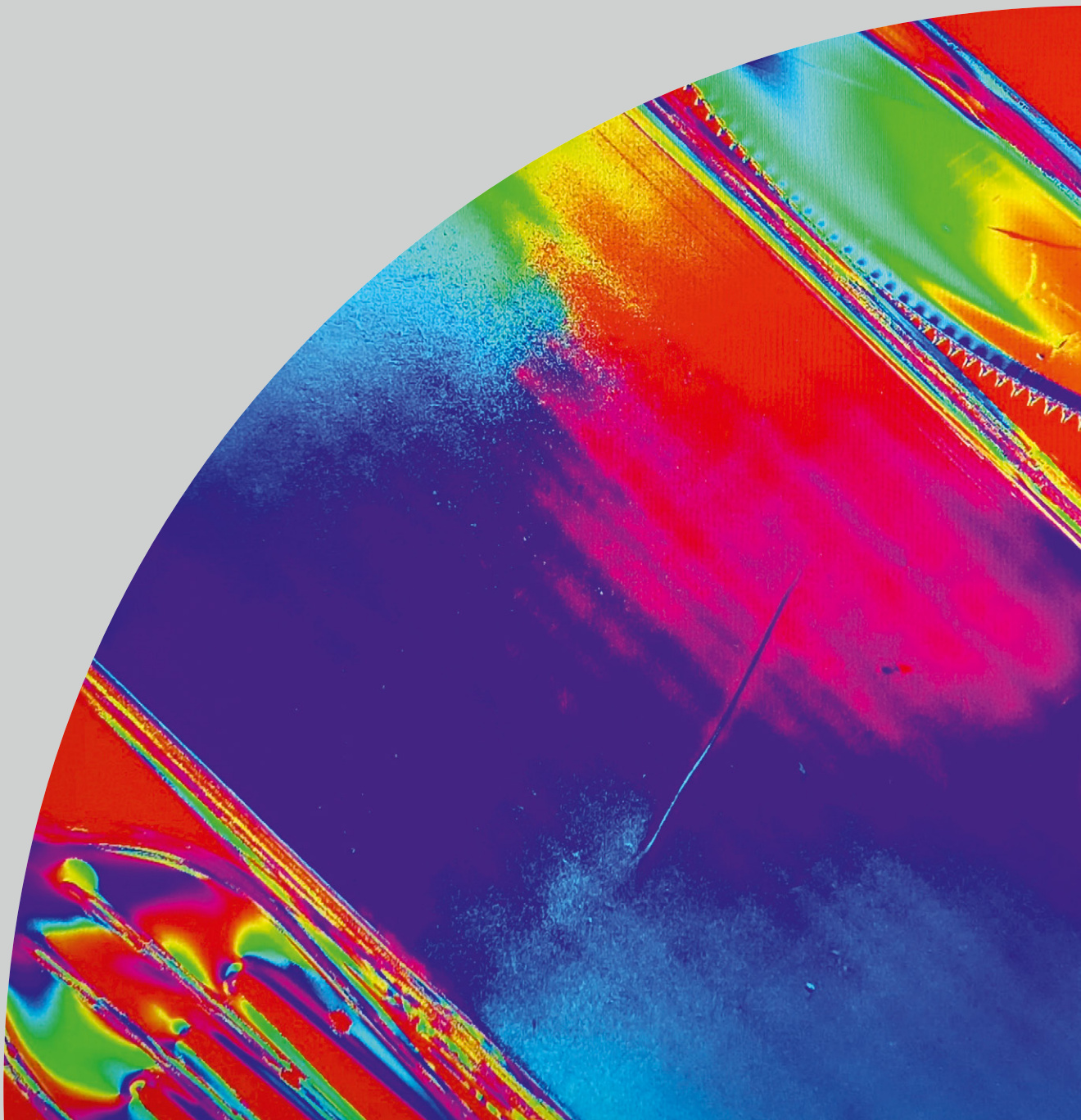
Machine Vision

Key Technology for Automation Solutions

Machine Vision 2021/22

Applications – Products – Suppliers



Contents

Machine vision – when machines see and comprehend

Cameras generate images that are automatically analyzed by software. Machine vision systems perform quality tests, guide machines, control processes, identify components, read codes and deliver valuable data for optimizing production. Machine Vision is constantly capturing new fields of application – also beyond the arena of manufacturing – always striving for higher quality, efficiency and product safety.

10 reasons to use machine vision

100% quality check for maximum product quality

Producing quality non-stop, 24 hours a day, 7 days a week – expensive product recalls, product liability claims and image loss can be avoided.

Higher productivity and competitiveness

Modern production is automated. Machine vision enables manufacturing companies to remain competitive, to prevent an exodus of key technologies, to generate qualified jobs, and to capture new markets. Not just since Covid-19 has it become clear that production is increasingly carried out where consumption takes place, not least because of rising environmental and transport costs. Production becomes competitive through the use of machine vision. The outsourcing of production to low-wage countries can be avoided.

Safe production, reliable products

Machine vision guarantees safety – in your production process as well as in the end product.

Sustainability

Smooth material flow, considerate use of energy and resources – machine vision makes it possible. At an early stage in the production process faulty parts are detected and sorted out before they are processed further. It prevents prevents defective components and a high reject rate of products.

Stable and optimised processes

Recognizing trends and irregularities in production processes early on – machine vision paves the way for realizing the smart factory of the future.

High savings potential

Machine vision systems lower your costs. They often pay off after only a few months.

Flexibility

Modern vision systems are flexible, able to learn and to adapt. This is ensured by self-training and standardised interfaces software. “Plug and play” – this is what the machine vision industry is working on. Even batch size 1 becomes feasible.

User-friendliness

Specific programming skills were perhaps previously required. Ease-of-use and seamless integration into the production process have been commonplace for a long time now.

Ergonomic workplaces

Checking tasks are often monotonous and tiring for the eyes. Sometimes they are too complex for the human brain. Monotonous and dull tasks are accomplished by a „seeing machine“ – machine vision systems support workers, ensure a perfect human-machine interaction resulting in a more advanced and safe workplace.

A technology serving people

With and for humans, ensuring security, higher quality, and safety in and outside the factories worldwide. Optimising traffic flows, the perfect swing in golf, training of medical doctors, checking moles, waste separation and recycling – all benefit from machine vision!

Machine vision – a growth market

The machine vision industry in Germany and Europe has been reporting high growth numbers and record sales figures for years. Between 2013 and 2019, sales in the German industry grew by an average of 9% per year. In 2020, sales declined due to the COVID-19 pandemic. But far from being as drastic as in other industries.

The reason for the boom: Equipped with machine vision systems, machines and robots are learning to “see”. Within the global race towards greater automation, this key technology is not just found in traditional industrial sectors, but is conquering brand new areas too. Improved quality, greater reliability, increased safety and cost-effectiveness are benefits that are just as crucial in non-manufacturing contexts as in the realm of industrial production.

www.seeing-machines.eu

Machines with eyes wide open
You want to know more about machine vision? Then take a look at the VDMA multi-media report about „seeing machines“.

The future of industrial production

The factory of the future will be designed to yield maximum benefit from the lowest possible consumption of material and energy. Interconnected and more flexible production processes will pave the way for new business models. All devices will be able to communicate directly with each other and thus create true interoperability.

Strict quality specifications are commonplace today. Random quality checks are increasingly replaced by a 100% quality control approach. Each and every stage of production becomes subject to comprehensive documentation and traceability, especially when the product is safety-critical. This is economically feasible thanks to machine vision systems that undertake infallible quality checks along the production cycle. Expensive product recalls, product liability claims and image loss can be avoided.

Global competition is becoming fiercer: only those production facilities that are among the leaders in terms of productivity and costs will be able to survive. Machine vision plays a key role in this because it offers solutions suited to meet the challenges of the future.

From inspection to optimization

Many machine vision systems today are more than pure inspection systems, as they make it possible to recognize trends in production processes early on. Thus quality control is evolving into production optimization, which allows to flexibly react in the intermediate stages of production, for example by implementing warning thresholds in the software for the classification of error types, sizes, dimensions and many other inspection criteria. This allows to detect at a very early stage any changes that are slowly creeping in. The documentation of characteristics that are relevant for quality, helps uncover the cause of an occurring error. The identified error can then be effectively avoided. Should errors occur nonetheless, it is increasingly possible to implement automated rework of the faulty workpiece.

The Industrial Internet of Things, Industry 4.0 and Machine Learning

Machines, production resources and products are increasingly directly communicating with each other and are interconnected; starting with the customer's order to quality control, from the shop floor to the board room. The resulting

data convergence will open up entirely new intelligent production options in which all objects influence and control each other by means of autonomous data and information exchange. The "Smart Factory" resulting from this will follow a completely new production paradigm: Products are identifiable, can be localised at any time and know their history, their current state as well as possible options on their way to finalisation. Customized one-off products, manufactured fast and efficiently, will thus become reality. Moreover, artificial intelligence, especially machine learning, will further optimize production. Deep learning algorithms continue to improve the performance of machine vision systems, allow for intuitive "teaching" of inspection tasks, help find anomalies and enable predictive maintenance.

Machine Vision: key technology for Industry 4.0

Machine vision is the trailblazer and key technology for these interconnected production processes. No other component is able today to gather and interpret as much data as machine vision systems. The idea is to verify and process what has been "seen" and transmit the results to the systems of the value chain in every phase of production. This is not only about finding out whether a part is good or insufficient but about triggering intelligent actions. Machine vision is perfectly suited to do this because it is the "seeing element". Increasingly, autonomous guided vehicles (AGV) and autonomous mobile robots (AMR) are roaming in the factory floor to transport things to the right place at the right time. Machine vision provides them with the sensory capabilities to navigate intelligently and safely in areas with constant movement of people. A new concept using many mobile robots is the so-called "matrix production". It consists of robot cells that are connected by mobile robots which bring tools and workpieces where they are needed – seemingly guided by an invisible hand, but in reality guided by machine vision and AI.

Interoperability, connectivity and standards are key factors

Interoperability and the ability to interconnect are key factors when it comes to implementing Industry 4.0. But standards are crucial: Information networks between companies and straightforward integration of different value chains are only possible if all those involved agree on standards. They define the mechanisms of cooperation and the information to be exchanged. Like many players, VDMA supports the communication architecture OPC Unified Architecture. Currently around 30 branch specific OPC UA companion specifications are being developed within VDMA, all of which work in cooperation with each other in order to ensure seamless interoperability with each other in the near future.

In September 2019, Part 1 of the OPC UA for Machine Vision Companion Specification (in short OPC Machine Vision) was published (Part 1: Control, configuration, management, recipe management, result management). Part 2 is currently being developed. The industry agrees which information, data, functions and services are to be integrated into a production network and mapped in OPC UA. The aim is an easy connection and straightforward integration of machine vision systems into production control and IT systems.

OPC Machine Vision describes the interface between machine vision systems and other systems in an automation scenario. Previously, the system integrator had to develop proprietary interfaces for each machine vision application. The working group has now defined a uniform interface that will significantly simplify the entire integration process in the future. Standardised integration of machine vision with all its possibilities will advance it from a mere inspector to a true production optimizer.

From product quality to quality of life

In industrial production, machine vision displays the qualities of a genuine all-rounder. Moreover it has proven itself in many other fields of application beyond the factory. Improved quality, greater reliability, increased safety and cost-effectiveness are benefits that are just as crucial in non-manufacturing contexts as in the realm of industrial production.

Are all pins in the right place?

This question is often only clarified when all the parts are assembled. But this is often too late and could lead to defective products, for example.

With the help of machine vision, it can be determined in a matter of millisecons whether the pins will fit into the PCB's hole pattern.

For this purpose, a high-precision image of the circuit board is created. This considerably simplifies the testing process for the pin inspection of connector assembly lines, as faulty connectors are sorted out before assembly. Good, because who would want a smartphone that does not work reliably?

Source: senswork GmbH

An acoustic camera makes sounds visible

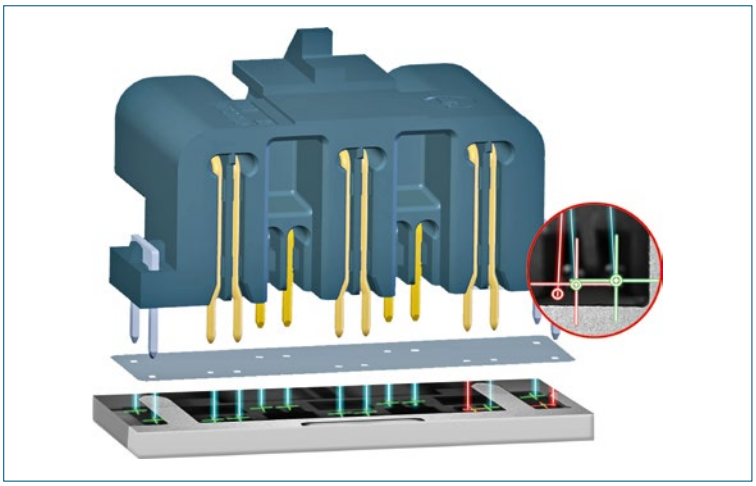
Integrated into the image processing software, an acoustic camera can be used to determine and visualize not only the presence, but also the exact location of an error source. Data obtained in this way can be used to draw precise conclusions about problems in the manufacturing process or to generate detailed repair instructions.

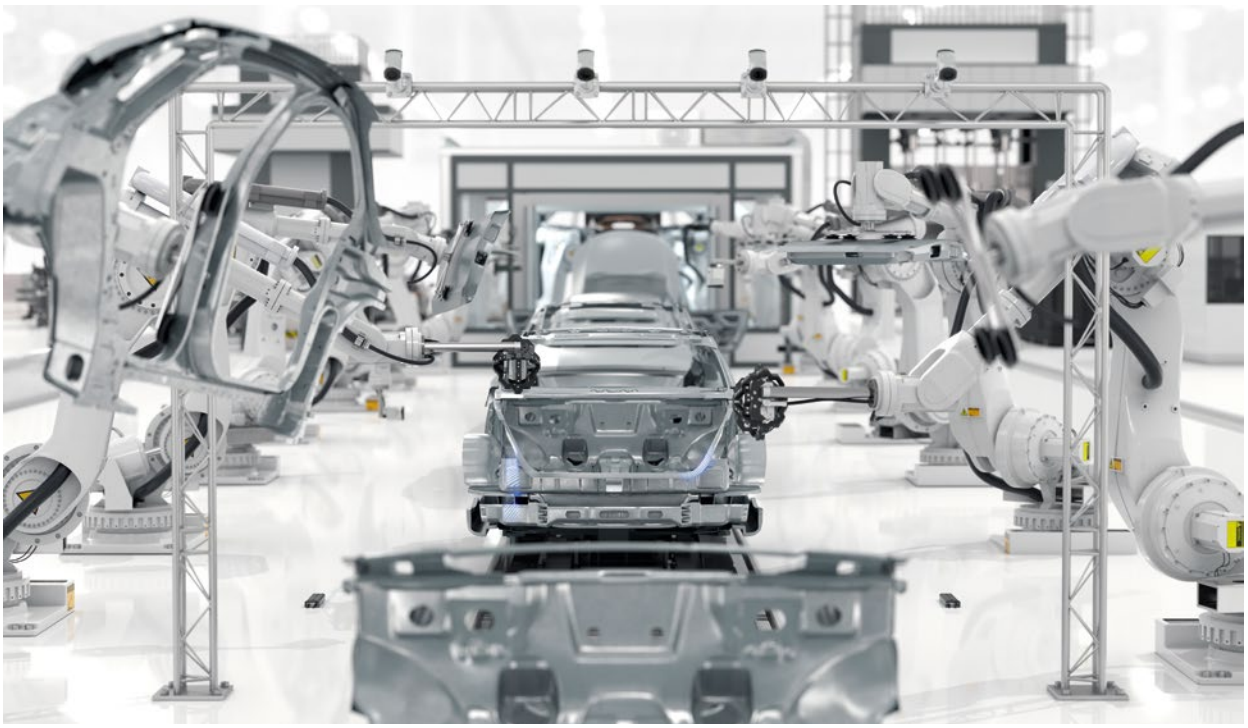
An acoustic camera is used, for example, to check plug connections. In addition to the visual appearance of a plug connection, the noise that occurs during the assembly process and its location can help to assess whether it has been executed correctly. In many cases, the mounting position is not ideally visible or not visible at all for a stable evaluation by purely optical means during the process. Especially in cases like these, the signal offers a variety of additional evaluation options to ensure the quality of the plugging process.

Source: NeuroCheck GmbH

Absolutely in-line with correlation-free metrology

In-line measuring systems in the automotive industry monitor the production process and provide production plant operators with trends regarding process stability and quality.





With high-precision and fast 3D sensors, features such as bolts, holes and edges can be measured directly in the line in milliseconds. The sensors enable the inspection of the quality-relevant features required for inline process control in production. As a result of the new tracking technology, which records the sensor position on the robot arm with high accuracy regardless of temperature influences, metrological tasks can be performed in a cell in the production line in addition to process monitoring. Thus, time-consuming correlation measurements with coordinate measuring machines in a dedicated measuring room are no longer necessary. This means that reliable, traceable measurement and test data are available from the first component produced during production start-up. In addition, the new tracked and traceable in-line measurement technology offers the potential to shift periodically occurring metrological measurement tasks into the line, which contributes both to a significant acceleration of responsiveness due to the greatly increased measurement frequency and to an increase in the efficiency of production processes. This results in a much higher measuring frequency for quality assurance and much higher accuracy for process control.

Source:
Carl Zeiss Automated Inspection GmbH

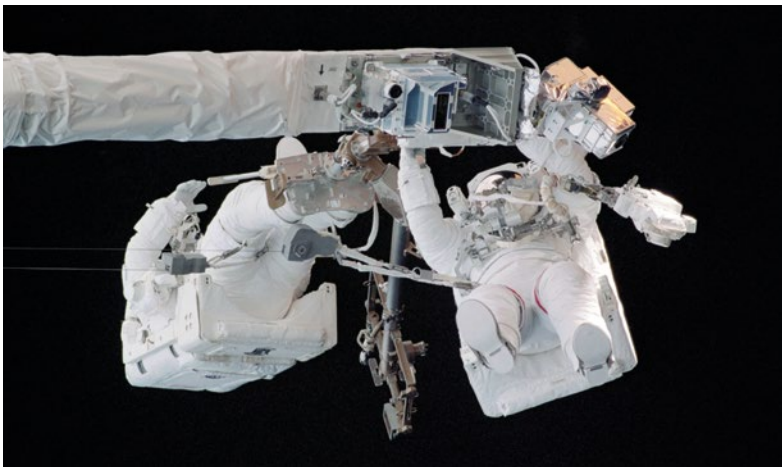
Surface inspection

In industrial production and quality assurance, surfaces often have to be inspected, either during production or in random samples of the finished product. Various 3D sensors, such as laser scanners and SfS sensors working according to the “shape-from-shading” principle, are used for this purpose. Three main areas of application can be distinguished:

- **Form test:** In a 3D image of the surface, deviations from the shape, outer contours, and often also flatness must be checked.
  Identification of defects: This is about finding and evaluating local defects. These can be scratches, bulges, blowholes, burrs, and bursts, etc.
  Roughness test: Surfaces always show a more or less pronounced roughness. Depending on the application, a maximum roughness is permissible, or a defined roughness is required.

This technology is used in many applications: from surface testing of aluminium, checking the roughness of textured lacquer samples during production, to testing Braille characters, or even measuring wrinkles after washing processes.

Source: in-situ GmbH



Weld visualization using 3D-welding helmet

For many years welding helmets have protected welders´ eyes at the cost of visibility and productivity. While worker safety is paramount, this reduction in capacity represents one of the biggest limitations to productivity in the field. To achieve better results, the Xtreme Dynamic Range (XDR) technology is introduced for creating the revolutionary 3D-welding helmet that enables operators to examine their work in real time. The helmet equipped with XDR acquires and synthesizes images as a stereo camera unit. As a result, welders can weld more reliably due to the ability to view weld beads, items being welded and the working environment simultaneously.

Source: XIMEA GmbH

Concierge robots

Concierge robots protect your employees and customers from risks, especially in times of COVID-19. They greet guests politely and professionally. They are reliable and always in a good mood. A cloud-based appointment management system informs the robot which visitors are currently expected. The identity of the visitors is confirmed with facial recognition and a comparison with their identity card data and passport photo. In addition, the body temperature of the visitors is checked with the help of a contactless thermometer. Anyone who has an appointment receives safety, hygiene and data protection instructions and has to agree to them before the appointment. The robot informs the host about the visit and motivates the visitor to disinfect their hands in the waiting area.

Source: Pi4_robotics GmbH

Lenses enable high-precision adjustment of positioning tasks

In the electronic assembly process, or in the space shuttle boom arm: highest precision is needed. The perfect solution to meet high precision requirements of positioning tools are large format lenses with a resolution of up to 100 line pairs per millimetre (lp/mm) and an excellent optical stability over the image field, be it on earth or in space.

Die-Attach is a lead-free process for bonding silicon chips to the pad or die cavity of the support structure of microelectromechanical systems (MEMS). Special pick-and-place tools are required to retrieve the die mount from the wafer tape and position it on the adhesive. A critical point in production comes when the adhesive needle must hit a target on the substrate within 0.3 µm. Depending on the

machine, the distance from one target to another can be up to 40 mm. The perfect solution to meet the precise requirements of positioning tools in die-attach machines are large format lenses with a very high resolution and an excellent optical stability over the image field. Equipped with a beam splitter, the coaxial illumination option provides uniform illumination in all RGB channels without reflections from the highly reflective substrate. Lenses without beam splitter can be used with ring lights for incident brightfield illumination.

Source: Jos. Schneider Optische Werke GmbH

Gripping into the box? child's play!

What is simple for an infant can be a difficult task for a robot. The complex "reach into the box" with the help of optical sensors is considered a particularly complex challenge in automation.

Process stability and high performance, even at top speeds - this challenge has been worked on for years. Machine vision technology is not only used for the " gripping", but also for optimised robot path calculation and the process-safe multi-pick function.

Source: ISRA VISION AG

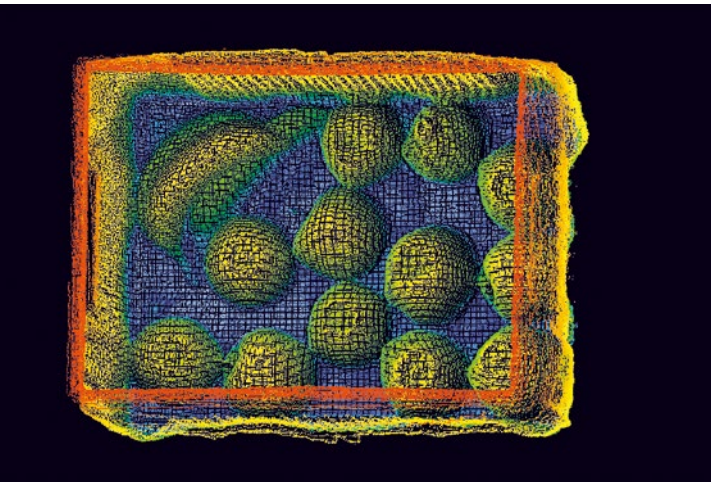
Returning bottles in the supermarket

Modern reverse vending systems, which are mainly used in food retailing, nowadays work with high-performance camera systems for the recognition of barcodes and security features. Within one second, up to 1,000 images from a total of six cameras are generated, evaluated and compared with a database of more than 35,000 data records. Such a high data processing rate enables an input speed of empty containers of up to two metres per second. Thanks to specially matched LED lighting elements, even very small and low-contrast barcodes can be reliably detected and evaluated. In addition, the camera-based continuous object tracking system can be used to monitor any position modifactions or withdrawings of the bottles. An attempt to defraud by pulling out already deposited bottles or goods – also known as the thread trick – can thus be effectively prevented.

Source: Diebold Nixdorf Technologies GmbH

Apples or pears?
Clearly recognized thanks to 3D vision and AI

Conventional image processing methods sometimes face great challenges if they are to reliably detect variants of an object or product that differ from one another in shape and color. This is often the case when recognizing and sorting



fruits, for example. With the help of trained neural networks and 3D image processing, not only can different types of fruits be precisely recognized and distinguished from one another, but also different varieties of a species, such as green apples from red ones.

How does it work?
A deep learning-based vision system uses 3D data as raw material. This system delivers high-resolution 3D images with nearly millimeter precision. A grayscale image as an intensity image is supplemented by distance measurements for each individual pixel using time-of-flight measurements of light pulses in the near infrared range. The resulting 3D point cloud provides additional information about the imaged scene. The shape information replaces the color information of a 2D RGB image, which in turn significantly simplifies the recognition and differentiation of differently colored fruits and enables additional applications, such as the exact positioning and measurement of the recognized objects.

Source: BASLER AG

Modern approach to farming using depth cameras

Depth cameras have proven themselves extremely effective in vertical farming and automated harvesting solutions. The information they provide can be used to monitor plant growth and health. Harvesting machines can better understand their surroundings and navigate efficiently. They are able to locate fruit on a plant, assess its ripeness and pick it, all without damaging the plant. Adding a 2D RGB sensor to provide colour information further augments the captured 3D data, e.g. to better assess a plant's health or the ripeness of the fruit. The visible spectrum and 3D data are used for agricultural machinery navigation systems, to avoid plants and other obstacles.

Source: FRAMOS GmbH

Stone collector 4.0

Finding and removing field stones automatically is possible thanks to image processing.

First, a drone conducts a survey using advanced sensors, GPS, and trained neural networks using computer vision to accurately map rocks' locations and sizes. Then there is a hydraulically controlled implement mounted on a front-end loader. A human then drives the tractor on the optimized route provided by the map, and the computer vision on the implement automatically identifies the rock and pulls it into the tractor bucket.

The core components of both systems (drone and tractor) are robust cameras whose high-resolution images are used in three areas: for accurate training of the neural networks, for identification of the stones on the aerial photographs and for real-time recognition of the field stones on the robot arm, which picks them up from the field.

Source: LUCID Vision Labs GmbH

Sensor fusion and artificial intelligence for the safe mobility of the future

How will we travel or transport our goods tomorrow? The answer is as simple as it is complex: autonomous, without drivers or pilots. The machines will decide, not humans. What sounds like a utopia is already in parts reality today.

In addition to public acceptance, safety will be the key to success. This can only be achieved if various sensors that are intelligently fused together support the decision algorithms of artificial intelligence. Whether for cars, delivery robots, air cabs or drones. High-performance industrial cameras are just as important as lidar lasers or radars. Due to their individual capabilities, they guarantee a safe flight, even under varying weather. Vehicles that have limited on-board sensor technology can be upgraded by customized hardware and software solutions, e.g. as a retrofit, and automated safely and efficiently. This not only enables drones to fly autonomously, but also to perform real-time operations. For example, centimeter-precise 3D maps can be generated, or GPS-free localization and exact environment recognition can be enabled. Automated inspection and monitoring missions are already reality and enable high-precision data evaluation in real time today.

Source: Allied Vision Technologies GmbH / Spleenlab GmbH

Recycling – no problem thanks to Hyperspectral Imaging

Applications in the recycling industry are becoming more and more demanding. Not only a suitable data acquisition and data processing is required, but also powerful data analysis and data evaluation.

Color cameras can only process information in the visible light band. Hyperspectral imaging in the near infrared range offers the degree of classification accuracy required for many recycling tasks by directly measuring the chemical molecular composition by means of light absorption (spectroscopy). Thus different materials can be measured exactly according to their chemical compositions in real time.

Due to a combination of a powerful real-time embedded vision system in the relevant wavelength range and a real-time analysis software equipped with a user-friendly interface, the degree of classification accuracy necessary for such applications can be achieved.

Source: EVK DI Kerschaggl GmbH

Safe train rides – thanks to image processing

When a train drives into the maintenance hall, camera gates automatically inspect the train. Thereby any damage or deterioration of the roof, side and underfloor structure is being detected. Using different imaging methods, it is possible to carry out inspections which the human eye cannot perform. All findings are carefully documented - within minutes. An analysis tool links the recorded data of the maintenance process with other collected information. External parameters can also be included, such as weather conditions, travelled distances or velocities.

Based on Big Data and Machine Learning, this huge data can be exploited to its full potential. Safety-relevant components and their diagnoses can be classified together so that correlations become clear and conclusions can be drawn as to when parts need to be replaced.

Frequent malpositions and external influences are detected and evaluated in order to implement preventive maintenance measures – not only on the train but also on the railroad track.

The system “learns” to understand correlations better and better the more data is collected. This saves valuable time and ensures that maintenance can be planned precisely. From the selection of components to the exact time of ordering and an optimised stockkeeping of spare parts.

Source: PSI Technics GmbH

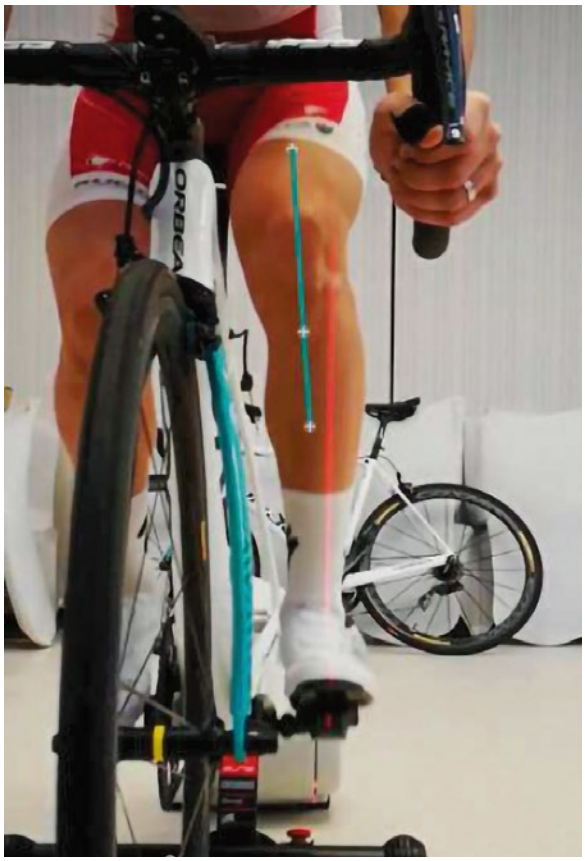
Success in the saddle

Cycling is a popular sport. Under exertion, however, it exposes the body to considerable stress. Pain, especially in the back, knees and hips, is common among competitive athletes.

A bike-fitting system with a camera and suitable analysing software helps professional and amateur athletes to position themselves optimally on the bike. This prevents incorrect postures, minimizes the risks of injuries, prevents pains and maximizes athletic success.

For analysis, the bicycle is fixed in a roller trainer. A camera records this set in a two-dimensional X-Y axis. While the cyclist pedals with different intensity and in different positions, the camera records the sequence of movements. Changes in the joint angles are recorded in high quality and at high frequency (60 frames per second), precisely and without any distortion. A motion analysis software measures the direct effects on the respective mechanical parameters of the cyclist, i.e. influence of force, movement and pedalling technique.

Source:
IDS Imaging Development Systems GmbH



The right solution for every job

The VDMA Sourcing Service helps you identifying the right partner for your machine vision application – no matter whether you need components, complete systems or services.

Choose between three comfortable search strategies:

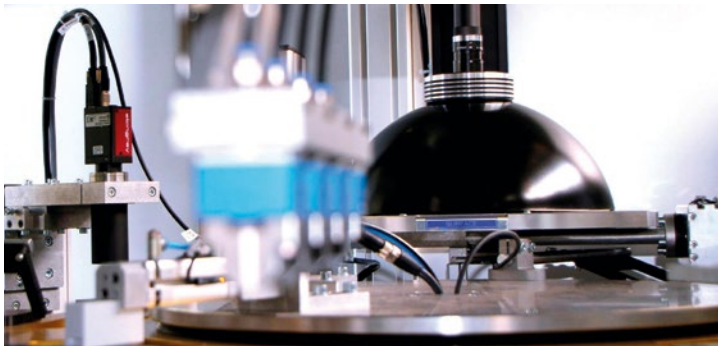
- Search by type of product (systems, components, services)
- Search by type of application (e.g. surface inspection, robot vision, identification)
- Search by type of customer industry

www.vdma.org/visionfinder

Diverse systems

Some machine vision systems are so compact you can hold them in the palm of your hand. Sometimes, they are integrated vision systems that work intelligently directly from devices and enable them to see and understand. Others could fill a whole room.

- **Application-specific vision systems** are turnkey systems for a specific application such as the inspection of flat glass or wafers. They are usually PC-based and offer high-performance.
- **Configurable vision systems** are usually PC-based as well. Unlike application-specific systems they are more versatile in their use. End users can often implement a range of applications via a graphical user interface.
- **Smart cameras (intelligent cameras)** are complete vision systems that include software for image analysis, all contained within the compact housing of the camera itself. They can be programmed flexibly to carry out different types of tasks.
- **Vision sensors** are also complete vision systems within a single compact housing. In contrast to smart cameras, they are made for one specific type of application, e. g. code reading.



System integrators, with their high level of sector- and application-specific know-how, offer made-to-measure solutions.

Making use of versatile components, solutions can quickly be developed to tackle a wide range of tasks.

Reaching into the box - child's play!
What is simple for an infant can be a difficult task for a robot. But with machine vision, the „reach into the box" works!

Robot Vision
Machine vision delivers sharp eyes for industrial robots and teaches them to do see and understand. Robot Vision is an important trend, also in robotics. 3D technology is being used here.

The most important trends

Machine vision is developing rapidly, creating ever greater benefits for users.

The third dimension

With machine vision becoming three-dimensional, many tasks can be accomplished in a cost-effective way – from the precise inspection of adhesive beading or welded seams and automated gripping of unsorted items in boxes through to non-contact precision measuring of formed sheet metal parts in the production cycle.

Standardisation

Standardised interfaces facilitate the integration of individual machine vision components into an overall workable system. This reduces the amount of effort required and makes the machine vision solution efficient and inexpensive.

Performance

The efficiency of machine vision systems is rapidly increasing, thanks to higher-definition cameras, steadily increasing processor performance as well as multi-core processor technology, state-of-the-art software and standardised interfaces. Ever more rapid inspection speeds and accuracies are thus achieved at comparable costs.

Colour

In many applications, colour recognition is of great advantage. For example, different models or components can be identified or sorted, and quality checks can be conducted on the basis of colour. Colour recognition has now become a standard routine for which numerous machine vision solutions are available.

User-friendliness

Whereas in the past experts were needed to implement machine vision solutions, today many adaptations can be carried out without any great prior knowledge, thanks to intuitive configuration options and ergonomic software user interfaces.

Hyperspectral Imaging

Hyperspectral cameras or sensors take several images of a scene in different wavelength ranges. Combined, the images provide a greater depth of information. This technology is used in areas and applications whenever ingredients or substances need to be identified and discerned, and are not recognizable through a standard color or monochrome picture. For instance, in the food or wood industry, in recycling, mining or agriculture.

Embedded Vision

Embedded Vision enables image processing on compact, high-performance, and low-energy computing platforms. They can be integrated in areas of limited space or small devices. This technology thus opens up many new fields of application which so far could be covered neither by PC-based nor by intelligent machine vision systems.

Machine Learning

Machine learning is an important area of artificial intelligence. Computer programs based on machine learning use algorithms to find solutions to new problems. The artificial system recognizes patterns in the learning data it receives. Deep Learning enables the classification of images with a better classification rate than with previous methods. The user does not have to explicitly program the different error classes, i.e. you just “show” the deep-learning algorithm images and it learns from them.

Would you have seen the scratch? Modern vision systems detect errors that the human eye tends to overlook or classify as irrelevant. As the example of the saxophone shows, such faults would be perceived as annoying when touching or playing the scratched key.

Standards for machine vision

Standards facilitate use of machine vision and integration of individual components into a complete system with optimum functionality. They cut down on development time and investment costs and also accelerate time-to-market. And, the number of standards is growing steadily.

You will find an overview of existing globally accepted machine vision interface standards in the brochure "Guide to Understanding Machine Vision Standards" which can be downloaded under

www.vdma.org/vision

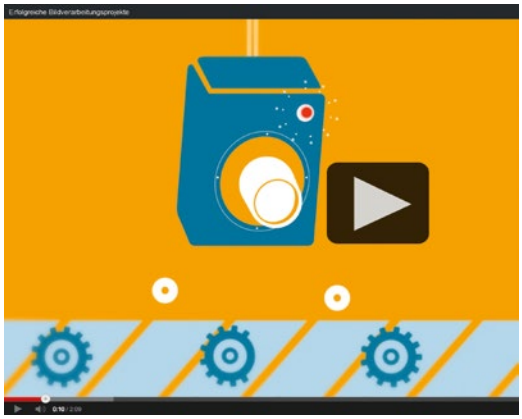
GLOBAL COORDINATION OF MACHINE VISION STANDARDIZATION

About G3 – Global Coordination of Machine Vision Standardization

In 2009, member supported trade associations from Asia, Europe and the USA began a cooperative initiative to coordinate the development of vision standards and founded the so called "G3" initiative. The aim of G3 is to develop globally adopted vision standards and hence to avoid overlapping or duplication of efforts.

Twice a year, technical experts meet in so called „International Vision Standards Meetings" for joint work and coordination according to a rotating system alternating between Asia, America and Europe. Existing G3 standards are: GenICam, EMVA 1288, GigE Vision, CoaXPress, Camera Link, Camera Link HS, USB3 Vision and VDI/VDE/VDMA 2632 and OPC Machine Vision. The newest G3-standardisation projects are emVision and the Open Optics Camera Interface.

Ensuring your vision project is a success



www.vdma.com/flawless –
The preparation of a requirement and system specification ensures successful machine vision applications.

The VDI/VDE/VDMA 2632 series of standards structures the communication between supplier and user. The standards help to avoid misunderstandings and to handle projects efficiently and successfully.

Part 1: Basics, terms, and definitions

Knowing what you are talking about is the start of every successful project. The guideline describes the principles and defines the terms necessary for the use of image processing systems. It defines a consistent terminology for all cooperation partners.

Part 2: Guideline for the preparation of a requirement specification and a system specification

The standard provides assistance in the preparation of specifications for industrial image processing systems. Particular emphasis was placed on the representation and description of influencing factors as well as on their effects. The project partners are thus able to identify influences at an early stage during planning and to find optimised solutions.

Part 3: Acceptance test of classifying machine vision systems

For measuring (non-classifying) machine vision systems, quantitative capability analysis is already well established. Measurement uncertainty is usually employed as an indicator. Until now, on the other hand, there have been no corresponding and accepted qualification indicators for classifying machine-vision systems whose results are attributive variables. Part 3 closes this gap and introduces indicators describing the classification capability of a machine vision system.

Part 4: Surface inspection systems in flat steel production

This standard describes concepts for continuous performance monitoring of surface inspection systems. It is intended for manufacturers and users of surface inspection systems and describes procedures for stability testing. Although this work is oriented towards the requirements of flat steel production, it is expected that the results can also be applied to other inspection tasks such as aluminium, paper or foil.

Publisher of VDI/VDE/VDMA 2632 series is the VDI/VDE Society Measurement and Automatic Control. The standards were elaborated in cooperation with VDMA Machine Vision. The documents are practice-oriented, thorough, and specifically address the requirements of machine vision. They include both a German/English and for part 2 an English/Chinese version, and can therefore be applied in the communication with customers worldwide.

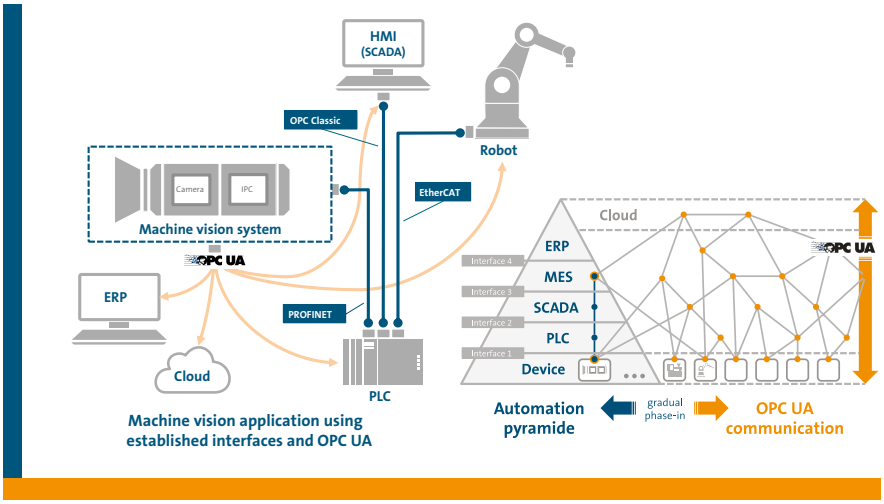
The VDI/VDE/VDMA 2632 standards can be purchased on:
www.vdi.de/2632

www.vdma.com/flawless

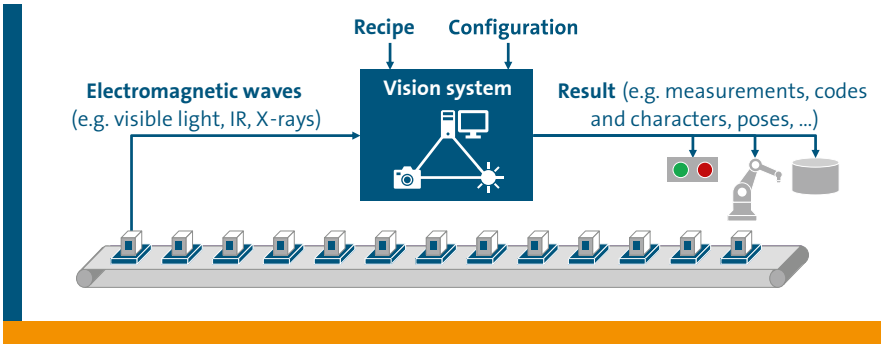
OPC Machine Vision

The OPC UA Companion Specification Vision (in short OPC Machine Vision) provides a generic information model for all vision systems – from simple vision sensors to complex inspection systems. Put simply, it defines the essence of any vision system that does not necessarily have to be a “machine” vision system. OPC Machine Vision is the accepted and officially supported OPC UA Companion Specification for vision systems by the OPC Foundation.

The scope is not only to complement or substitute existing interfaces between a vision system and its process environment by using OPC UA, but rather to create non existing horizontal and vertical integration abilities to communicate relevant data to other authorized process participants, e.g. right up to the IT enterprise level. It is possible to have a gradual phase-in of OPC Machine Vision with coexisting other interfaces. The benefits are a shorter time to market by a simplified integration, a generic applicability and scalability and an improved customer perception due to defined and consistent semantics. Specific example: OPC Machine Vision enables Machine Vision to speak to the whole factory and beyond.



The possibility of a gradual phase-in of OPC Machine Vision



Basics of Machine Vision

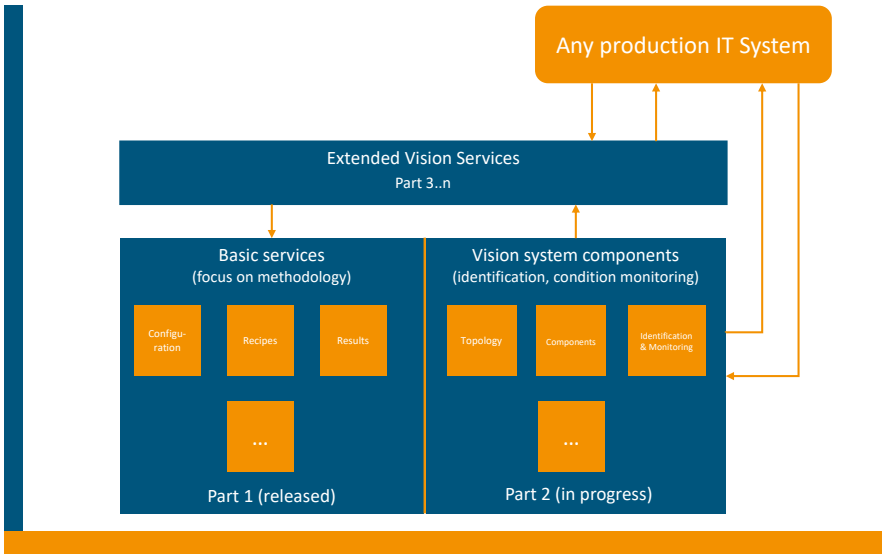
Fundamentals

A vision system is any system that has the capability to record and process digital images or video streams, typically with the aim of extracting information from this data. The output of a vision system can be any image-based information like measurements, inspection results, process control data, robot guidance data, etc.

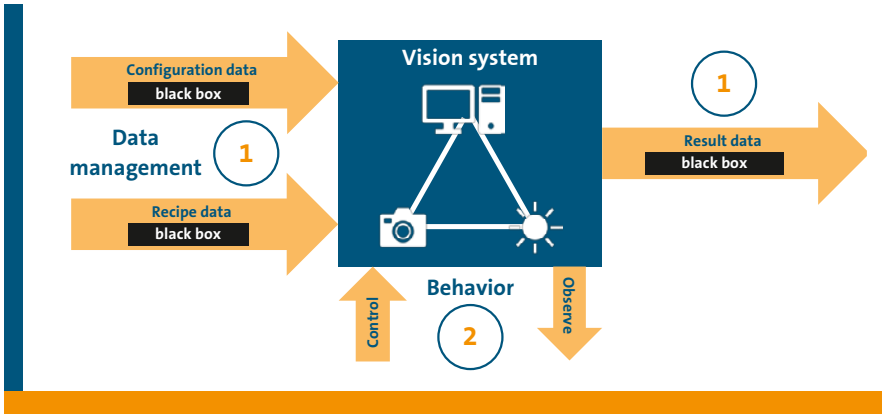
The basic concept of OPC Machine Vision is a subdivision into several parts. Part 1 includes the basis specification and describes an infrastructure layer which provides basic services in a generic way. In part 2, the vision system described in part 1 has been enhanced with information pertaining to asset management and condition monitoring. It provides identification and condition monitoring parameters for the components that build up a machine vision system.

OPC Machine Vision, part 1

Part 1 describes an abstraction of the generic vision system, i.e. the representation of the so called “digital twin” of the system. It handles the management of recipes, configurations and results in a standardized way, whereas the contents stay vendor-specific and are treated as black boxes (1). It allows the control of a vision system in a generalized way, abstracting the necessary behavior via a state machine concept (2).



Conceptual model for OPC Machine Vision



Main scopes of OPC Machine Vision, part 1

OPC Machine Vision, part 2

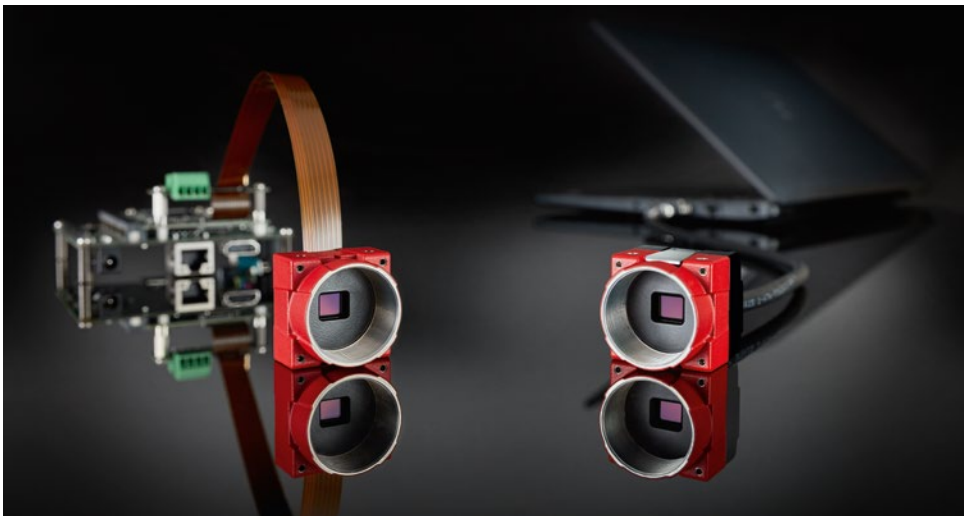
Part 2 pertains to the Asset Management and Condition Monitoring use cases. For the asset management use case, one of the most important requirements is to be able to successfully identify the asset itself. The components that build up a machine vision system have also been considered as assets in this case. The condition monitoring use case forms a basis for business cases like predictive and preventive maintenance. Therefore, part 2 also defines the parameters for the identified components of a machine vision system, monitoring and analysing which can provide us with useful information needed for maintenance and diagnostics of the system and its components.

Future parts

The aim for future parts is to break down the proprietary input and output data black boxes defined in Part 1 and to substitute them with standardized information structures and semantics. Currently a possibility to provide standardized structures for the Result data black box is being discussed in the working group.

Company profiles

Company profiles



Focus on what counts – digital industrial cameras for your application

For more than 30 years, Allied Vision has been helping people to reach their imaging goals. We don't just develop cameras. We provide answers.

Allied Vision supplies camera technology and image capture solutions for factory automation, industry and science, traffic monitoring and many more application areas in digital imaging. By focusing on what counts for each customer, Allied Vision finds solutions for every application, a practice which has made Allied Vision one of the leading camera manufacturers worldwide in the machine vision market.

Our engineers design digital cameras with a large scope of resolutions, frame rates, bandwidths, interfaces, spectral sensitivities, sensor technologies, and technical platforms. We have created a modular concept to ensure that your camera adapts to requirements of your application and not the other way around.

Allied Vision is at your side throughout the life cycle of your image-processing project.

We know how to help you find the best camera solution for your application. That includes a digital camera, but also the right lens, the right connectivity hardware and the right software interface. Our job is to reliably deliver the image you need, when you need it and how you need it.

To deliver the precision and reliability our customers need, we manufacture our products according to the highest quality standards in state-of-the-art clean room facilities. All our manufacturing sites are ISO 9001 certified and comply with the ISO 13485 quality standard for medical devices. Our three-year warranty reflects our commitment to quality.

Our worldwide sales and support network allows us to deliver first-class service before, during and after your purchase. We have offices and sales representatives in Germany, the UK, France, the USA, Singapore, and China and have teamed up with selected distribution partners in more than 40 countries to ensure we are always there to help you whenever you need us.

Allied Vision

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Providing solutions that ensure quality – consistently, effectively and economically

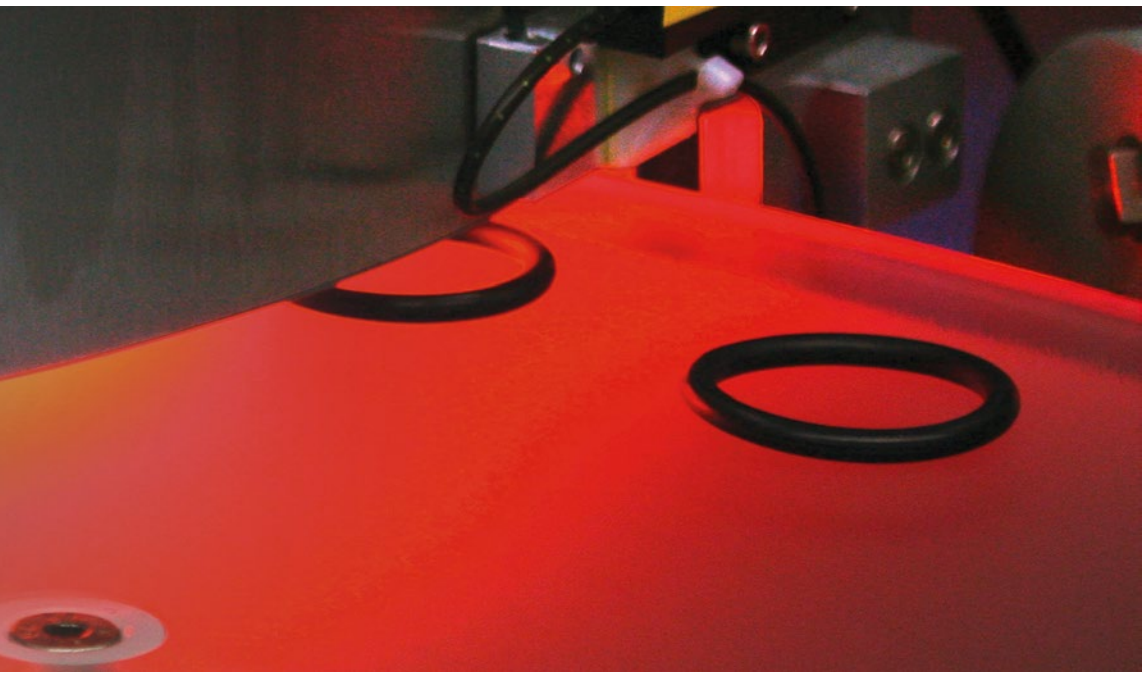
ASENTICS – 360° inspection and 100% quality control using standardized OPC UA Interface (VDMA 40100-1) for Industrie 4.0 communication

By definition, quality is the match between the expectations of a product and its properties. Producers in all markets are facing major challenges because of our globalised world, the desire for 100% quality is continuously facing the demand for competitive prices. To accomplish these tasks, ASENTICS has created solutions that grow together with the demands and meet the highest standards of the quality checks.

ASENTICS is one of the leading application-oriented image processing companies in Europe. We have been providing solutions for optical/visual quality assurance in all fields of production for more than 20 years, from small, intelligent stand-alone devices for simple tasks right through to universally applicable modular and scalable image processing systems for in-line monitoring.

ASENTICS is excellently prepared for the challenges of Industry 4.0. We consider machine vision as not only a forerunner, but also a key technology. The images have to be verified at every stage of production, processed and made available to the systems operating in the value network. Apart from making a statement on a good or bad part, ASENTICS machine vision products also manage intelligent actions down the line.



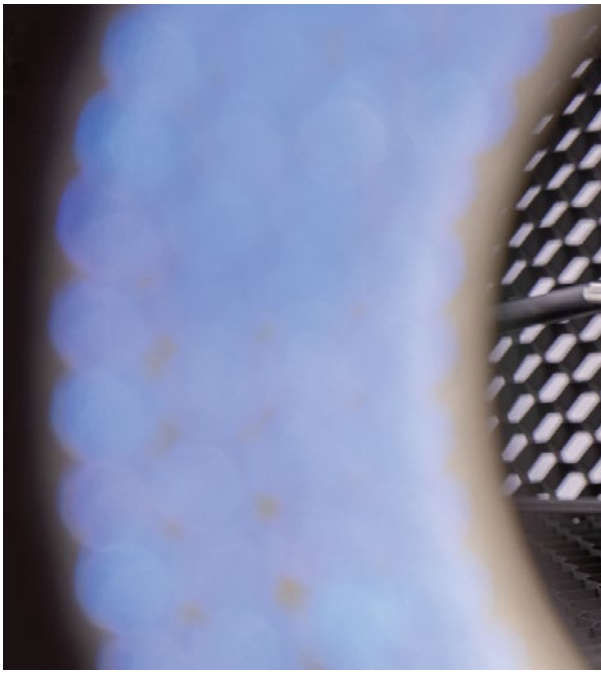
In addition, with our modern Industry 4.0 concepts, we have the means to provide extensive and important secondary information, for example about the condition of the machines, wear or possible maintenance cycles as well as the familiar primary information.

Holistic thinking, focusing needs and meeting expectations: this is how we solve the problems facing our customers. Always true to the motto "What's the problem? – Here's the solution!"

In terms of communication, ASENTICS relies on OPC UA architecture, an open interface standard, in order to make cross-system information, data, functions and services available in one production network. This means that ASENTICS products in a networked infrastructure are able to monitor and control processes easily, collect data related to machine efficiency, translate these into statistics and visualise them.

With the ASENTICS Inspection Net, we are supplying a meaningful supplement for concentrating information and making this available to either the ERP system directly via OPC UA or an Inspection Net Remote Server developed by ASENTICS. This intermediate component allows data to be filtered so that only data that is really relevant for process control is forwarded.

Keeping Your Eyes on the Future – Leading Vision Technology from Basler

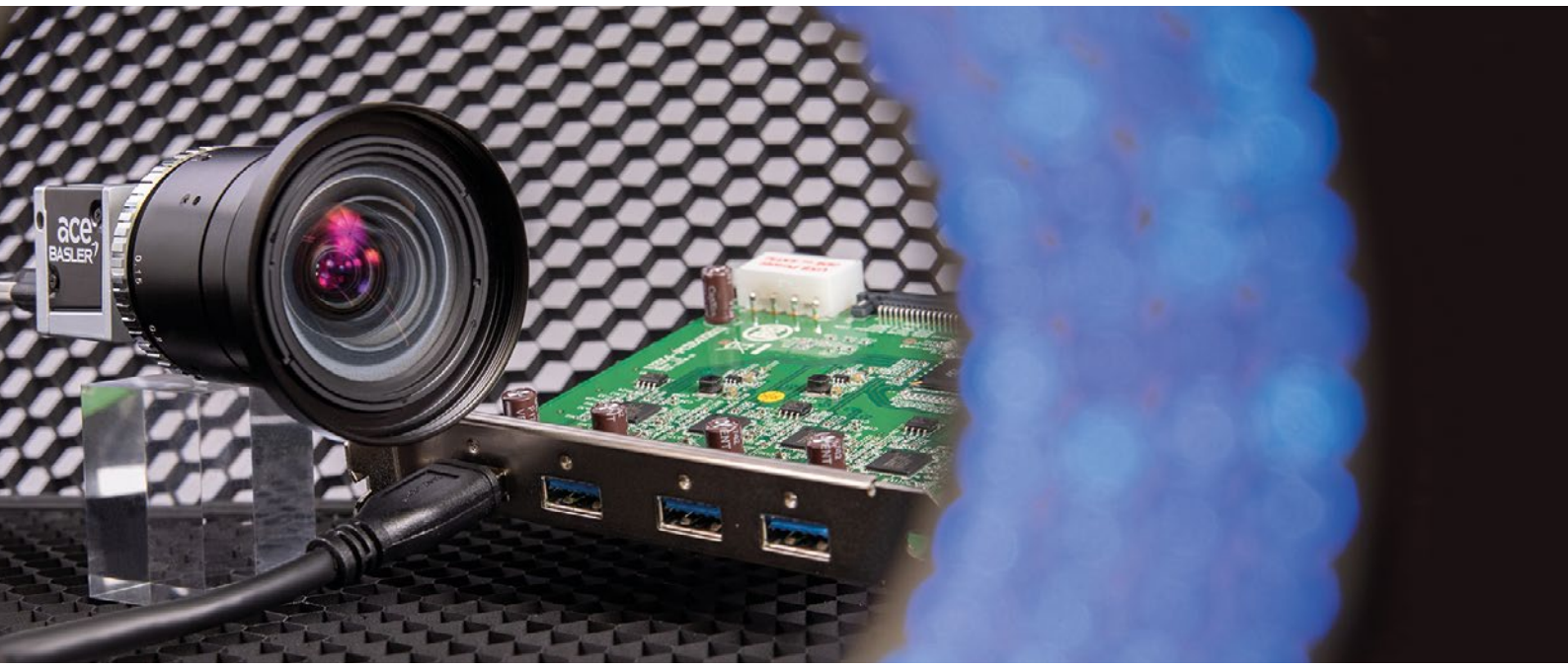


Basler is a leading international supplier of high-quality image processing components for computer vision applications. Founded in 1988 by Norbert Basler, the group is an innovative, value-oriented family business with over 800 employees. Through its worldwide sales and service organization and its cooperation with renowned partners, Basler provides suitable solutions for customers from a wide variety of fields. Their three-plus decades of experience create both a head start and an obligation.

Basler products and solutions are used in a variety of markets, including factory automation, medical and biotechnology, traffic and transportation, logistics, retail, and robotics. Applications range from surface inspection, testing of electronic components or food, to robot guidance and autonomous driving in logistics centers. The company invests significantly in the development of innovative, compatible and reliable products, always with an eye on the latest technologies, market developments and customer benefits. In addition to classic area scan and line scan cameras, lenses, frame grabbers, light modules, and software, Basler offers embedded vision modules and solutions, 3D products, and customer-specific product adaptation and consulting services.

Well Prepared for Industry 4.0

The technological development towards Industry 4.0 and Smart Factory is progressing rapidly. Traditional production processes are changing and creating new requirements. Basler is very well positioned with suitable products and extensive know-how: The Basler team supports and



The Basler portfolio includes a wide range of vision components for a variety of image processing tasks. Source: Basler AG

advises customers in purchasing standard components as well as in dealing with more complex issues such as development of customer-specific product adaptations or even entire embedded vision systems or AI solutions. This makes Basler the most trusted brand in the field of machine vision.

A Mature, Family-Friendly Corporate Culture

At Basler, the compatibility of work and family is not only a priority on paper, but is lived every day and regularly certified through Hertie Foundation ”berufundfamilie” audits. Transparency and open communication are an integral part of the corporate culture. Management’s commitment to cooperation across all hierarchical levels as well as to prudent strategic planning was rewarded in 2020: The Management Board of Basler AG was honored for entrepreneurial excellence in the Axia Best Managed Company Awards and Basler was highlighted as an “outstandingly well-managed medium-sized company in Germany”. The company regards this confirmation of its chosen path as a mission to continue to offer exciting products and services with continuous improvement and a spirit of innovation, giving the power of sight to as many applications as possible.

BASLER

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Benchmarks redefined: Industrial image processing with Baumer. High-performance components and automatic inspection systems

From left to right:
Headquarters Baumer Group in Switzerland;
ColourBrain® MFC 4.0 – less rejects through optimized process control;
ColourBrain® X-Side 4.0 – miniaturized surface inspection;
ColourBrain® Furniture 4.0 – surface inspection on furniture

Baumer is leading at international level in the development and production of sensors and encoders as well as products for automatic image processing. With more than 2,700 employees in 39 subsidiaries and 19 countries, the family-owned company is always close to the customer. By combining innovative technology and customer-oriented service, Baumer ranks among the leading manufacturers in the machine vision industry.

In the field of industrial image processing, Baumer offers a unique range of products and technologies, from image processing components like cameras and vision sensors to complete inspection systems for quality control in batch production, in a variety of industries.

With an eye for the essential – Digital industrial cameras and vision sensors

Modern image processing applications face the challenge of successfully completing complex inspection tasks at top speed. Baumer industrial cameras and VeriSens® vision sensors are specially developed for demanding applications which have high performance and quality requirements. With long-time stable reliability, versatility and easy integration, they convince customers all over the world. A special Baumer strength lies in the development of customised finished products, providing a competitive edge in the market.

Powerful CMOS cameras by Baumer are the core of high-performance image processing applications. No matter whether you are looking for maximum speed, resolution or flexibility, the broad portfolio with both cutting-edge image sensors and all typical, standardized interfaces offers the right product for many different applications.

Intuitive operation, fast and easy integration and configuration within minutes: that characterises the Baumer VeriSens® vision sensors. From automotive to the food, beverage and packaging industries, the compact all-in-one image processing systems perform complex inspection tasks in automation technology in a variety of industries.

Focus on surface and edges – Automatic inspection systems

ColourBrain® inspection systems guarantee process reliability and highest product quality when producing batch size one or serial mass production. For an outstanding production safety, our patented ColourBrain® system combines highly devised camera and illumination modules. We are market leader in inspection systems for the wood material industry. Our globally active service guarantees the functionality of more than 800 installations worldwide around the clock. Further to precise and production-integrated inline detection of smallest defects, the Baumer scanners generate the digital data required for targeted process monitoring and control. Doing so they enable our customers to achieve a “preventive quality” for optimum exploitation of system performance.

Baumer
Passion for Sensors

Industrial Cameras & Vision Sensors:
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E-Mail sales.de@baumer.com
Internet www.baumer.com

Inspection Systems:
Baumer Inspection GmbH • Konstanz, Germany
Phone +49 7531 9943-0
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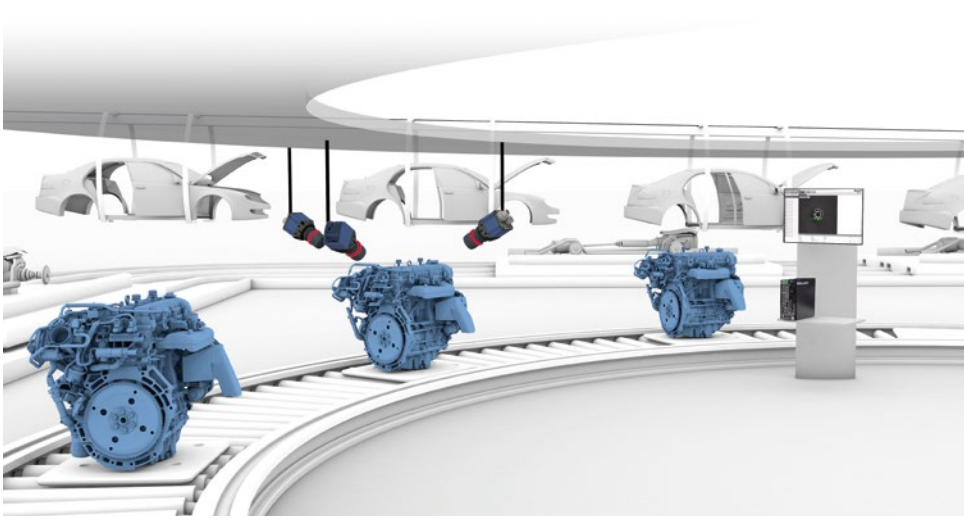
Internet www.baumerinspection.com



Balluff Vision Solutions – Simplifying industrial applications

Balluff stands for customer-tailored solutions in automated industrial environments – including the use of scalable image processing concepts. They are the perfect answer for the rapidly increasing requirements in production in terms of flexibility, productivity and quality. With current and future vision solutions, Balluff covers a diverse range of tasks in the fields of object detection, identification and quality assurance. For example, the range covers everything from comparatively easy tasks, such as reading barcodes and data matrix codes, to position-independent testing of complex characteristics as part of a 100% quality inspection in a production process. The results are passed along to the production system as specified by the customer.

innovating automation

To achieve robust and flexible complete solutions, the vision experts at Balluff use industrialgrade products with corresponding accessories. Customers can therefore draw on a customised range of consulting services and project integration in all project phases.

With Balluff concepts, you can cover the widest range of application fields – scalable from one- to multi-camera solutions. These can include a manual process such as reading a barcode using a handheld reader, or fixed SmartCameras and vision sensors in a semi-automated process, to fully automated, robot-assisted applications. Balluff products not only offer the required features at a particularly good price-performance ratio for the application. They are also impressive because of their ease of handling and integration into the customer's existing system environment. To also be optimally prepared for future challenges in automation, Balluff constantly continues to develop, maintain and expand its vision portfolio. This dedication pays off: the number of installed image processing solutions from Balluff has rapidly increased in recent years.

BALLUFF

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We believe in vision solutions for everyone

As DVC Machinevision b.v. we are inspired by mankind and technology working together and we trust in co-creating together with our partners.

All employees of DVC Machinevision b.v. are committed to practice the corporate believes which enables us to aid other companies to achieve their goals.

Our outstanding team of vision experts can resolve your individual vision challenges. With our team, we support you through the process of machinevision and will deliver customization when needed. We love working together with all kinds of different companies that share our believes and values. The small tech companies which will only need aligned vision components, or the bigger family owned companies which will develop their own system with our vision knowledge. But also multinationals in manufacturing, which will be in need of a turn key solution from beginning to end.

Key for DVC is a long term relationship that we can build on in the future. We will help you with your challenges and together we will find a perfect solution for your problem. We achieve this by challenging the known technologies each and every day. We also want to share our knowledge with you through training, workshops, events and technical support.

How do we successfully establish a collaboration? By creating a coherent team functioning as a family. By listening to you. Those fundamentals will result in suitable vision solutions.

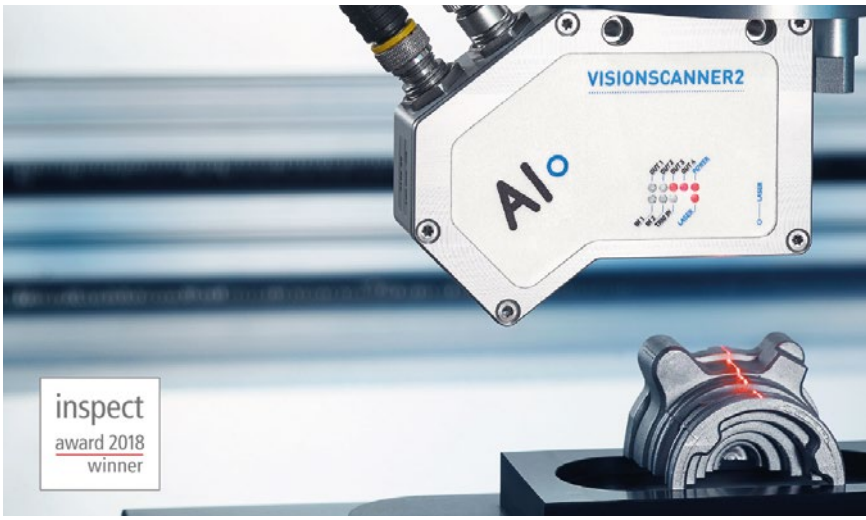
We are DVC Machinevision b.v.; your strategic partner of aligned vision components to state-of-the-art system solutions. Curious what we can do for you?

Contact us by e-mail or telephone.

Be part of our vision family now!

DVC Machinevision b.v. • Minervum 7069 • 4871 ZK Breda • Netherlands
Phone +31 76-5440588 • E-Mail sales@machinevision.nl
Internet www.machinevision.nl

Our mission is to develop the automation for manufacturing companies one step further. For this purpose, we supply machine vision enhanced Pick & Place solutions, complete Vision Automation Systems, Integration of autonomous Mobile Robots and solutions for Robot Guidance through the in-house brand AI°. Furthermore, our company is a market leader in the sensor and robot guided Roller Hemming Technology for automotive body shops.



Robotic & Vision Solutions

Robot guidance from AI°
in the Porsche Leipzig body shop.

Vision Automation

Since many years already, our Company supplies solutions with help of industrial machine vision into the field of automation. On the basis of VISIONELEMENTS, a software which was developed under the brand name AI°, but also under usage of existing products on the market, such as cameras, sensors and lighting systems, the team realizes successfully multiple projects for a variety of producing companies.

We value direct customer service and our strong partner network with robot manufacturers, as well as sensor-, software and lighting suppliers to fulfill the individual requirements of our customers.

As experts in machine vision supported automation solutions, we are keen to keep the full process in our view.

A careful integration of machine vision into the entire automation concept succeeds best, if you are able to master the central technologies and processes.

Robotic & Vision Engineering

Our services in Robotic & Vision Engineering include:

- Concept development
- Preliminary concept investigations & test
- Project Management
- Safety engineering services
- Electrical planning
- Electrical & mechanical design
- Software development in PLC & Robotics
- Software development in high-level languages
- Software development of vision applications
- Manufacturing & controls cabinet build
- Assembly & commissioning
- Training & support

EngRoTec Solutions

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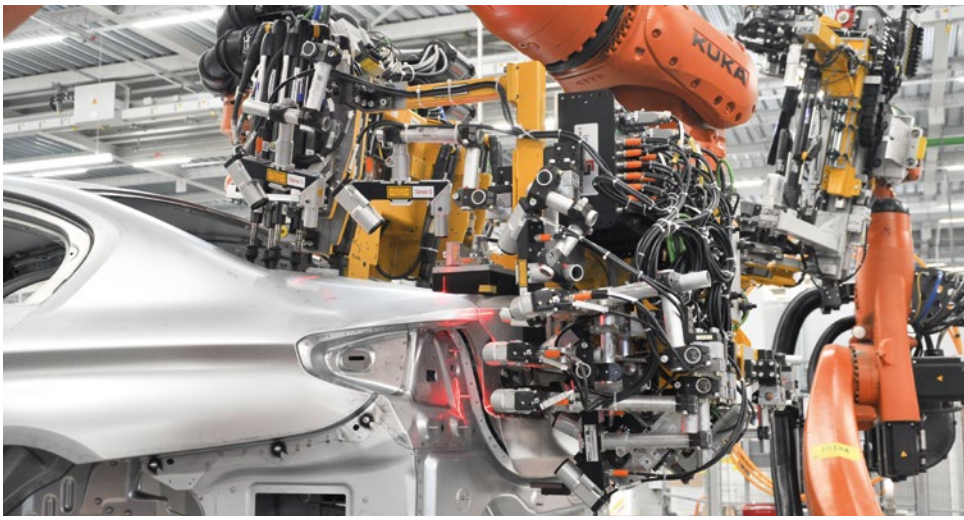
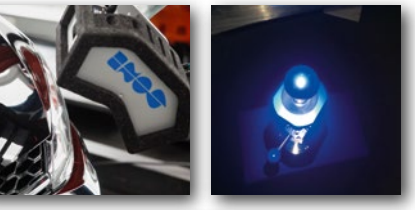
Phone +49 6652 793948-480 • E-Mail solutions@engrotec.de
Internet www.engrotec-solutions.de



With Passion:
Solution Provider for the Best Manufacturers Worldwide



At inos, we do much more than just teach your robots how to see! inos combines innovative industrial vision technology with intelligent system software to create powerful, adaptive solutions for the global automotive industry. We offer a wide range of product options to meet the full spectrum of your needs.

Robot Guidance and Automated Assembly:
Reliable material handling, de-racking, part positioning, and complex assembly solutions for body shop, paint shop and final assembly.

Inline Dimensional Gauging:
Highly-accurate, 2D and 3D point cloud, thermally compensated, correlation-free.

Inline Gap and Flush Measurement:
Precise, correlation-free, stationary and robot-guided.

Build Verification:
Robust badge and label validations, feature inspections and absence/presence checks, etc.

inos Automationssoftware GmbH was founded in 1997 in Stuttgart and became a member of the Grenzebach Group in 2012. Our talented and dedicated R&D team strives to integrate the most cutting-edge technologies and image processing techniques into each and every inos solution.

inos closely cooperates and coordinates with their customers and partners in the global automobile industry in order to create the most powerful, innovative, and capable solutions in the market. inos solutions are built upon the building blocks of precision sensors and intuitive proprietary software modules.

A Member of GRENZEBACH

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Internet www.inos-automation.com

IDS NXT – redefining industrial cameras
It's so easy!

IDS is a leading manufacturer of digital industrial cameras with USB or GigE interface as well as 3D cameras with a wide range of sensors and variants. With the vision app-based cameras IDS NXT and Adaptive Robot Vision solutions we open up new dimensions in image processing.

Vision technology as the eye of the machine in the smart factory of Industry 4.0.

IDS is considered a pioneer in the development of powerful USB 3.0 and USB 3.1 Gen 1 industrial cameras. The change in digitalization inspires us to develop new concepts: With IDS NXT we have created a platform for a new generation of vision systems for industrial applications. It is freely programmable and extremely versatile through the use of apps. This results in flexible complete systems that can be used to implement all steps of a vision solution, from image acquisition to image analysis and processing to the control of industrial production machines.

Artificial intelligence for industrial cameras

Artificial intelligence (AI) opens up new fields of application for camera technology and image processing. IDS NXT ocean shows what an easy-to-use complete solution for industry looks like. It makes it possible to solve tasks in which classic, rule-based image processing reaches its limits – without any programming effort.

Thanks to the cloud software IDS NXT lighthouse, even non-specialists without any prior knowledge of artificial intelligence can train an AI classifier with their own image data that can be executed immediately on IDS NXT

IDS NXT cameras with AI solve classification tasks with organic and varying objects, e.g.

cameras. This makes it particularly easy to get started with deep learning-based image processing.

Hardware, software, infrastructure, knowledge and support come from one source.

Automation with 3D Vision

3D image processing is the future of robot vision. Our Ensenso 3D cameras convince through precision, speed and economy. First and foremost, the Ensenso X-Series: a camera system that enables perfect, individual adjustments and thus makes 3D vision even more precise and flexible. Or the Ensenso XR series with integrated data processing. It combines the flexible, modular design of the Ensenso X-Series with the advantages of an embedded system. In combination with the easily configurable, adaptive robot controller Mikado ARC (Adaptive Robot Control), a complete 3D robot vision solution is created.

From Obersulm to the whole world

Since its foundation in 1997 as a two-man company, IDS has developed into an independent, ISO-certified family business with more than 300 employees. The headquarters in Obersulm, Germany, is both a development and production site. With subsidiaries in the USA, Japan, South Korea and the UK as well as representative offices in Europe and Asia IDS is internationally represented. IDS cameras are developed exclusively in Germany, produced there in a resource-saving manner and sold worldwide.

IDS Imaging Development Systems GmbH
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Reliable and efficient:
3D Machine Vision Applications for Smart Factory Automation

For over 35 years, international industry leaders have relied on ISRA's portfolio of innovative 3D machine vision products and high-end inspection solutions.

"Touch & Automate" sensors are connected without cables and adjust flexibly to changes within the manufacturing process – for maximum efficiency and optimized costs. As a source of information for production databases, sensor networks compatible with Industrie 4.0 enable complete transparency in the production line, plant, or even the whole company throughout the world.

Smart factory automation with 3D machine vision systems

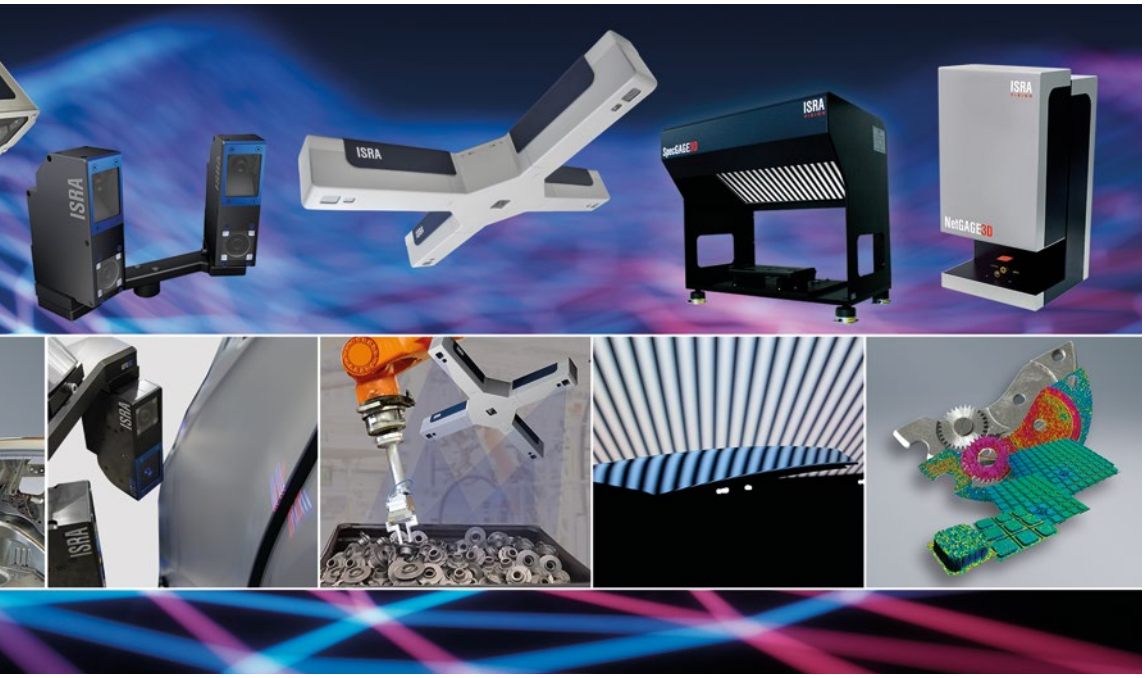
ISRA has established 3D machine vision as the global industry standard. In doing so, the company has developed an array of efficient and ready-to-use solutions for automating highly complex tasks in the most important applications:

- 3D robot vision
- 3D metrology
- 3D surface vision
- 3D quality inspection

Maximum efficiency thanks to 3D robot vision

ISRA optimizes production performance while at the same time lowering costs through its integrated 3D robot guidance solutions for contactless identification, position detection and the optimal assembly of parts throughout the entire process chain.

- Automated bin picking
- Position detection and removal of parts
- Reliable depalletizing
- Best-fit joining processes
- On-the-fly assembly



Smart factory automation:
With its broad product portfolio, ISRA offers the right sensor for every application

Source: ISRA VISION

3D metrology for high-precision quality control

High-precision 3D measuring systems capture object and surface properties right down to the nanometer range. In inline metrology, the robot-guided sensor systems ensure extremely accurate geometry inspections of all relevant measured surfaces such as edges, holes, surfaces, and gaps.

- Robot-guided 3D geometry measurement – in-line, at-line and off-line
- Highly precise 3D geometry inspections via a multi-stereo sensor system
- Precise 3D measurements with white-light interferometry
- 3D structured light sensor for 100% component inspection

3D quality inspection for perfect quality and error-free processes

3D quality inspection systems make shape inspection and defect detection objectifiable and traceable. These solutions reliably detect and remedy process errors, thereby increasing the overall quality.

- Glue bead inspection: 3D inspection systems for identifying geometry and positioning errors
- Measurement and inspection of surfaces of curved and planar objects through the 3D deflectometry process
- Paint inspection: Robot-guided 3D quality inspection for detecting surface defects

Maximum value creation

Optimized quality, maximized earnings, minimized use of resources: Connected 3D systems give users the best possible flexibility and productivity in the smart factory.

ISRA VISION

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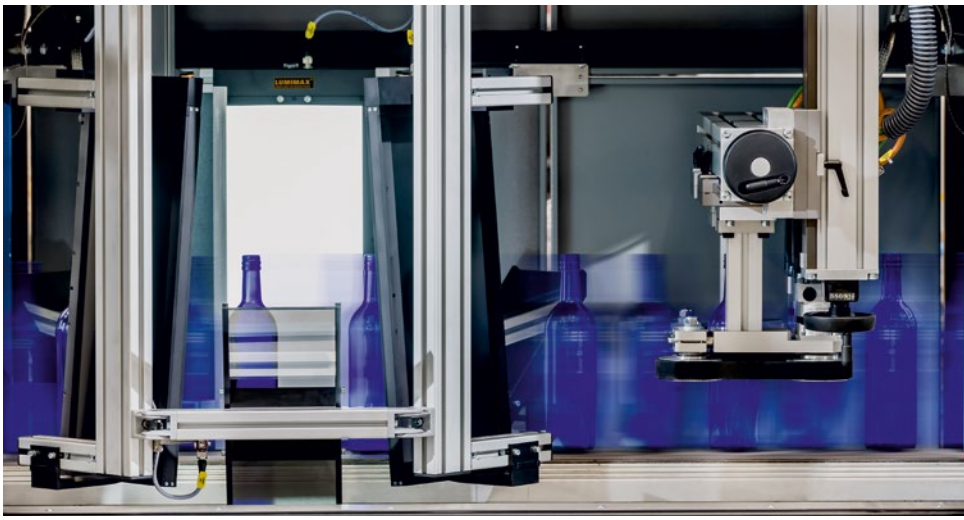

LUMIMAX® High Power LED Lights – High-quality, high-versatility, high-performance

Since 1998, iiM AG measurement + engineering has been developing, manufacturing and distributing high-quality, high-performance products for industrial image processing.

Under the LUMIMAX® brand we develop and manufacture high-performance and highly functional LED lights for machine vision applications in a very wide range of industrial areas, such as for the automobile, semiconductor, pharma, logistics, food, drinks and tobacco industries.

Portfolio

- High-Quality LED lights with the standard shapes : Square, Ring, Bar, Dome, Dark Field, Spot and Coaxial
- Extensive technical and optical accessories
- Customer-specific developments & adaptation of products
- Feasibility studies
- Loaned equipment and laboratory equipment
- Consulting and support
- Training

Technology

High-performance lighting products with integrated controller technology for continuous, switch or flashing operation guarantee the utmost functionality and enable the stable, extraneous light- independent illumination of your test objects – even for extremely fast processes. Functional accessories and sophisticated connection concepts reduce the time needed to integrate the LED lights into your image processing application.

Quality

Made in Germany – we are committed to the highest level of quality and functionality, guarantee you excellent service, and work with regional partners.

Experience

We have extensive experience in industrial image processing and can apply this knowledge excellently when designing and realising our products and when providing consulting. We see our customers as partners. We thus rely on continuous and close cooperation.

LUMIMAX®
iiM MEASUREMENT ENGINEERING

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Phone +49 3681 455 19-0 • E-Mail info@iimAG.de
Internet www.iim-AG.com

MATRIX VISION GmbH develops components and customised solutions for industrial image processing and is one of the leading companies in this field. Our focus is on the distribution of digital and intelligent cameras for various sectors of manufacturing and non-manufacturing industries.

We change your Vision.

Our cameras are used, inter alia, for quality control in manufacturing processes with high speed and high information density, as is required by enterprises in the mechanical engineering, electronics, food, pharmaceutical and printing industries. In the non-manufacturing industry, they are used, in the areas such as surveillance, microscopy and medicine.

Time to market – your competitive advantage

To us, you are not just a customer. You are our partner, and we will always be at your side to offer help and advice. We will never lose sight of your goal and will always strive to find the ideal solution for you. Through this, we will reduce your time to market, giving you a competitive advantage. Our priorities: Comprehensive, personal customer service and support in all project phases with fast response times; Knowledge sharing through customized, interactive workshops and training; Top quality standards and longer-than-average solution availability.

Made in Germany

Since 1986 MATRIX VISION has been an innovative and trustworthy partner in the image processing market for customers around the world. Based on many years of experience as a vision technology pioneer and currently backed by over 100 employees, we are shaping the industrial image processing future as an active member of the GigE Vision, the USB3 Vision, and the GenICam standard committees. By belonging to the Balluff family, our customers benefit from a global sales and support network and, first and foremost, from the synergies of two market leaders.

Product portfolio:

- USB 3.0 and USB 2.0 cameras
- GigE and Dual-GigE cameras (PoE)
- Smart cameras
- Embedded Vision board level cameras
- Frame grabbers
- Image Processing Software
- Customised solutions
- Due to the modular camera construction kit, our standard products offer an ideal basis for OEM projects, for customized products or for new developments.

A brand of Balluff MATRIX VISION

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Internet www.matrix-vision.com

Factory Tough GigE Vision Cameras

LUCID Vision Labs designs and manufactures innovative 2D and 3D machine vision cameras and components that utilize the latest technologies to deliver exceptional value to customers. Our compact, high-performance GigE Vision cameras are suited for a wide range of industries and applications such as factory automation, medical, life sciences and logistics.

We innovate dynamically to create products that meet the demands of machine vision for Industry 4.0. Our expertise combines deep industry experience with a passion for product quality, technology innovation and customer service excellence. LUCID Vision Labs, Inc. was founded in January 2017 and is located in Richmond, BC, Canada with local offices in Germany, Japan, China and Taiwan.

Delivering industrial certification standards to our machine vision cameras means that they can be relied on for 24/7 operation. Whether it is integrating cost-effective IP67 protection into our compact Triton cameras, or through pushing the limit for Time-of-Flight precision in the Helios2, LUCID continues to focus on its primary goal: developing innovative machine vision cameras that withstand the challenges of continuous industrial use.

Maximize Efficiency and Reliability

Our experience in camera manufacturing allows us to produce industrial cameras with exceptional quality. We test and qualify our cameras for wide environmental tolerances and low EMI. Our cameras are built to withstand industrial environments without unforeseen interference with other components.

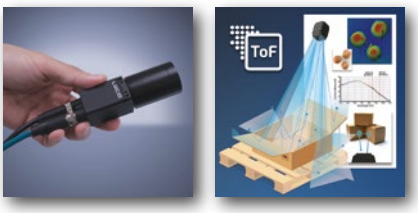
Our on-camera firmware update tool ensures a user-friendly and save update process. We've added multi-layered inspection points to the update process so that in the event of a failure, the camera will recover its previous firmware, allowing it to get back up and running automatically.

Active Sensor Alignment

All our Triton and Atlas cameras are actively aligned to minimize image sensor tilt, image sensor rotation, and to place the center of the image sensor at the lens optical axis. Our six degrees of freedom manufacturing process accurately and precisely positions the image sensor to the lens mount so that images are sharp and crisp, even in the corners.

Connect, Control and Create

All LUCID cameras conform to the GigE Vision 2.0 and GenICam3 standards and are supported by LUCID's own Arena software development kit. The Arena SDK provides customers with easy access to the latest industry standards and software technology. The SDK supports Windows, Linux 64bit and Linux ARM operating systems, and C, C++, C# and Python programming languages.



LUCID VISION LABS

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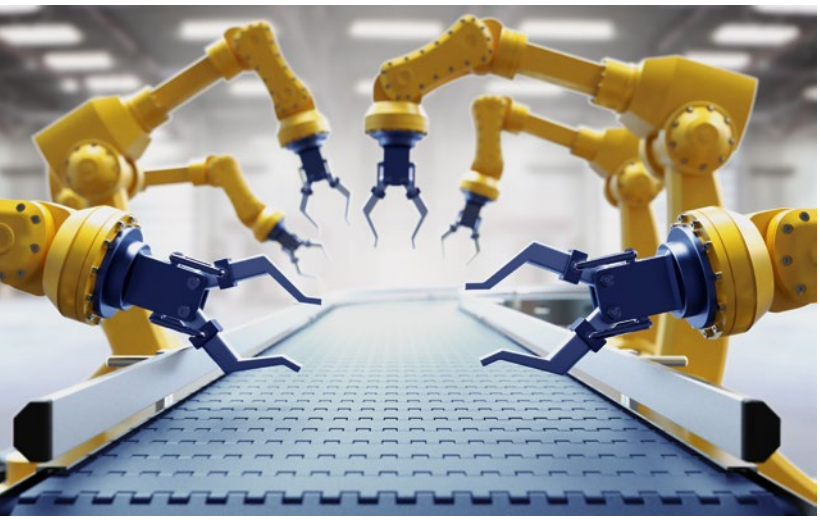

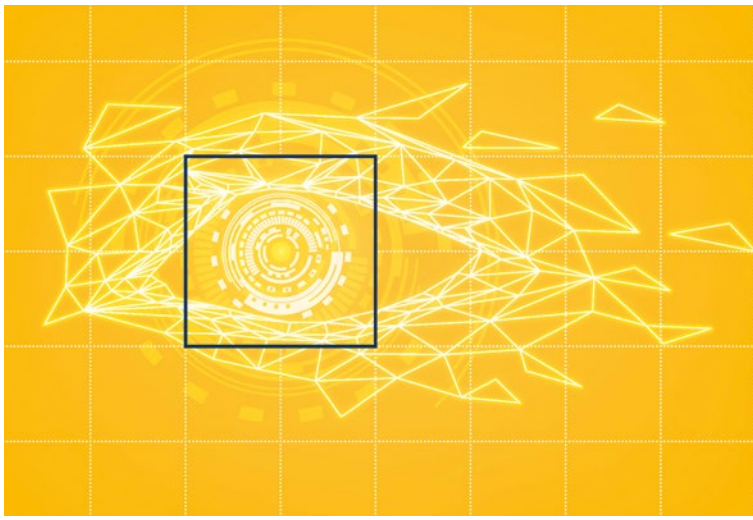

Machine Vision Software – the Key for IIoT

The Industrial Internet of Things (IIoT) and smart factory environments are characterized by highly automated process chains which are enabled by the digital interconnection of systems, machines, objects, and people. This processes require sophisticated supporting technologies like machine vision. MVTec Software GmbH from Munich, Germany, sets standards in machine vision with its software products since 25 years and helps you to optimize your applications.

For all machine vision challenges in modern industrial scenarios, MVTec's software products HALCON and MERLIC enable innovative best-in-practice solutions – in industries like machinery, logistics, semiconductor, electric components, food and agriculture, pharma and many more.

The flexibility and high quality of MVTec software "Made in Germany" contribute decisively to your sustainable economic success: The software allows the fast development of all kind of machine vision applications and thus paves the way for new automation solutions. For you, his results in cost savings and a faster time to market.

MVTec's software places a comprehensive machine vision toolbox right at your fingertips:

- Fast, accurate, and robust machine vision methods: Deep Learning, Matching, 3D-Vision and many more
- Available for a multitude of platforms, embedded devices and industrial PCs
- Supports hundreds of industrial cameras, frame grabbers, and all common vision standards

Best service for your applications:

- Free application evaluation
- Feasibility studies
- Customer-specific projects
- Trainings and workshops
- Porting to your device and platform

Learn more about the use of machine vision in your industry. Exciting success stories are waiting for you:
www.mvtec.com/industries

MVTec Software GmbH

MVTec Software GmbH • Arnulfstr. 205 • 80634 München • Germany
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Internet www.mvtec.com

As leading solution provider, NeuroCheck GmbH has been developing turnkey inspection systems for quality assurance in production processes for more than 25 years. The application potential covers the entire range of industrial visual inspection tasks. The basis for this are consistently integrated standards that guarantee smooth interaction of illumination, camera, optics and evaluation software. As a reliable partner, the company provides industrial vision applications at the highest level of quality.

NeuroCheck – System Solutions & Software for Industrial Vision

NeuroCheck Services
- Engineering
- Project planning
- Deployment
- Service at customer's site
- Service hotline
- Remote maintenance
- Software support
- Training courses

At the NeuroCheck Engineering Center, a team of experienced and highly-qualified project engineers provides effective solutions for challenging inspection tasks based on the company-owned applications software NeuroCheck.

High-performance system solutions for every industry

- Automotive and automotive supplier industry
- Electronics and photovoltaics
- Machine manufacturing
- Medical technology and pharmaceuticals
- Robotics/3D

NeuroCheck Application Software

The NeuroCheck application software is the ideal platform for businesses of any size that wish to make use of industrial image processing. The easy configuration of the application and the smooth interaction of established hardware and software standards make NeuroCheck solutions what they are: Reliable and successful in over 20,000 applications worldwide.

New Technologies of NeuroCheck Software

The integration of the latest technology into NeuroCheck application software offers security for both investments and the future.

- **3D Vision**
  The NeuroCheck 3D-Xtension inspects and gauges complex 3D freeform surfaces.
- **Robotics – Flexible quality inspection**
  The NCRoboDirector allows for complex inspection tasks with dynamic processes and a broad range of variants.
- **Deep Learning – In the Paradigm of Industry 4.0**
  The NeuroCheck AI-Xtension uses mature algorithms for machine learning. Available training data is used to solve complex tasks in a fully automated and highly efficient way.
- **SoundCam – Visualizing sounds**
  NeuroCheck SoundCam-Xtension localizes and visualizes acoustic interference sources thus making the precise location of a possible assembly error visible.

NEURO CHECK
Industrial Vision Systems

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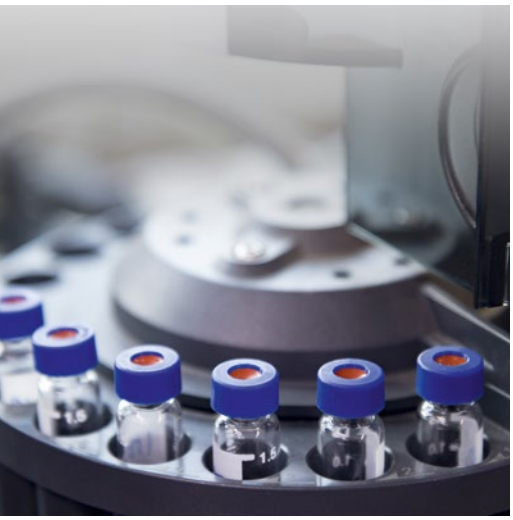

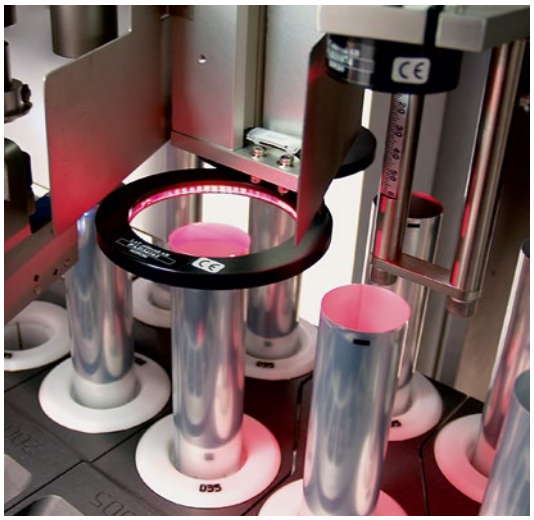

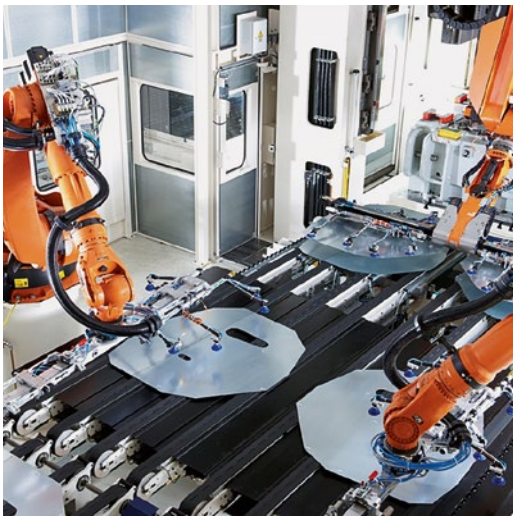

OCTUM – Experts in Machine Vision Solutions.

For 25 years our customers worldwide have been receiving machine vision solutions for inspection and identification of a wide range of parts for the target industries of pharmaceutical and medical technology, cosmetics, food, automotive and metal processing.

OCTUM machine vision systems have proven themselves in the following areas of application: Surface inspection, completeness and assembly inspection, optical measurement, reading of codes and characters, robot guidance. Our machine vision systems for pharmaceutical and medical technology are designed according to GAMP5 guidelines and meet the requirements of 21 CFR Part 11. With more than 5,000 installed system solutions worldwide, OCTUM is one of the most experienced suppliers in the industry.

Individual solutions

On the basis of globally available and proven technologies, our dedicated team translates your requirements into process-safe solutions for:

- Vials, glass and plastic syringes
- labels
- Plaster and wound material
- Plastic bottles
- Pipettes and Cups
- Lipsticks and jars
- Cheese and sausage products, ice cream
- Tubes and ampoules
- Metal goods
- Automotive parts and ZSB

The OCTUM Service

During the entire project phase, we offer you an all-round service to meet your requirements and wishes: electromechanical in-house production, project management, own documentation department, 3D design, E-Plan, specific customer training, commissioning and service.

Highest security for your investment

You will receive your machine vision system in industrial design with long-term available components worldwide, ready to use and with functional guarantee.

Benefit from our many years of experience and technological competence!

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Internet www.octum.de

Polytec offers a wide range of components and solutions for machine vision. The company specialises in dealing with challenging individualised solutions for machine vision. By drawing on its considerable experience in a range of application areas, Polytec is able to provide competent help and advice in choosing and integrating components such as LED lighting, fiber optic systems, lenses, filters, cameras, 3D camera systems, vision sensors, machine vision software and accessories.

Machine vision by Polytec – components, systems & advice

Intelligent 3D camera sensors for distance, hight, contour and profile measurement

Custom tunnel light with several camera holes

Strengths

Polytec takes pride in providing complete care of its customers, from analyzing and selecting components for the task through to the implementation of the production system. The fully trained service department means that downtimes are kept to minimum and long-term partnerships are maintained making Polytec a reliable service partner. Long-term partnerships with top international suppliers also constitute the basis for providing advice that is independent of manufacturers and that focuses on the best possible product selection for the customer.

Products

At Polytec, standard products cover a wide range of applications. Around 3000 standard products can be selected in the area of LED lighting.

Despite the comprehensive standard programme, applications repeatedly arise that call for customized solutions. Polytec is known for short development times and prices that are close to the standard cost.

About Polytec

Polytec GmbH was founded in Waldbronn near Karlsruhe, Germany in 1967 and has an international presence with worldwide branches.

Polytec is a partner of leading international manufacturers who are engaged in sales, application and service with respect to products from the broad range of optical technologies. One major area is machine vision.

Furthermore, Polytec develops and produces highly developed optical measurement systems for the analysis of vibrations, measurement of length and speed for use in industrial processes, determining surface properties such as topography, as well as analyzing spectral material properties.

Polytec

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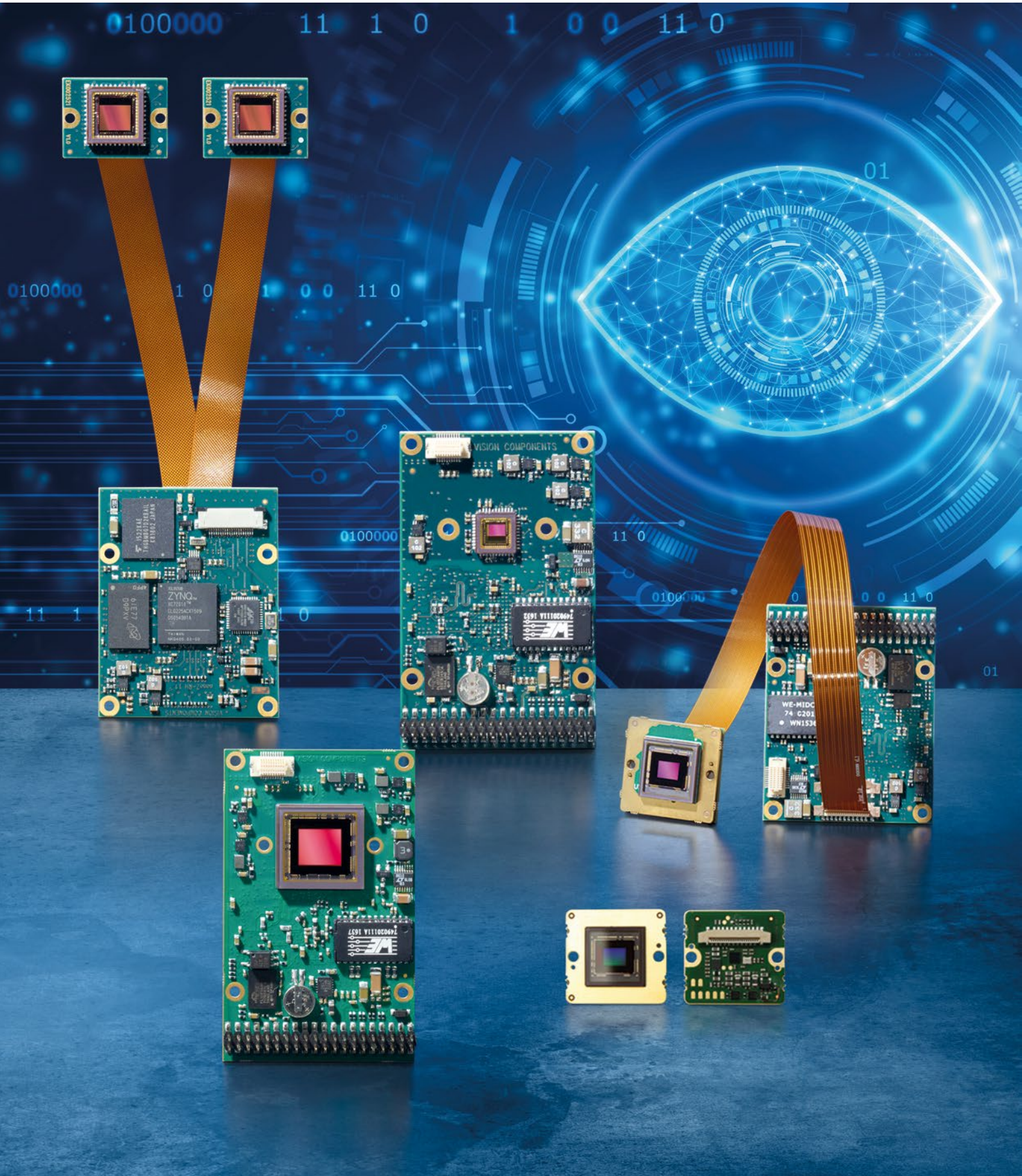
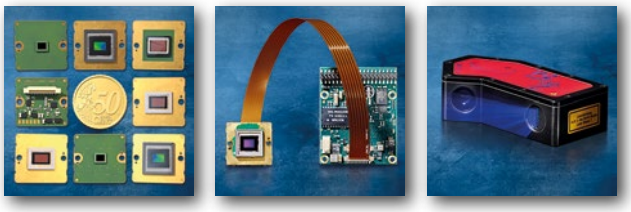
Bring vision to your products!
Intelligent components for embedded vision





Powerful components for embedded vision create new possibilities and added value for your products. We support you on your way to the perfect solution: optimally adapted to your specific needs and requirements, Vision Components© provides you with MIPI modules for greatest flexibility, intelligent cameras with their own CPU, or 3D Laser Profilers and complete solutions for special applications. Suitable for industrial use, highly efficient and well proven.

Welcome at the home of the intelligent camera

Michael Engel invented the first intelligent camera suitable for industrial use in 1996 and founded Vision Components©. Our standards of product quality and our partnership at eye level with customers and suppliers have remained the same until today. With many of them we have a long-term cooperation over several projects and product generations.

The comprehensive embedded vision kit for your applications: flexible MIPI modules with a large variety of sensors, powerful camera modules with CPU and individual ready-to-use systems.

Your choice: MIPI module, embedded vision camera or ready-to-use solution

The modular design of our systems gives you free choice for your project: Depending on your requirements, we offer you numerous sensors, board and housing variants, individual hardware developments as well as ready-to-use systems for laser triangulation for 3D applications. The ARM-based and real-time capable embedded vision solutions are optimally tailored to your specific requirements and can be flexibly integrated. With their Linux operating system they are freely programmable. Our own VC Lib software library is the perfect jumpstart for the development of your own applications.

Well proven – in all industries

Today, more than 250,000 embedded vision systems from Vision Components© are proving their worth in worldwide use. In numerous sectors and industries they set standards in terms of performance, flexibility and compact design.
These include:

- Pharmaceutical and medical technology
- Food and beverage industry
- Semiconductor and electronics industry
- Security, Monitoring, ITS and Traffic
- Robotics & Automation

Consulting and services for OEM and end customers

Thanks to the modular design of our systems, standard components can be quickly adapted to individual requirements. In addition to the development of new cameras and software, the corresponding consulting and development services are part of the core competencies of VC©.
We bring more than 20 years of expertise in embedded vision and intelligent cameras to your projects, show industry-specific potentials and develop customized solutions for OEMs, machine builders and end customers.

vision components®

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Internet www.vision-components.com

Since more than 30 years SVS-Vistek stands for innovation and precision in industrial image processing. The wide, high-quality product portfolio allows this technology to be used economically in many industries.

Cameras, components and know-how

Under the “SVCam” brand we develop and produce CCD and CMOS cameras with the highest demands on image quality for industry. With Gigabit Ethernet, 10GigE, USB3, CoaXPress and Camera Link, we have answers to almost each application scenario with the latest interface technology. Our cameras include groundbreaking features such as multi-channel strobe controllers, extremely precise sequencers and trigger controls and are able to operate controllable lenses such as Canon EF or MFT and the Varioptic Liquid Lens directly from the camera. Our high-resolution cameras (up to 151 megapixels) set international standards for image quality.

Quality, reliability and a high degree of customizability are always the basis of our developments. Depending on the task, there are currently five product lines to choose from: ECO (powerful and compact), EXO (multifunctional), FXO (highest frame rates), HR (high resolution) and SHR (super high resolution).

We advise on the implementation of image processing solutions and deliver customized OEM cameras as well as suitable lenses, lighting, cables, software or hardware for image capture. System integrators and OEM customers receive customized solutions and benefit from our expertise in a wide range of fields of application.

We work closely with strong, reliable suppliers to ensure maximum quality and reliability. We develop and produce our cameras exclusively ourselves, in our own clean rooms at our headquarters in Seefeld near Munich: “Quality made in Germany”.

SVS-Vistek cameras are used worldwide. Our local distributors and partners take care of sales, service and support for our cameras on site.

Click here to find our latest camera models!

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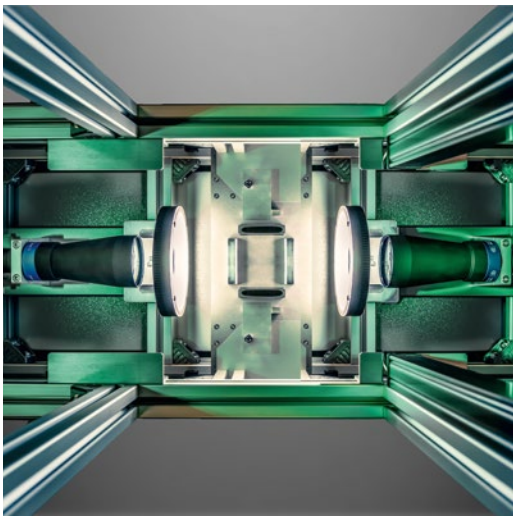

Quality inspection and robot vision systems

Your system under focus: VMT is a leading, internationally operating developer of systems designed with particular emphasis on image processing solutions, laser sensor systems and robot vision guidance.

Experience with well over 1,000 successful customer systems enables VMT to offer a broad range of standardized as well as individually developed client-specific image processing solutions. As part of the Pepperl+Fuchs Group, VMT is in the position of being able to offer you state-of-the-art technology and optimal investment security.

VMT delivers image processing solutions and optical control systems for all industrial inspection tasks. Using sensor and software solutions of our own design, we provide highly efficient and economical turnkey solutions specially optimized for your production requirements. From project planning to servicing – you can count on the professional advice and care from our staff anytime.

The application portfolio we offer is particularly broad in the following divisions:

Automotive:

- Optical measuring and testing technology for all kinds of use in automobile production – from press loading to final assembly (e.g. 2D/3D position control, completion testing, type recognition, geometry inspection, glue application control).
- Compact machine vision systems for automotive tier 1 supplier.
- Robot vision systems for all assembly tasks (BestFit door/lid assembly, soft-touch form and pierce, cockpit assembly), gap and flush measuring, precision robot guidance for glued and sealed seams.

Pharmaceutical, medical, food and beverage:
Inspection and control systems for application such as position recognition, quality control, completion inspection, geometric control and code/text reading. Validated systems per FDA 21 CFR Part 11.

Material handling:
System solutions and commissioning for palletizing, depalletizing, bin picking and automatic and flexible material handling.

VMT PEPPERL+FUCHS

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