selecting the most suitable settings ensuring the correct level of data is captured. Now, when capturing a point cloud, the feature properties option provides the following scanning profiles:

- Full: Captures with the full resolution of the laser line probe, the laser scanner attached to the Faro measuring arm.
- Fine detail: For small components which present fine details such as very small detailed moldings.
- Detail: For components where some details are present, such as, for example, small pressings with etched or stamped part identification numbers.
- Curvature: For molded or pressed parts that have many small curved or radi-used surfaces, such as plastic molded or pressed automotive components.
- Smooth: For larger parts with flat or large curved surfaces, such as motorbike fuel tanks or car body panels.

To use a scanning profile, the user simply selects the required icon. It is also possible to create custom profiles, by double clicking an existing profile and editing the settings.

Preset Scanning profiles enable any user to choose the appropriate scan setting for the specific part type with a simple click of a button, thus streamlining the overall measurement experience.

Moreover, with the live deviation color scan functionality, users can quickly check the quality of parts during the scanning process rather than as a post process. CAM2 provides real-time feedbacks with different colors showing deviations of scan data from CAD models as the operators are scanning, allowing live identification of potential issues. An additional feature that facilitates users' activities is the align-my-part wizard, which simplifies CAD-to-part alignment. With a single button click, the operator is guided through the process of defining an alignment using three features or six or more surface points.

New Meshing Algorithms

CAM2 also presents new meshing algorithms to provide aesthetic metrology-grade STL files that can be trusted when measuring to a golden part, while the export mesh wizard has been simplified to aid users in choosing the correct meshing profile for their data. Once a point cloud has been created, the operator can simply export to mesh: as soon as the required point cloud has been selected a profile-selection window assists the users to identify the correct meshing profile for their components. There are three different profiles available which are specific to component surface types. Once the required profile is selected, the operator can determine where to save the STL file and whether to import into the software, prior to the mesh creation.

Geometric dimensioning and tolerancing (GD&T), the system for defining and communicating engineering tolerances, has also been optimized. Simplified analysis and visual reporting allow the results from a part inspection to be displayed just like a print to easily interpret part quality. This overall perspective eliminates the need to look at each feature sequentially in order to make the same determination.

Once measurements have been completed or anytime required by the manufacturing processes, the software's reporting capabilities allow operators to generate and share customized, comprehensive and easy-to-understand overviews of quality inspections, both inside and outside their organization. Based on specific needs, the graphically-rich reports can be customized in terms of format and information, while the use of colors intuitively highlights the status of inspected parts according to the defined tolerances.

Actionable Intelligence Through Statistical Process Control (SPC)

The new software has been designed to allow any user to step through even the more complex inspection routines. "RPM" – repeat part management provides an ecosystem where part programs from CAM2 can be uploaded and run within the RPM control station, a fully-guided inspection software that can be executed by anyone, anywhere across a factory floor. That means that a specific inspection process can be designed once and then repeated and easily executed by anyone on the factory floor.

The software platform also supports an effective and smooth interconnection between metrology measurements (quality assurance) and production. It features the RPM control center, an integrated, web-based dashboard reporting tool that delivers real time inspection results and insightful trend analysis in a user-friendly set of adaptable visual reports.

This addresses the increasing needs for SPC, delivering actionable manufacturing insights that go beyond simple component quality, with statistically based graphs and results for trend analysis and predictive alerts. These alerts not only highlight that the measurement target is trending beyond tolerances, but also provide advanced intelligence into the process and why a specific situation is occurring. This helps companies improve their processes and predictively anticipate when and why components may drift out of specification. ■

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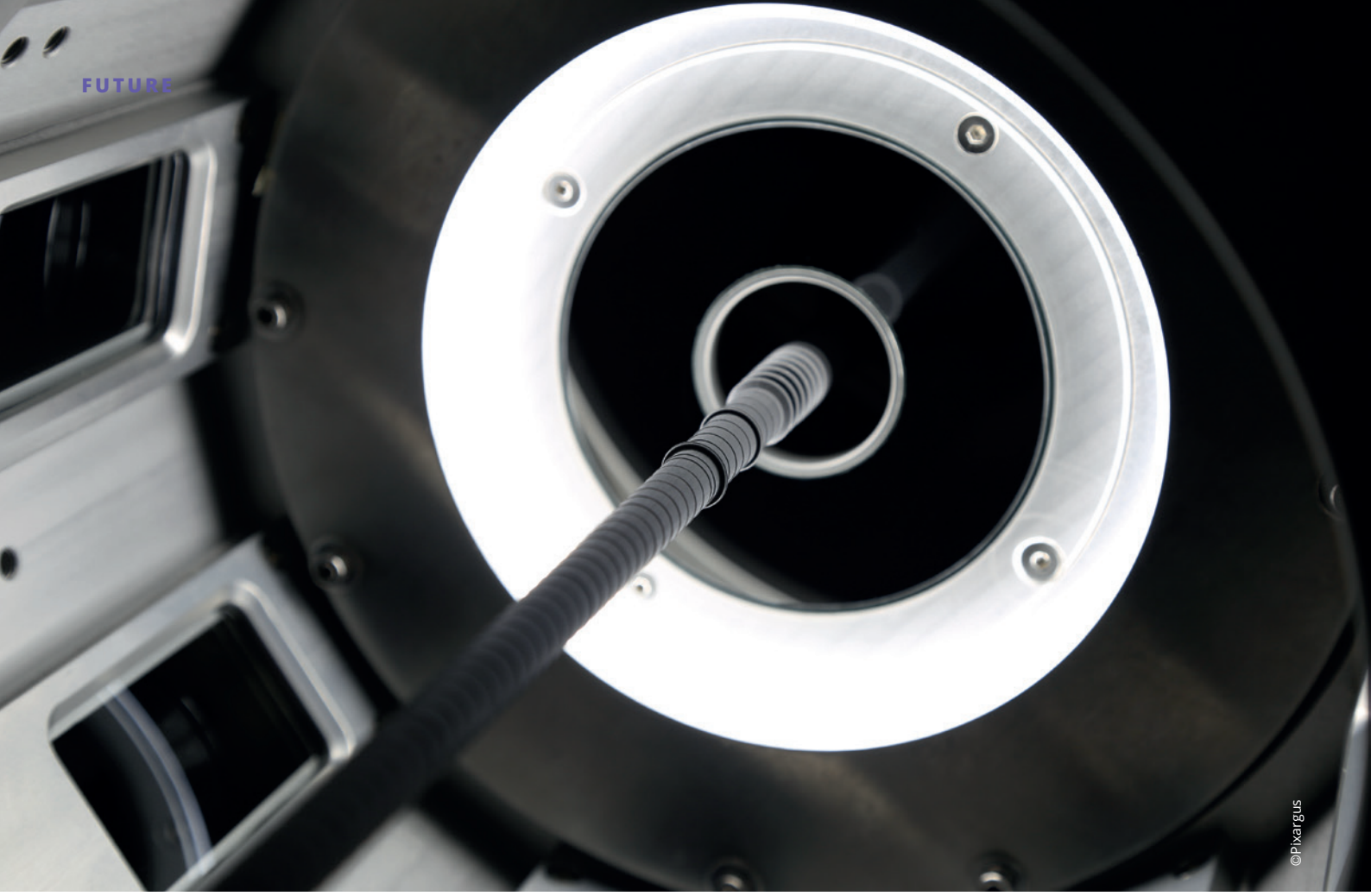


Perfect Waves

New Inspection System Excels as Quality Checker of Corrugated Tubing

A new inline gauge enables the inspection of the complete wavy structure of corrugated tubing gaplessly, taking measuring technology for plastic products to a new level.

With the new inline gauge Profil control 7 S Corrugated Tube developed by Pixargus it is now possible to inspect the complete wavy structure of corrugated tubing gaplessly. Newly developed algorithms enable, for the first time ever, the inspection of so far undetectable areas: not only the peaks and valleys, but also the transition areas in between. This inspection capability reduces out-of-spec production and will cut process costs.

Special Structure Challenges Quality Inspection

Corrugated tubings have become a multi-talent in machines, instruments and vehicles thanks to their extraordinary flexibility, which is rendered by their wavy structure. The special structure that gives plastic tubing this unique flexibility used to be a very rough terrain for quality inspection systems, because of the challenge of having to deal with a product surface that alternates between plane and curved structures. A reliable surface inspection system must be able to automatically differentiate between the two and inspect them – continuously – according to different specific quality parameters. All this is now possible with the groundbreaking inspection system ProfilControl 7 S CorrugatedTube (PC7 S CorrugatedTube) developed by Pixargus.

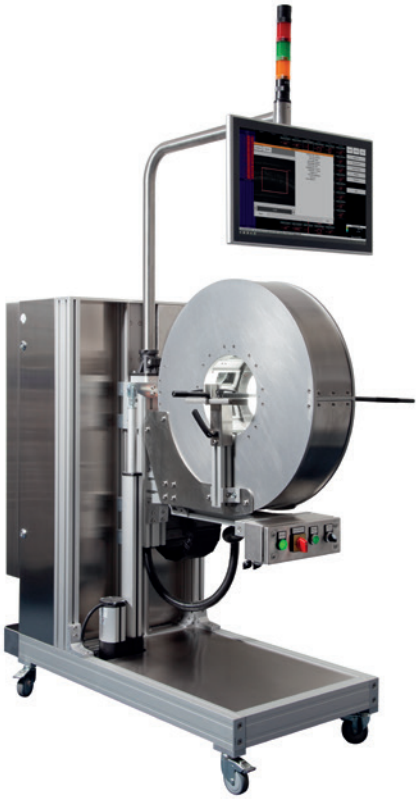
Pixargus

Pixargus, founded in 1999, develops, manufactures and markets systems for optical inline measurement and inspection of continuously running long products, such as profiles, tubing, tubes and cables as well as webs made of a great variety of materials, and for single-piece inspection.

Today, the company's systems are in use 24/7 in manufacturing operations in the automotive, health care, building and infrastructure as well as consumer goods sectors.

The medium-sized company is a "hidden champion" in optical inline quality inspection. Worldwide all major manufacturers of automotive rubber profiles use Pixargus systems for surface inspection and profile measurements. An additional mainstay of the company is the carbon composites and fiber market. Here, the company's inline systems inspect and measure webs, plates and roving made of carbon and fiber composites. Also, in medical engineering the manufacturer has set new standards with its inline surface inspection systems for medical tubing.

»Eight high-performance cameras capture the surface structure of corrugated tubing from different angles, inspecting not only the peaks and valleys, but also the transition areas.«



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Profilcontrol 7 S Corrugated Tube sets a new standard as it is the first ever inspection system capable of performing high-accuracy inline quality control of flexible tubing.

An Innovative Sensor Head and New Algorithms Assure Total Defect Detection

Using the successful technology of its proven PC7 S Tube inspection system, Pixargus has developed an entirely new sensor head for corrugated tubing. Eight high-performance cameras capture the surface structure of corrugated tubing from different angles, inspecting not only the peaks and valleys, but also the transition areas. Entirely new algorithmic processes were developed to enhance the software which is now able to detect the change from plane to wavy and vice versa by masking out specific surface structures. This makes even extremely small flaws visible. Holes, dents, blisters, nodes, scratches, fissures or poorly crimped joints will be detected with 100 percent reliability. As a result, out-of-spec production of corrugated tubing can be immediately reduced – as well as the production costs.

Easily Scalable and Optimally Networkable

The PC7 S CorrugatedTube inspects, with highest precision, the corrugated and spiral tubing of virtually any geometry, surface structures and colors. It is designed for tubing of up to 30 mm and more. The modularly scalable system can be easily integrated into Industry 4.0 environments and comes with all common interfaces, such as OPC-UA, for example. ■

©Pixargus

Even flaws too tiny for the human eye to discern are recognized by Profilcontrol 7 S Corrugated Tube in a matter of seconds: holes, dents, blisters, nodes, scratches, fissures, for example, or poorly crimped joints are detected with 100 percent reliability.

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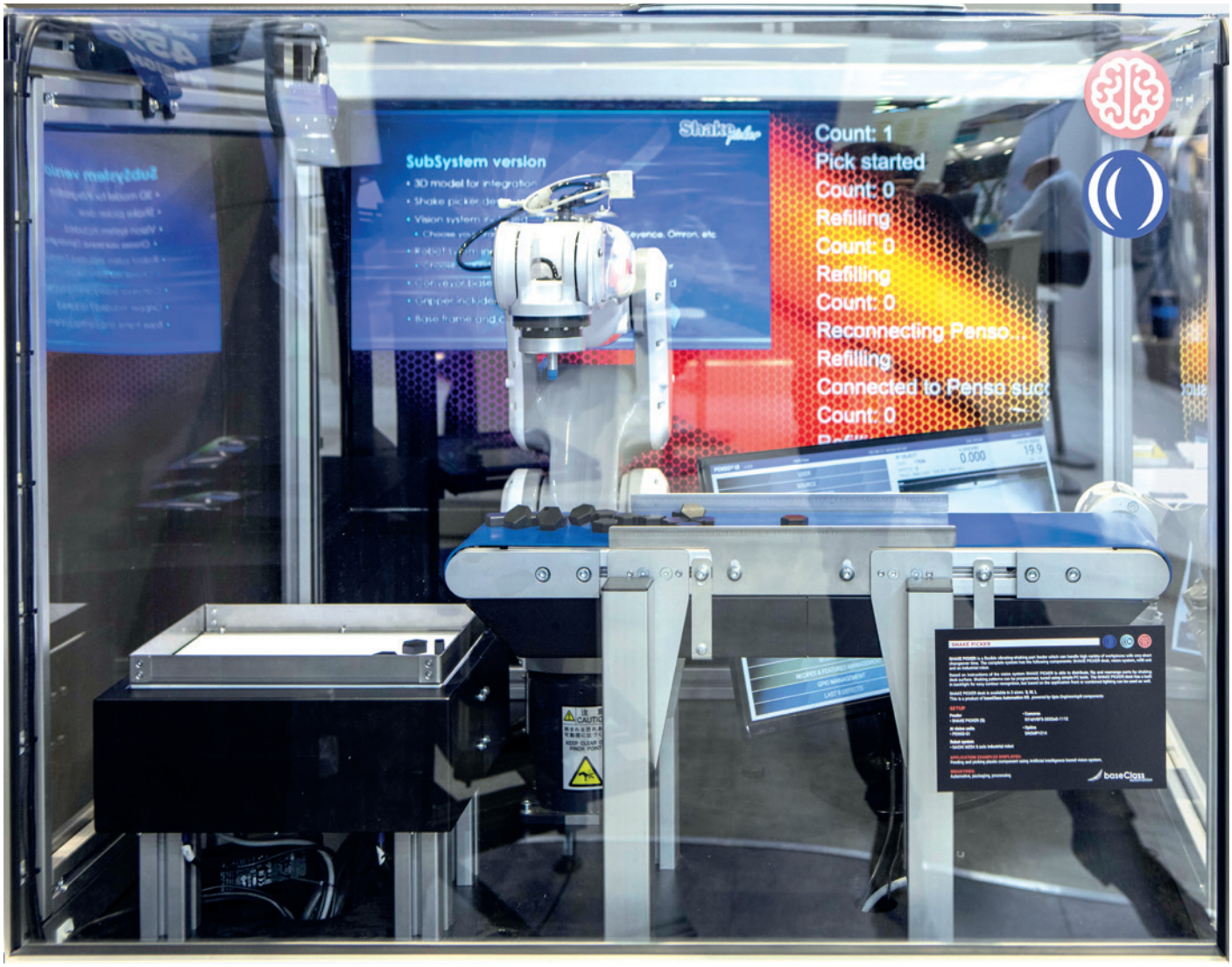

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AI for Imaging Applications

System for Part Handling Powered by an Artificial Intelligence-Based Computational Unit and Data Flow Based Software

A new, complete solution for imaging applications includes a module for flexible part feeding, an AI-based computational unit equipped with camera and fixed focal lens, a robot arm with gripper, a conveyor based refilling system, and a complete guarding and safety system.

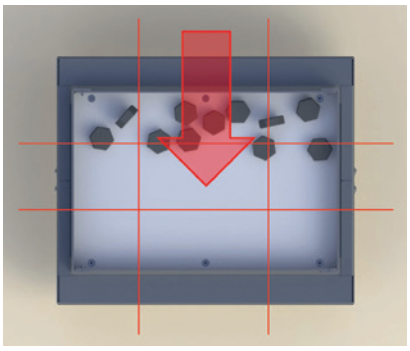
In today's industry one of the main features sought after is simplicity. Every day, vision engineers are faced with many different tasks and challenges, but the beauty of a bright idea, an exceptional moment of genius, a simple trick which solves everything – that is what everyone is looking for.

Simple Works Better

At imaging component manufacturer Opto Engineering, the motto is: simple works better. One can work on a simple and efficient solution from many sides. Choosing the right hardware is, of course, critical – and that is where your trusted supplier of components comes into play. But it is with software that things usually come to a halt. Many software products on the market are either too complex or too simple, and they do not provide the optimal combination of capabilities and ease of use needed to move things forward smoothly and save precious time. That is the spirit behind an innovative solution developed by BaseClass Automation from Hungary that recently released Shake Picker, an innovative system for part handling powered by two special products from Opto Engineering: Penso, an artificial intelligence-based computational unit for imaging application, and FabImage, a data-flow based software designed for machine vision engineers.

Flexible Part Feeding

The Shake Picker system is a vibrating, shaking solution for flexible part feeding. The parts laying on its flat, backlit surface can be



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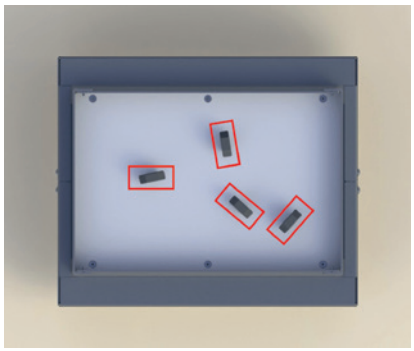
Directional shake program – uniformity of parts distribution



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Custom shake program – verticalization of parts

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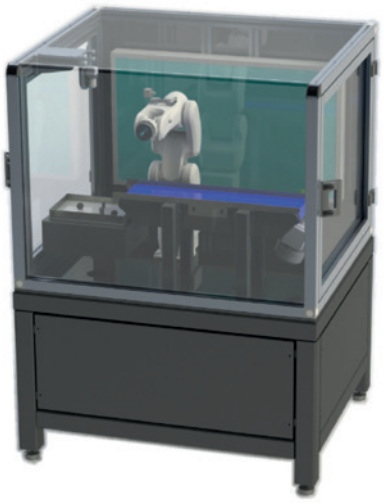
Penso

moved and distributed as needed by its 4D shake engine, with an adjustable frequency in the 0.5 to 100 Hz range and customizable wave shape. Using either one of the 32 shaking pattern program banks – or a custom program – parts distribution can be controlled precisely. According to the actual parts distribution, directional shake programs can be executed to redistribute parts equally. In addition, the system integrates a digital I/O based program selection. The module offers several advantages:

- it is suitable for parts that cannot be handled by bowl feeders;
- fine tuning is carried out via software rather than mechanically and can thus be done remotely;
- there is no part jamming;
- part changeover does not require hardware changes.



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The Base Class Shake Picker – System version

AI-Based Computational Unit

Of course, to exploit its entire potential, the module must be governed by a vision system. That is where the collaboration with Opto Engineering comes into play. The manufacturer helped Base Class to finalize the first version of the system called Shake Picker – System version which was successfully presented at the Vision show in Stuttgart in 2018.

©Opto Engineering

Fab Image

Shake Picker – System version is a complete solution which in its complete setup includes the Shake Picker module, Opto Engineering Penso, an AI-based computational unit equipped with camera and fixed focal lens, a robot arm with gripper (for example from NACHI, OTC-Daihen, Fanuc, ABB, or others), a conveyor-based refilling system, and a complete guarding and safety system.

Penso is an artificial intelligence-based computational unit for imaging applications. It self-learns the expected features of an object by simply looking at a small series of samples, regardless of the possible presence of defective product among them. The information related to defective parts can be sent to the robot arm via TCP/IP protocol. The robot arm can then move or discard the respective part.

New Projects with Data Flow-Based Software

Recently, Opto Engineering cooperated with Base Class again providing components for new projects with Shake Picker. This time, instead of using Penso, the robot was controlled using a vision application developed with Opto Engineering FabImage Studio Professional. Fab Image is a data flow-based software designed for machine vision engineers. Its graphical design allows for fast software prototyping, while the easy "export to code" function provides developers with the freedom needed for the most advanced applications. Its architecture is highly flexible, ensuring that users can easily adapt the product to the way they work and to specific requirements of any project – as it was the case with the Shake Picker – System version.

The right choice of components, the support provided by the vendor to integrate them and the innovative ideas of the integrator are a sure recipe for success. ■

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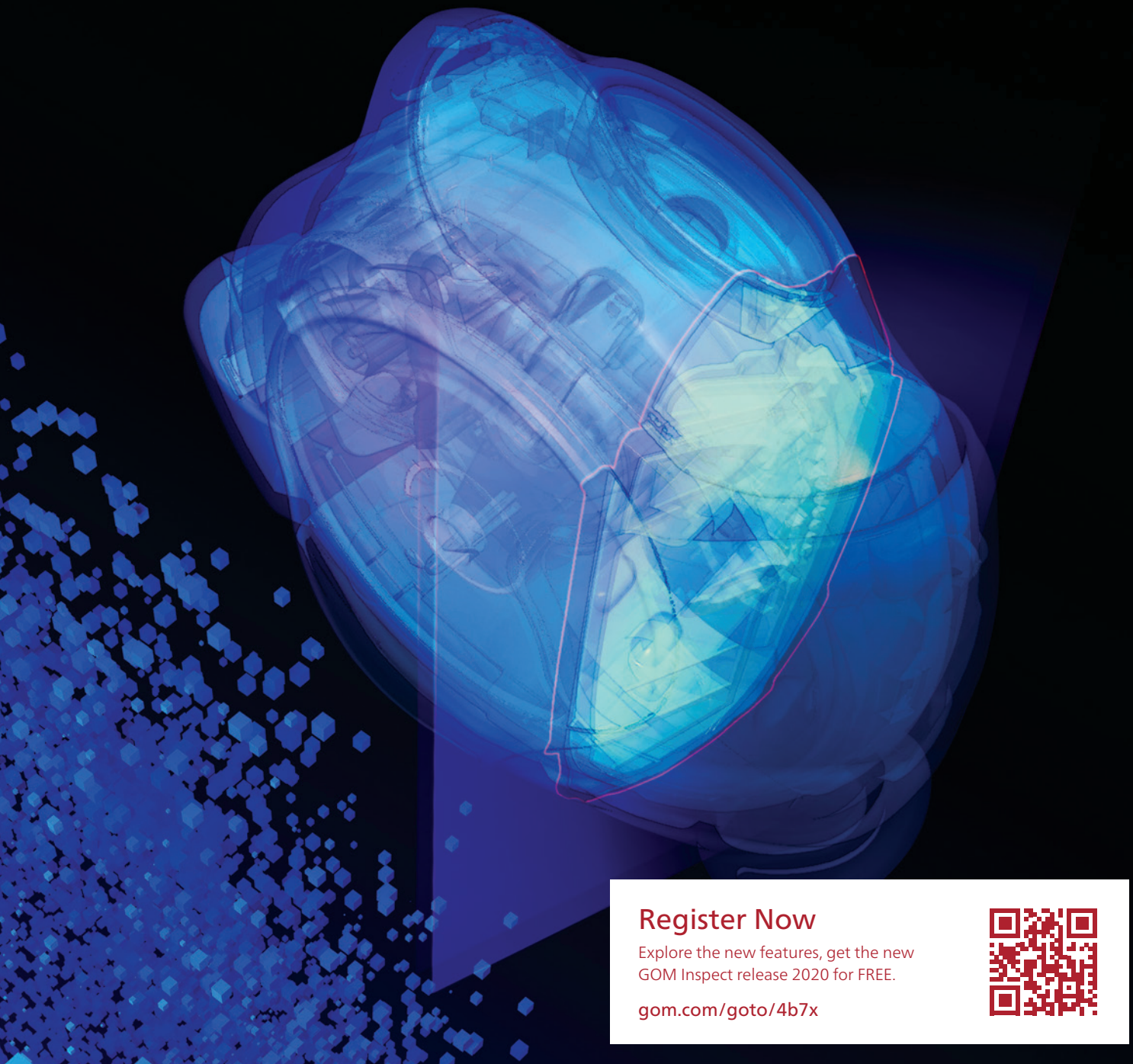

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